Western Regional Office - www.ncenet.com/LTPP
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Long-Term Pavement Performance

December 5, 2001
File: 800.12.3.1

Ms. Pam Marquez
California DOT
PO Box 99
Soulsbyville, CA 95372

RE: SPS-2 Draft Report

Dear Ms. Marquez:

Enclosed for your review is the draft construction report for the SPS-2 project constructed near Delhi. We would appreciate it if you would review this report and provide us with any comments at your earliest convenience.

We are also sending copies of this report to those persons copied below

If you have any questions, please do not hesitate to call Dr. Sirous Alavi or me at (775) 329-4955.

Sincerely,
NICHOLS CONSULTING ENGINEERS, Chtd.

Kevin Senn, P.E.
Agency Coordinator

KS/rkp
Enclosure

cc: Alfredo Rodriguez, Jack Springer, Gonzalo Rada
cc (w/o encl.): Tom Hoover, Monte Symons, Sirous Alavi

N/1221/Reports/Construction/SPS-2/CvrLtr doc

FEDERAL HIGHWAY ADMINISTRATION
Long Term Pavement Performance (LTPP)
Specific Pavement Studies

CALIFORNIA SPS-2
"Strategic Study of Structural Factors for Rigid Pavements"

DRAFT

Prepared for:

California Department of Transportation

December 2001

TABLE OF CONTENTS

List of Figures

Page

List of Figures (cont'd)

Page

List of Tables

Page

ABSTRACT

Variables, such as drainage, base type, concrete strength and thickness, and lane width impact the performance of portland cement concrete (PCC) pavements. However, the relative influence of these variables is not completely understood. Under the Strategic Highway Research Program (SHRP), Specific Pavement Studies (SPS), experimental studies are carried out as part of the Long Term Pavement Performance (LTPP) Program across the nation. The SPS-2 experiment, "Strategic Study of Structural Factors for Rigid Pavements," is a study designed to precisely determine the relative influence of these parameters. The California SPS-2 sections combine 12 PCC sections of varying surface course thicknesses, lane widths, concrete strengths, and base and drainage types. The environmental conditions will be continuously monitored with the weather station installed at this site. Over time, the relative influence of these variables on the performance of these sections will be monitored.

Twelve rigid sections were constructed on the northbound truck lane of S.R. 99. S.R. 99 is a high volume road that runs from Sacramento until just south of Bakersfield. The automated weather station (AWS) at this site collects wind speed, ambient temperature, precipitation, and solar radiation data on a continuous basis. Construction of the test sections began in January 1999 and the construction operations were completed in two phases: phase one was completed in May 2000 and phase two was completed in September 2000. The test sections were opened to traffic in June 2000 (phase one) and October 2000 (phase two). Details of construction are presented in this report, along with minor problems encountered during construction that may affect the pavement performance.

I. INTRODUCTION

The following construction report provides documentation of the as-built properties for the California SPS-2 project and provides details of any deviations from the experiment construction guidelines. This report is available as an archival reference for future in-depth analysis of the SPS-2 materials and performance. Areas addressed within are construction sequence, layer thicknesses, material properties (as-placed), surface preparation techniques, problems encountered during construction, and weather conditions. Also included are the PCC mix design, lean concrete base (LCB) mix design, and summaries of slump and air content results. A photographic log illustrating construction procedures, equipment and materials, testing procedures and equipment, and problems encountered during construction is located in appendix A. The sampling areas and tests conducted for each layer are presented in appendix B. Appendix C contains the auger probe results and appendix D contains the PCC mix design.

SPS-2 PRODUCTS

The primary products of the SPS-2 experiment are the:

- evaluation of existing design methods
- development of improved design equations for new and reconstructed pavements
- determination of the effects of specific design features on pavement performance
- development of a comprehensive database for use by state and provincial engineers and other researchers

BACKGROUND

The SPS-2 experiment was developed to investigate the effect of selected structural factors on the long-term performance of rigid pavements constructed on different soil types in different climatic environments. The structural factors include concrete slab thickness, concrete strength, base material and drainability (permeability), base course thickness, and lane width. The basic experiment addresses doweled jointed plain concrete pavements. The supplementary experiments, designated SPS-2A and SPS-2B, address undoweled joints and jointed reinforced concrete pavements, respectively. However, the option of constructing these sections was not exercised on this project. In table 1, the eight environmentally-related (soil type and climate) combinations are shown along the left side. To make construction more feasible to the participating agencies, the 24 test sections required were divided into two separate experimental combinations with 12 sections each. The sections constructed on this project fit the "X Series" of experimental sections.

Special recognition should be given to the following individuals for their roles in nominating, designing, constructing and documenting this project: Martha Nevai with FHWA, Kevin Herritt, Raymond Tritt, Pamela Marques, Kurosh Borashan, Tom Hoover, and Alfredo Rodriguez with Caltrans.

Table 1. Basic experiment doweled jointed plain concrete pavements (SPS-2).

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

DGAB = Dense-graded untreated aggregate base
LCB = Lean concrete base
PATB = Permeable asphalt-treated base (4-in thickness placed on a DGAB layer)
All perpendicular doweled joints, 15-ft spacing

II. SPS-2 PROJECT DESCRIPTION

This section of the report describes in detail the geographical location, section layout, climatic zone, subgrade and structural attributes and construction of individual sections.

LOCATION AND LAYOUT

This project is located on the northbound truck lane of S.R. 99 near Delhi, California. Delhi is located in Merced County about 55 miles (88 Km) south of Stockton, California. The GPS coordinates of the beginning of the project are 37° 25' 25.74" N latitude and 120° 46' 09.84" W longitude. The project is located at an elevation of 36m (118'). Figure 1 presents the geographic location of the project. The project consisted of the construction of twelve 152.4m (500') long portland cement concrete (SPS-2) sections.

The test sections were built as part of a realignment of S.R. 99 and a conversion to a 4-lane freeway. The project was constructed with the test sections meeting the criteria shown in table 2. The layout, stationing and structural attributes of individual sections are presented in figure 2 and table 3. Due to limited space, there was no room to construct any supplemental sections.

Table 2. SPS-2 experiment criteria.

Base Types:	Dense-graded aggregate base (DGAB) Lean concrete base (LCB) Permeable asphalt-treated base (PATB)
Concrete Strengths:	3.8 Mpa flexural 6.2 Mpa flexural
Pavement Thickness:	205 mm 280 mm
Lane Widths:	3.7 m 4.3 m
Drainage Systems:	Non-drainable (figure 3) Drainable (figure 4)

CLIMATE

The project is located in the LTPP "Dry No-Freeze" climatic zone. The estimated average precipitation at the project location is 316mm. The average maximum and minimum temperatures during the summer and winter seasons are enumerated below:

	Summer	Winter
Average Maximum Temperature	34.7 °C	14.2 °C
Average Minimum Temperature	14.6 °C	2.8 °C

TRAFFIC

The estimated annual average daily traffic (AADT) in two directions for these sections is 89,000 vehicles with 24.6 percent trucks. For a design period of 20 years, the total design 18k ESALs is estimated at 48,100,000.

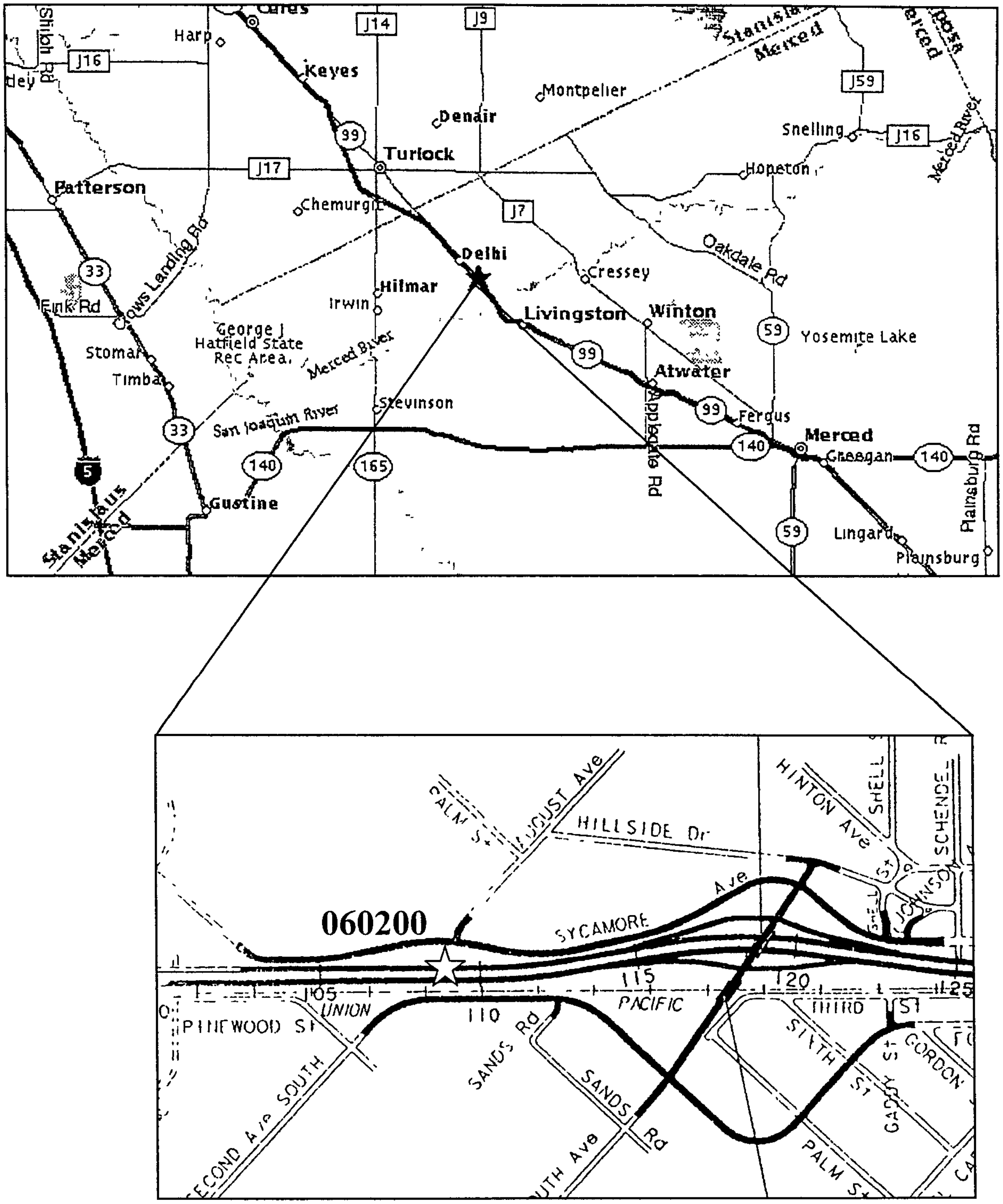


Figure 1. 060200 site location.

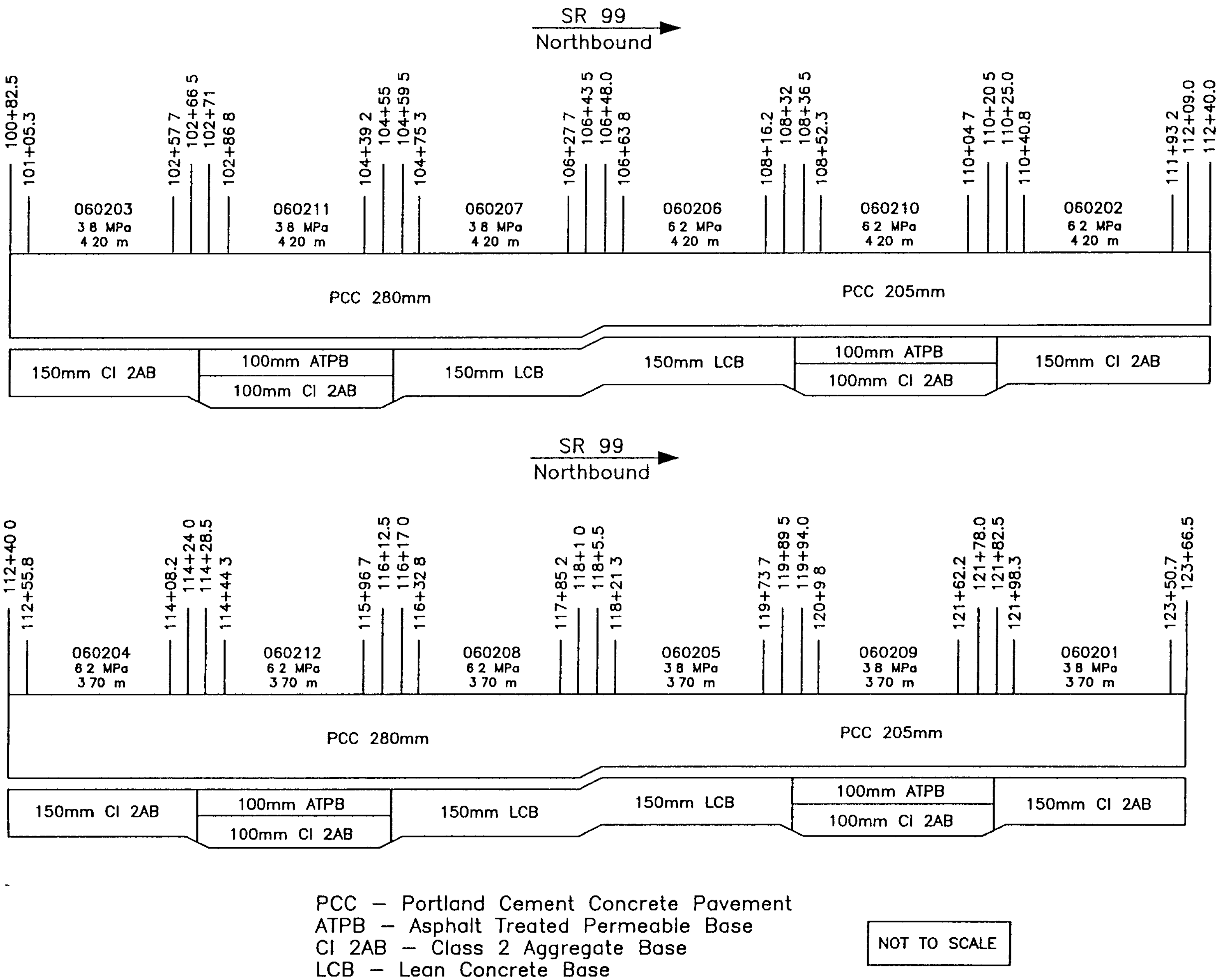


Figure 2. Layout of experimental test sections, California SPS-2, SR 99.

Table 3. Test section details for 060200.

Site	Location	Construction Stationing	Test Section Stationing	Test Section
Transition 100+77.8 to 100+82.5				
060203	Begin	100+82.5	0-22.8	11" PCC
	Begin Monitoring	101+05.3	0+00	6" DGAB
	End Monitoring	102+57.7	1+52.4	14' Lane
	End	102+66.5	1+61.2	
Transition 102+66.5 to 102+71.0				
060211	Begin	102+71.0	0-15.8	11" PCC
	Begin Monitoring	102+86.8	0+00	4" PATB
	End Monitoring	104+39.2	1+52.4	4" DGAB
	End	104+55.0	1+68.2	14' Lane
Transition 104+55.0 to 104+59.5				
060207	Begin	104+59.5	0-15.8	11" PCC
	Begin Monitoring	104+75.3	0+00	6" LCB
	End Monitoring	106+27.7	1+52.4	14' Lane
	End	106+43.5	1+68.2	
Transition 106+43.5 to 106+48.0				
060206	Begin	106+48.0	0-15.8	8" PCC
	Begin Monitoring	106+63.8	0+00	6" LCB
	End Monitoring	108+16.2	1+52.4	12' Lane
	End	108+32.0	1+68.2	
Transition 108+32.0 to 108+36.5				
060210	Begin	108+36.5	0-15.8	8" PCC
	Begin Monitoring	108+52.3	0+00	4" PATB
	End Monitoring	110+04.7	1+52.4	4" DGAB
	End	110+20.5	1+68.2	12' Lane
Transition 110+20.5 to 110+25.0				
060202	Begin	110+25.0	0-15.8	8" PCC
	Begin Monitoring	110+40.8	0+00	6" DGAB
	End Monitoring	111+93.2	1+52.4	12' Lane
	End	112+09.0	1+68.2	
Transition 112+09.0 to 112+40.0				
060204	Begin	112+40.0	0-15.8	8" PCC
	Begin Monitoring	112+55.8	0+00	6" DGAB
	End Monitoring	114+08.2	1+52.4	14' Lane
	End	114+24.0	1+68.2	
Transition 114+24.0 to 114+28.5				
060212	Begin	114+28.5	0-15.8	8" PCC
	Begin Monitoring	114+44.3	0+00	4" PATB
	End Monitoring	115+96.7	1+52.4	4" DGAB
	End	116+12.5	1+68.2	14' Lane

Site	Location	Construction Stationing	Test Section Stationing	Test Section
Transition 116+12.5 to 116+17.0				
060208	Begin	116+17.0	0-15.8	8" PCC 6" LCB 14' Lane
	Begin Monitoring	116+32.8	0+00	
	End Monitoring	117+85.2	1+52.4	
	End	117+98.3	1+65.5	
Transition 117+98.3 to 118+02.8				
060205	Begin	118+02.8	0-13.1	11" PCC 6" LCB 12' Lane
	Begin Monitoring	118+15.9	0+00	
	End Monitoring	119+68.3	1+52.4	
	End	119+84.1	1+68.2	
Transition 119+84.1 to 119+88.6				
060209	Begin	119+88.6	0-15.8	11" PCC 4" PATB 4" DGAB 12' Lane
	Begin Monitoring	120+04.4	0+00	
	End Monitoring	121+56.8	1+52.4	
	End	121+72.6	1+68.2	
Transition 121+72.6 to 121+77.1				
060201	Begin	121+77.1	0-15.8	11" PCC 6" DGAB 12' Lane
	Begin Monitoring	121+92.9	0+00	
	End Monitoring	123+45.3	1+52.4	
	End	123+61.1	1+68.2	

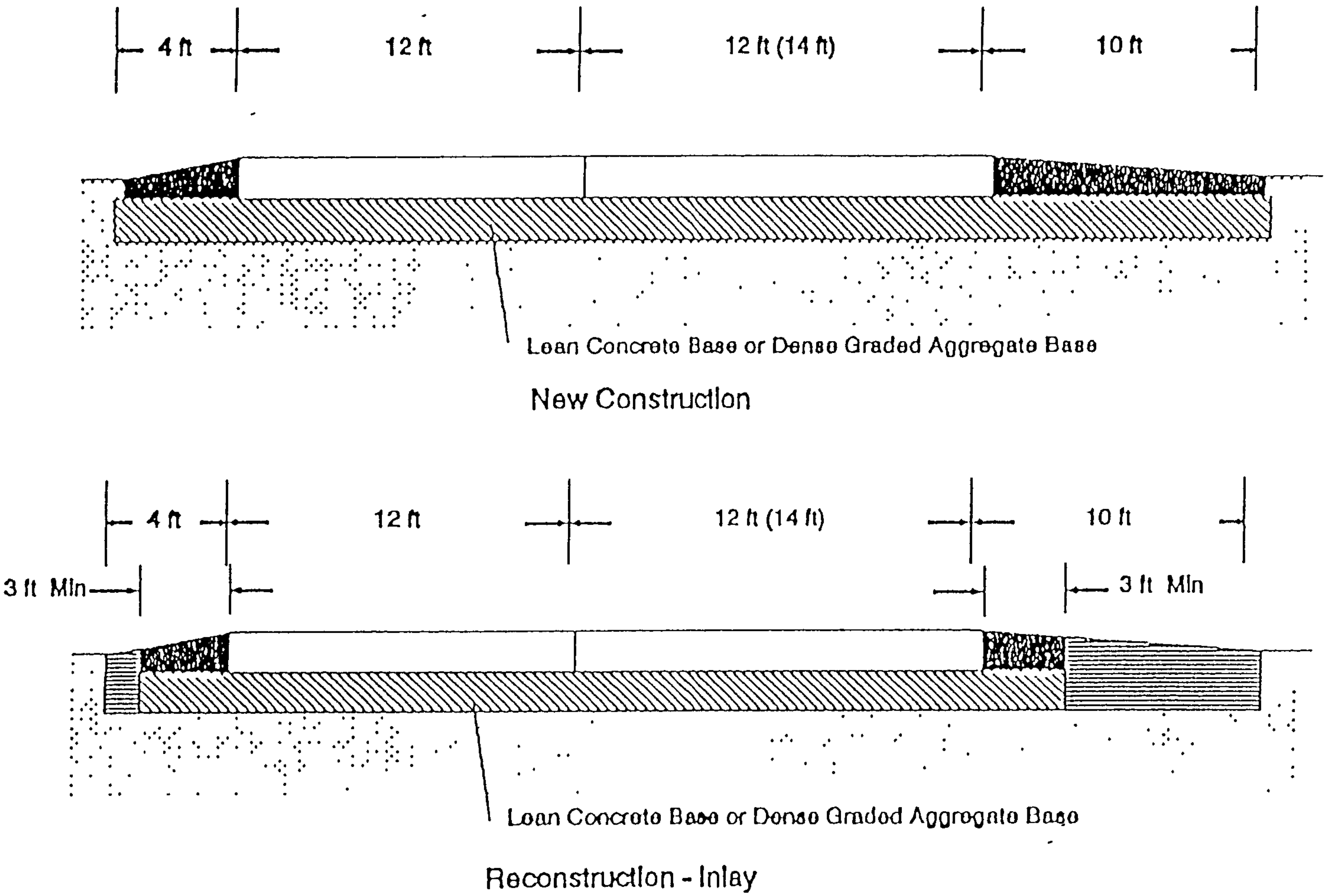


Figure 3. Typical section for test sections with non-drainable base layer.

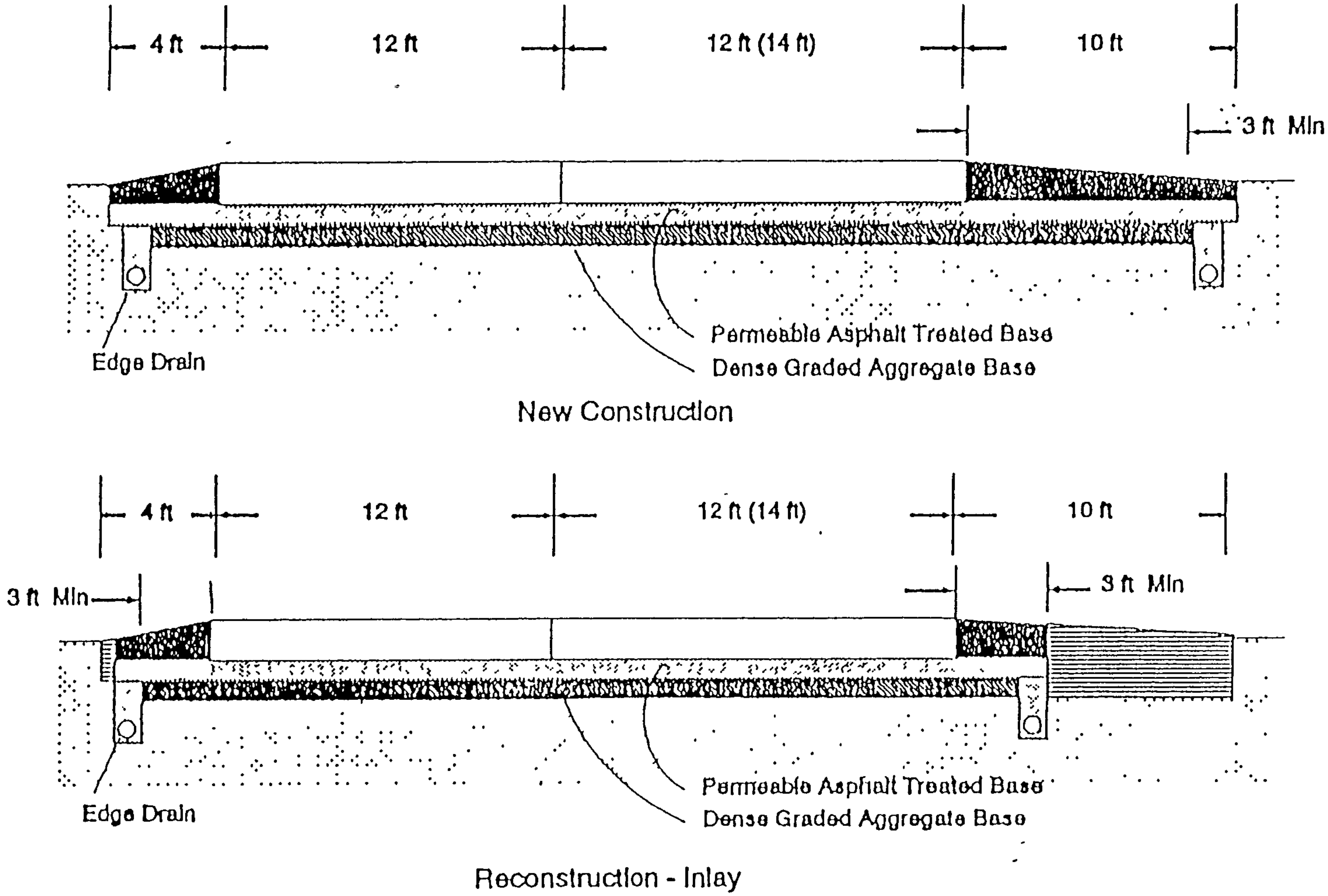


Figure 4. Typical section for test sections with drainable base layer.

GEOMETRICS AND SUBGRADE

The SPS-2 test sections were constructed on a slight downgrade (-0.3 percent). There was a small degree of horizontal curvature through the project, but nothing that would effect the dynamics of the traveling public. The major geometric feature on this project is an on- and off-ramp within which five of the sections are located. These ramps are projected to have very low volumes. The sections were new construction along a new alignment for S.R. 99. The subgrade material was a silty sand.

AGENCIES AND PERSONNEL

This project was constructed under an agreement between the California Department of Transportation (Caltrans) and the Federal Highway Administration (FHWA). The following personnel were involved in the project at various phases of construction.

Caltrans

Ms. Pamela Marquez was the resident engineer for the project and was assisted by Kurosh Borashan who was the assistant resident engineer. Rodney Soderland was the inspector responsible for finished subgrade and DGAB. Other inspectors were Sukhamandir Deol, Kwami Appauh, and Osama Abdel-Magied.

The field sampling and testing crew was headed by George Crowly. Douglas Hammerstrom, David Bracy, Manpreet Singh and Baldev Singh were the other field personnel responsible for field sampling and field testing.

Jay Abegglen and Alfredo Rodriguez coordinated testing and marking the sections from Caltrans headquarters.

Contractors

FCI Constructors was the prime contractor. Greg Le Blanc was the project manager, Rudy Bravo was the construction superintendent. FCI Constructors had subcontracted to the following agencies:

Sand and Aggregate:	Santa Fe Aggregate at Livingston, California
Gerald Miller Construction:	Subgrade and DGAB construction
Tom Mayo Construction:	ATPB construction
Bartholomew Paving:	LCB and PCC paving

Western Region Coordination Office Contractor (WRCOC)

Pierre Pradere, Srikanth Holikatti, and Mark Potter were present during construction for LTPP monitoring. Michael Esposito, Richard Smith, Robert Fogg, Nathan Andress and Mark Potter performed construction and post-construction FWD and profile testing.

WEATHER STATION

In order to assure the proper climatic data would be available during analysis, an Automated Weather Station (AWS) was installed by the Western Regional Contractor. The AWS is located on-site. Nichols Consulting Engineers, Chtd. (NCE) personnel installed the AWS equipment on January 18, 2000. The installed equipment consists of a wind monitor that measures wind speed and direction, a probe to measure the temperature and humidity, a pyranometer to measure solar radiation, a rain gauge tipping bucket, a solar panel, and a datalogger. All equipment was provided by FHWA. A phone line was also installed so that the data could be downloaded and reviewed on a weekly basis.

III. CONSTRUCTION

This section of the report covers the actual construction operations, material sampling, and field testing performed during construction and any deviations that occurred during the construction process.

SUBGRADE PREPARATION

Equipment

The following equipment was used in the material processing and construction work of subgrade on the test sections.

2 CAT 623F Scrapers
2 Ingorsoll Rand Series 100 Steel Drum Vibratory Rollers
1 CAT large backhoe for excavating cross drains
1 CAT 140H Motor Grader
1 CAT 140C Motor Grader
2 Front End Loaders
8 Belly Dump Trucks
3 Water Trucks

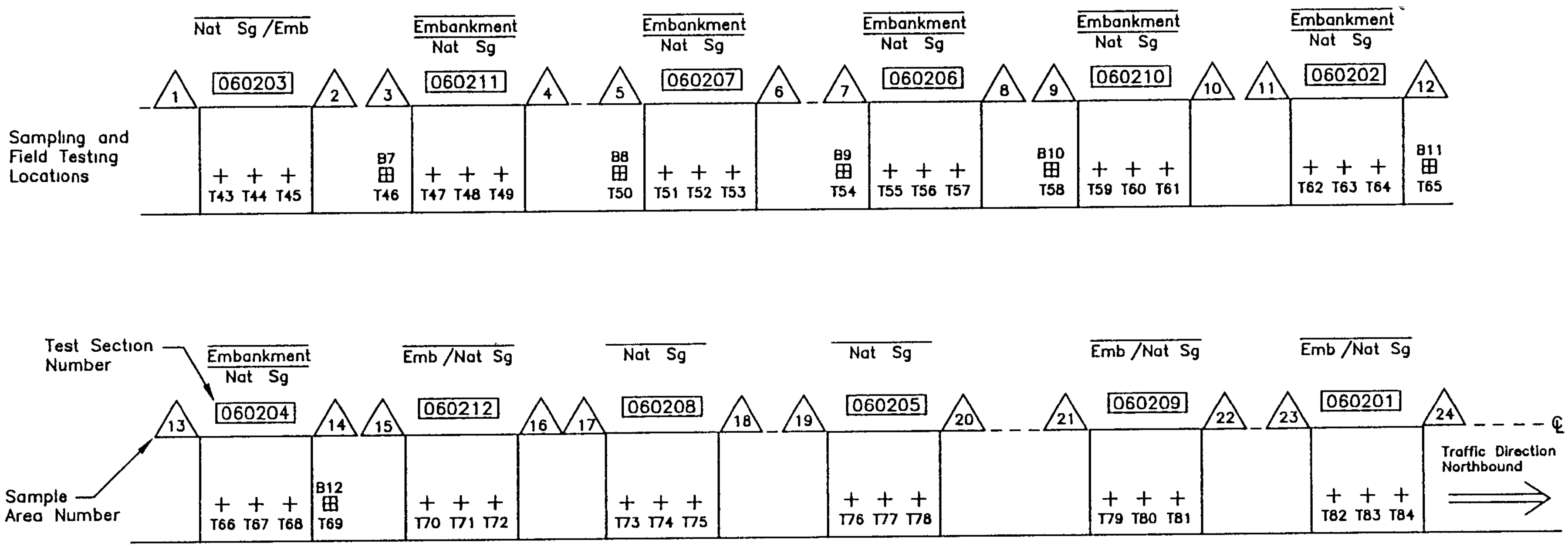
Overview

This project was constructed in two phases. Sections 060201,060202, 060204, 060205, 060206, 060207, 060208, 060209, 060210, and 060212 were constructed in phase I. Construction of sections 060203 and 060211 were included in phase II. Initial subgrade work for both phases began in January 1999. Early efforts were focused on obtaining grade and involved cut in some areas used to fill others. Water trucks and steel rollers were used to attain the target compaction and moisture content. Subgrade work was completed on March 30, 2000 (phase I) and August 9, 2000 (phase II). Photograph 1 in appendix A shows the site conditions before construction. Photograph 2 in appendix A shows the work on the subgrade layer.

Bulk Sampling

Bulk sampling of finished subgrade was performed on March 20, 2000 by excavating test pits (photograph 3, appendix A). One sample (B1) was taken of the undisturbed subgrade in 1999. The bulk sampling pits were backfilled with similar subgrade material and compacted. Figure 5 shows the subgrade bulk sampling locations. An additional bulk sample (B35) was taken at station 0-10 of section 060203.

The subgrade gradations are presented below in table 4. The material has been classified a sandy silt per SHRP/LTPP classification codes.



NOT TO SCALE

□ 0.6m x 0.6m bulk sampling location (B7–B12) to 0.30m below top of embankment
\+ Location of nuclear moisture–density tests (T43–T84)
△ Sample areas
Nat. Sg. – Natural subgrade

Figure 5. Overview of material sampling and testing on subgrade, SPS-2 California.

Table 4. Subgrade gradations, 060200

Sieve Size(mm)	Percent Passing
75.00	100
50.00	100
37 50	100
25 00	100
19.00	100
12.50	100
9.50	100
4.75	100
2.00	100
0.425	78
0.180	43
0.075	16

Inspection

The finished subgrade was visually inspected for problem areas and none were observed.

Field Density and Field Moisture Testing

Field density and field moisture tests were performed on prepared subgrade layer on March 29, 2000 (phase I) and August 9, 2000 (phase II). The density tests were carried out using nuclear gauge at locations shown in figure 5 in accordance with the procedures in AASHTO T239-97 (photograph 4, appendix A). An additional density test was performed at station 0-10 of section 060203 at was labeled T115.

Auger Probes

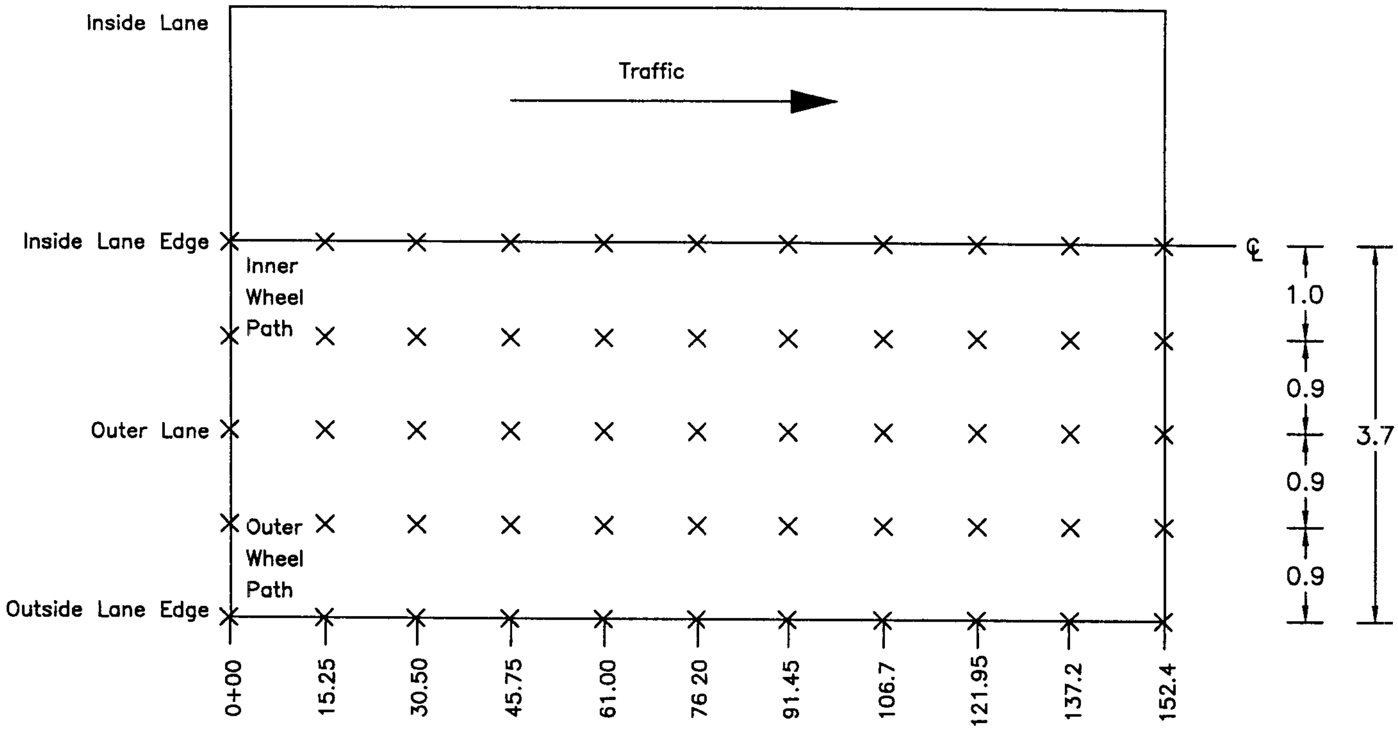
Shoulder auger drilling to a depth of 6.0m was performed on May 30, 2000 to determine the existence of bedrock or any stiff underlying layer within 6m of pavement surface. Auger drilling was performed at ten locations along the project. Neither bedrock nor any stiff layer was encountered during this operation. The majority of the material within 6m of the surface was silty sand. At three locations the water table was present at a depth of 5.2m. Complete details on auger probe results can be found in appendix D.

Subgrade Surface Elevations

Baseline elevation surveys on the surface of prepared subgrade were performed at locations indicated in figure 6. The purpose of the elevation surveys is to obtain a profile of prepared subgrade surface and to determine the thickness of subsequent layers. Photograph 5 in appendix A shows the completed subgrade.

FWD Testing

FWD testing of the subgrade was completed on March 30, 2000 (phase I) and August 9, 2000 (phase II) by the WRCOC in accordance with the procedures and guidelines outlined in SPS



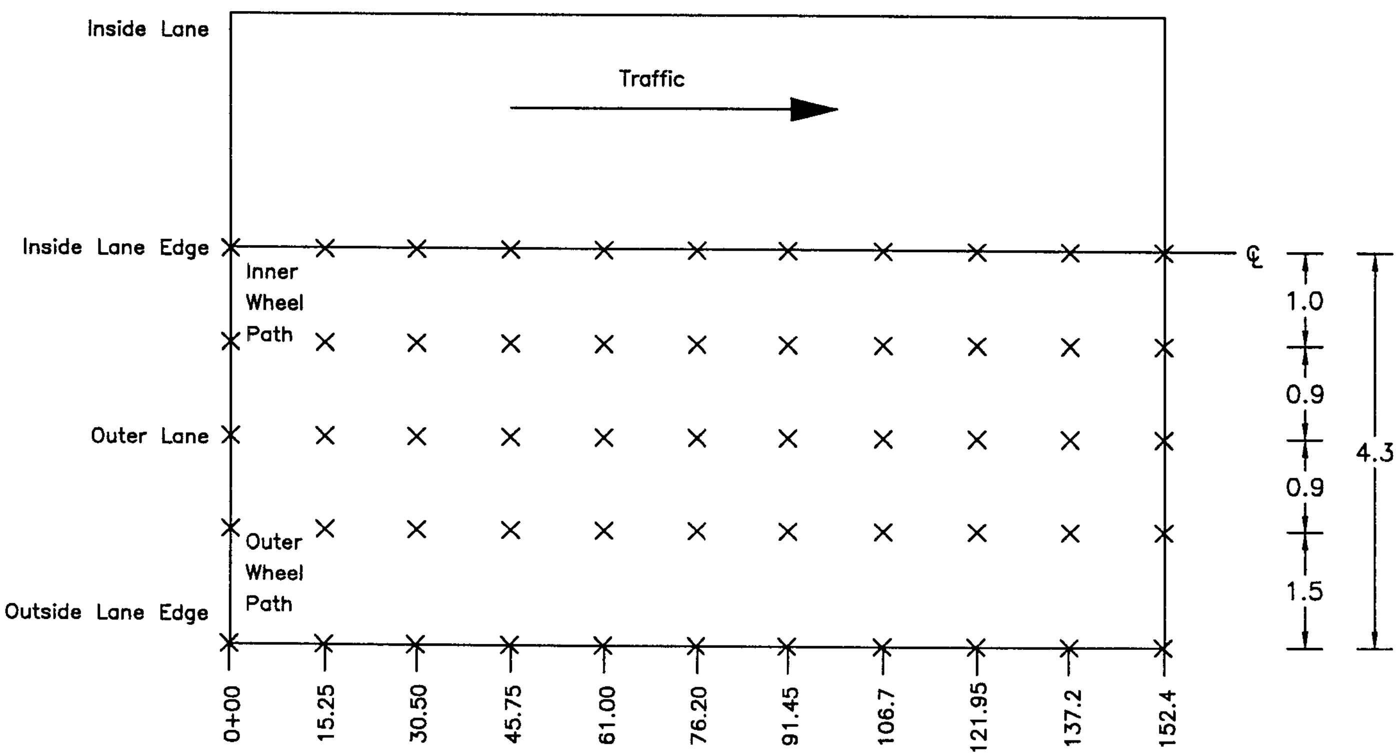


Figure 6. Test section elevation measurement location for SPS–2 California

Directive Number S-4, "Deflection Testing of Subgrade and Base Layers for SPS-1, -2 and -8 Experiments." The subgrade was extremely soft and, despite the best efforts of the WRCOC staff, even at the smallest loads, the deflections measured were outside of the allowable range for the sensors and no measurements were possible for 060204. Therefore, the FWD subgrade testing data has not been entered into the LTPP database. FWD testing results are plotted in figures 7 through 17. These deflections are not normalized and are plotted for an average loading indicated in each figure. As can be seen in the figures, 060203, 060206, 060207, and 060208 are relatively uniform, while the remaining sections have significant variation.

DENSE GRADED AGGREGATE BASE (DGAB) PREPARATION

Equipment

The following equipment was used in the material processing and construction work of aggregate base on the test sections.

- 2 CAT 623F Scrapers
- 2 Ingorsoll Rand Series 100 Steel Drum Vibratory Rollers
- 1 CAT large backhoe for excavating cross drains
- 1 CAT 140H Motor Grader
- 1 CAT 140C Motor Grader
- 2 Front End Loaders
- 8 Belly Dump Trucks
- 3 Water Trucks

Overview

By design, eight of the SPS-2 sections have a DGAB layer. Sections 060201, 060202, 060203, and 060204 have a DGAB design thickness of 150 mm. The other four sections (060209, 060210, 060211, and 060212) have a DGAB design thickness of 100 mm (shown earlier in figure 2).

DGAB construction took place during April 2000 (phase I) and August 2000 (phase II). DGAB material was brought in by belly dump trucks. It was then windrowed and worked by the graders and blades to achieve the required grade and profile (photograph 6, appendix A). Water trucks and rollers were employed to achieve target compaction and moisture.

Inspection

The finished DGAB layer was visually inspected for problems and none were observed.

Bulk Sampling

Bulk sampling of the DGAB material was performed on April 4, 2000 (phase I) and August 14, 2000 (phase II) by excavating a test pit in the finished layer that would provide the required quantity of material. After the bulk sampling, the pits were backfilled with similar material and

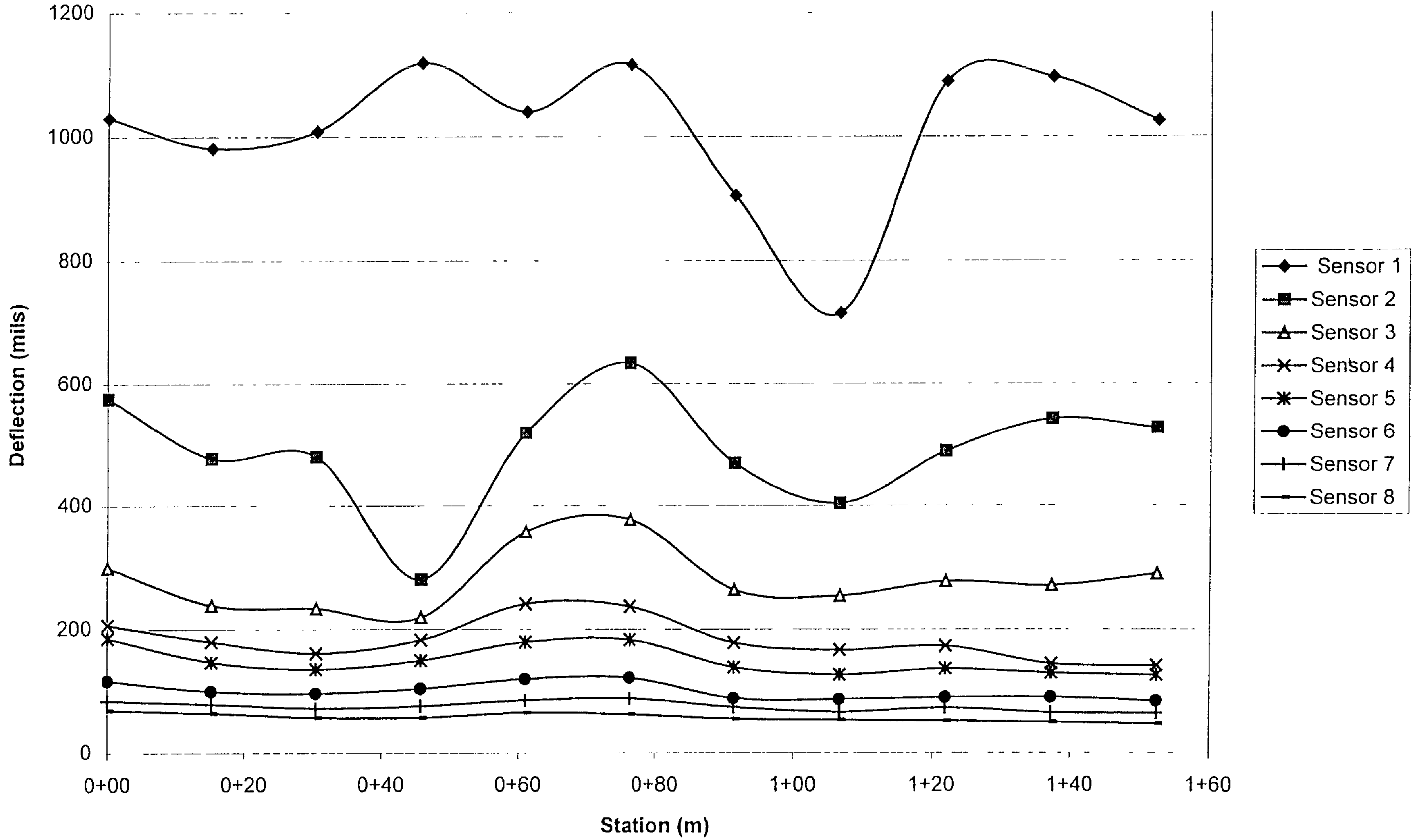


Figure 7. Section 060201 subgrade deflection averaged at 406 kPa.

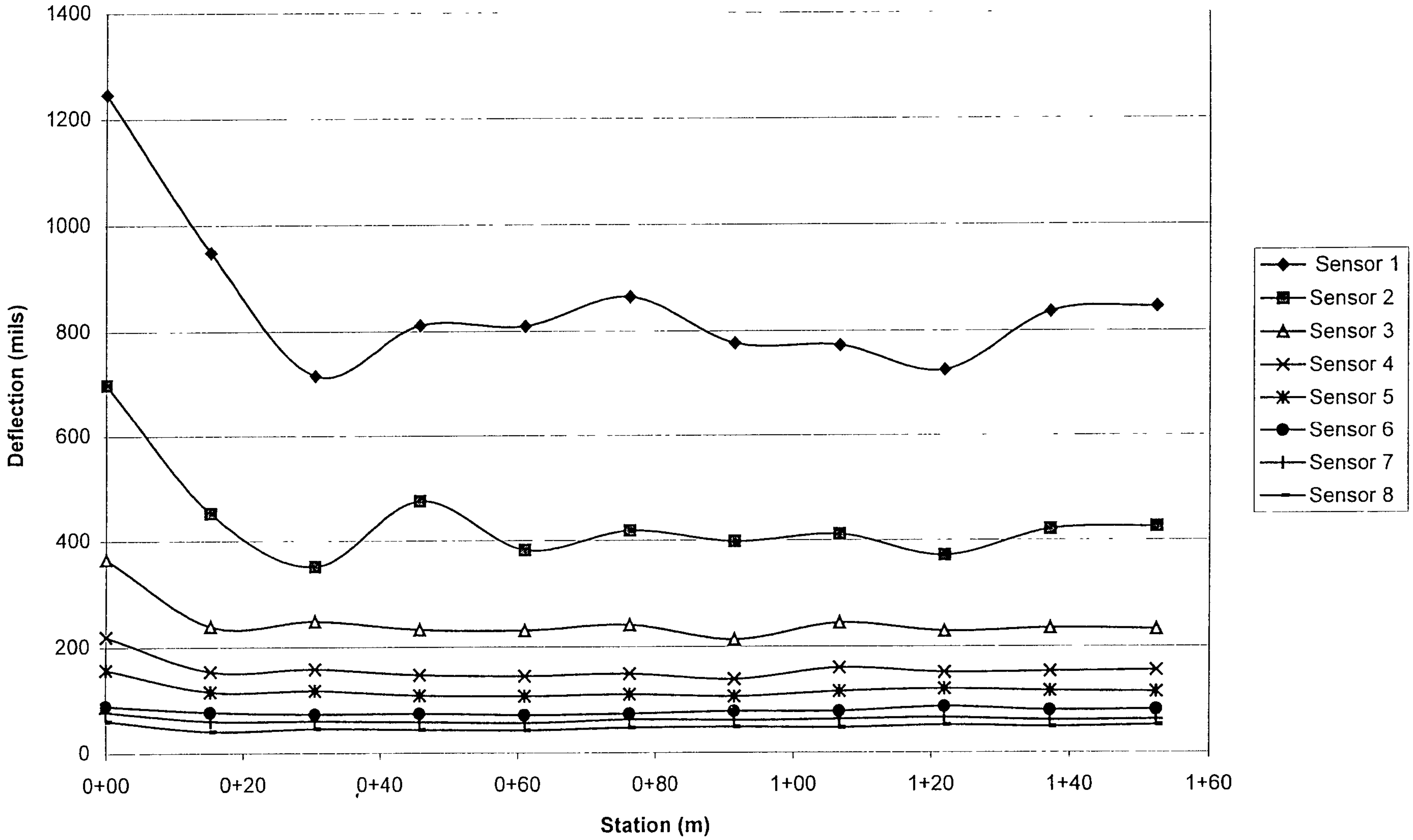


Figure 8. Section 060202 subgrade deflections averaged at 442 kPa.

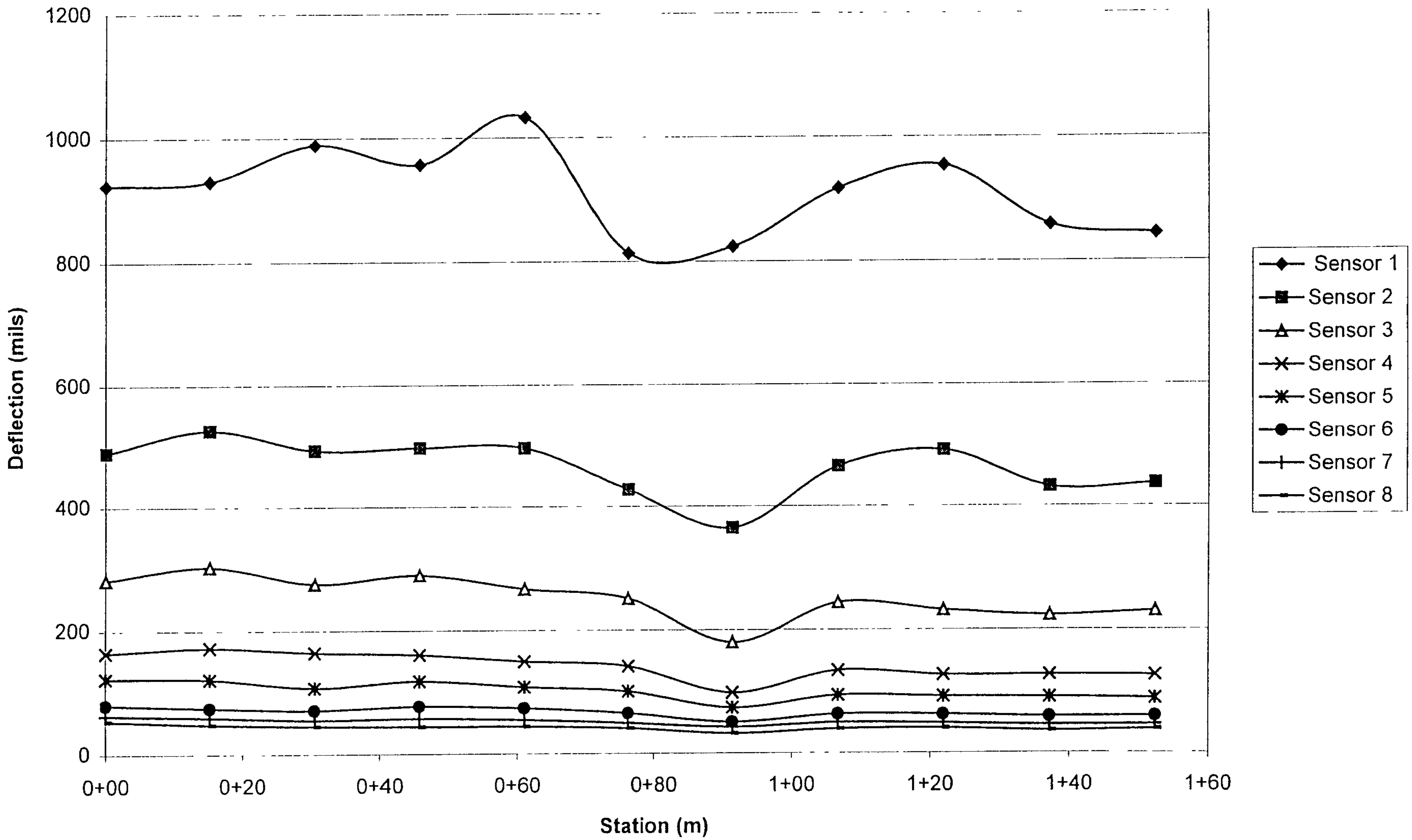


Figure 9. Section 060203 subgrade deflections averaged at 448 kPa.

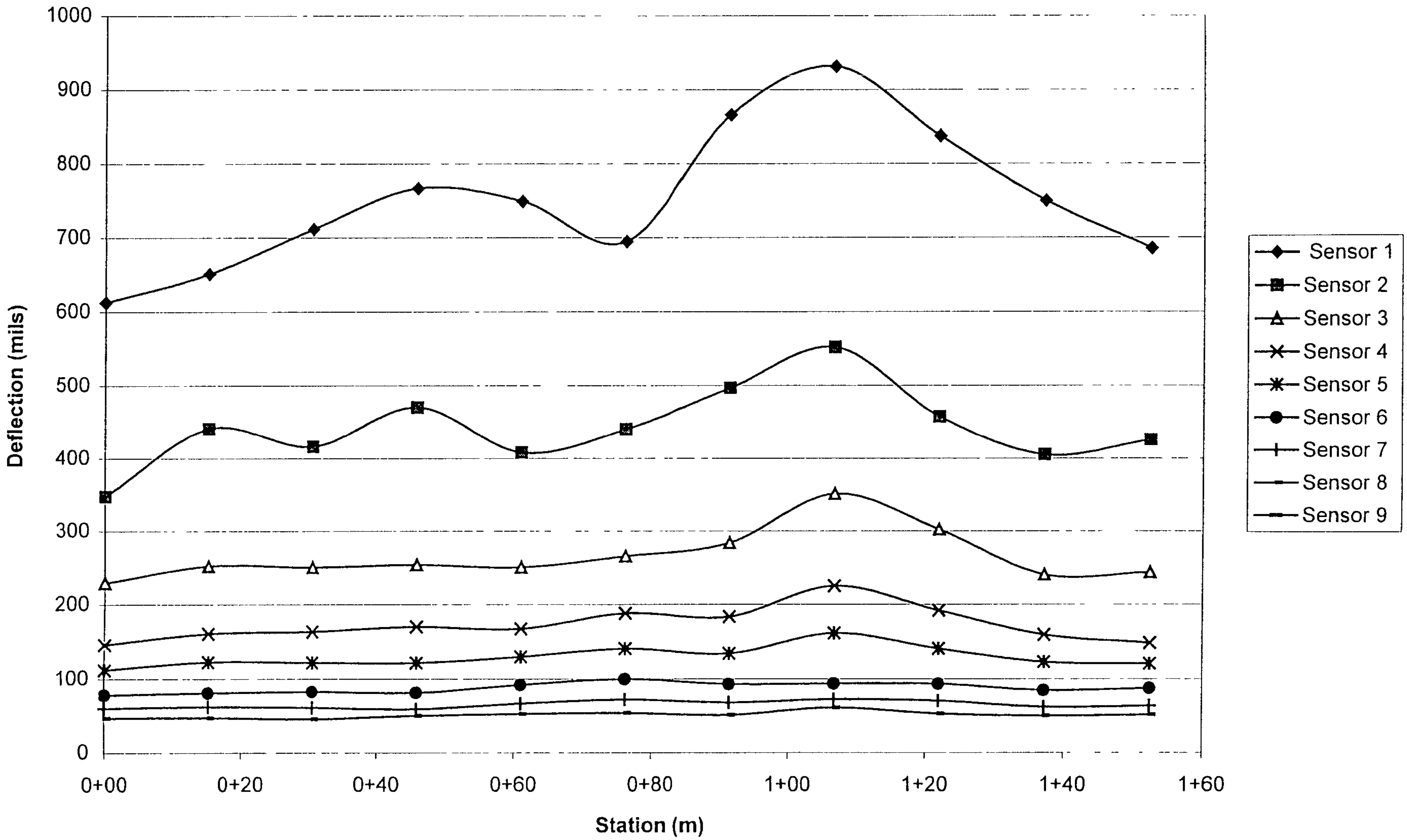


Figure 10. Section 060205 subgrade deflections averaged at 434 kPa.

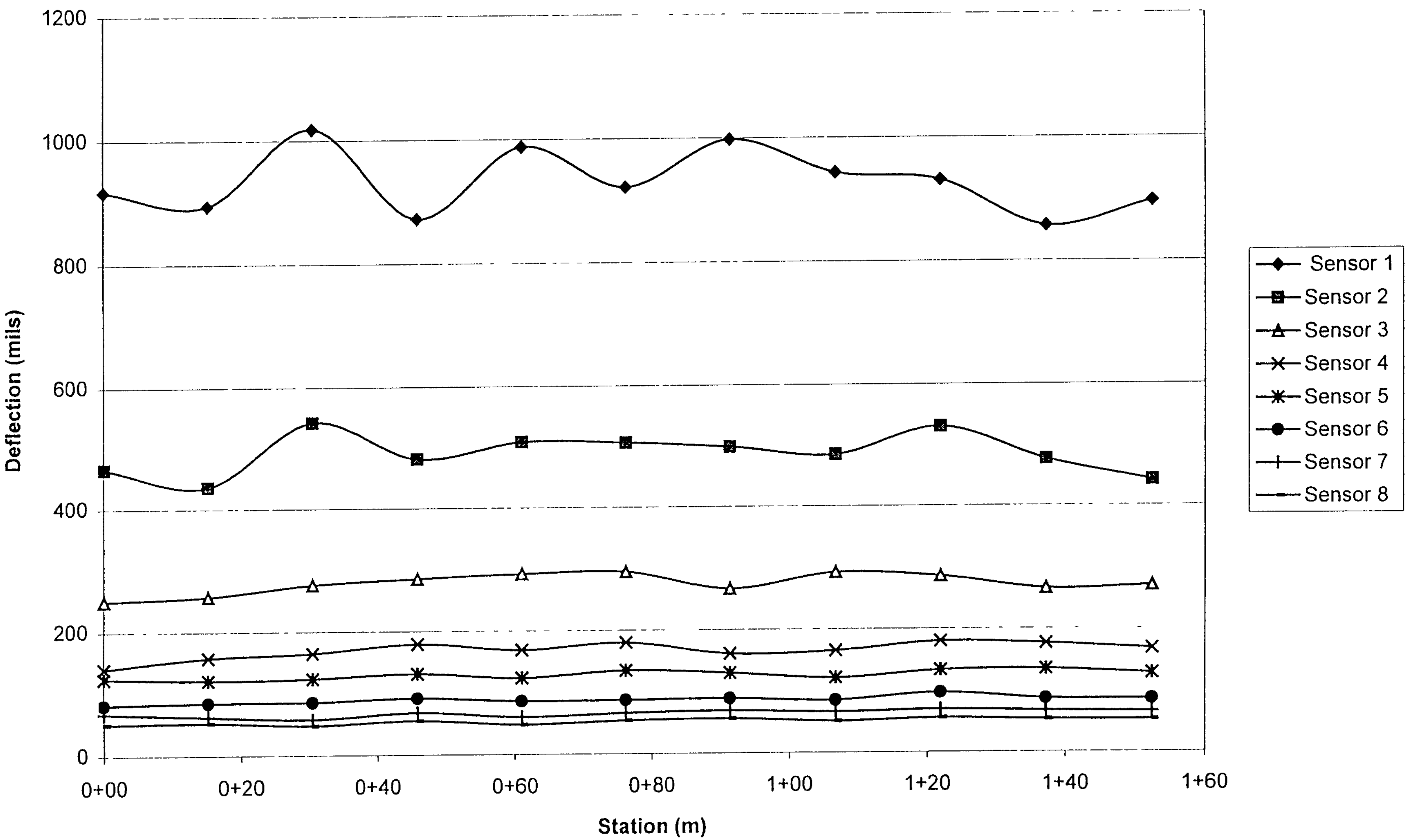


Figure 11. Section 060206 subgrade deflections averaged at 440 kPa.

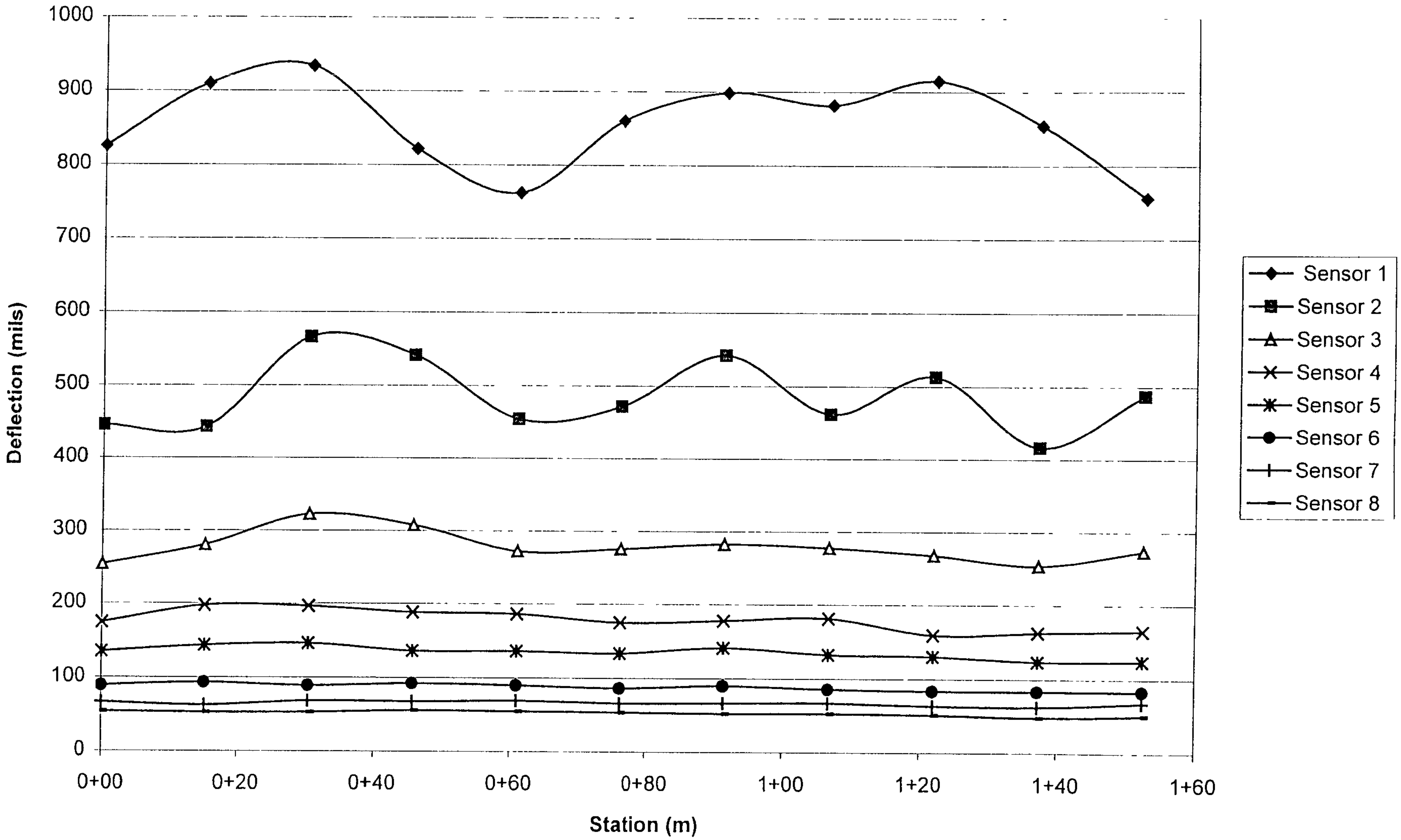


Figure 12. Section 060207 subgrade deflections averaged at 440 kPa.

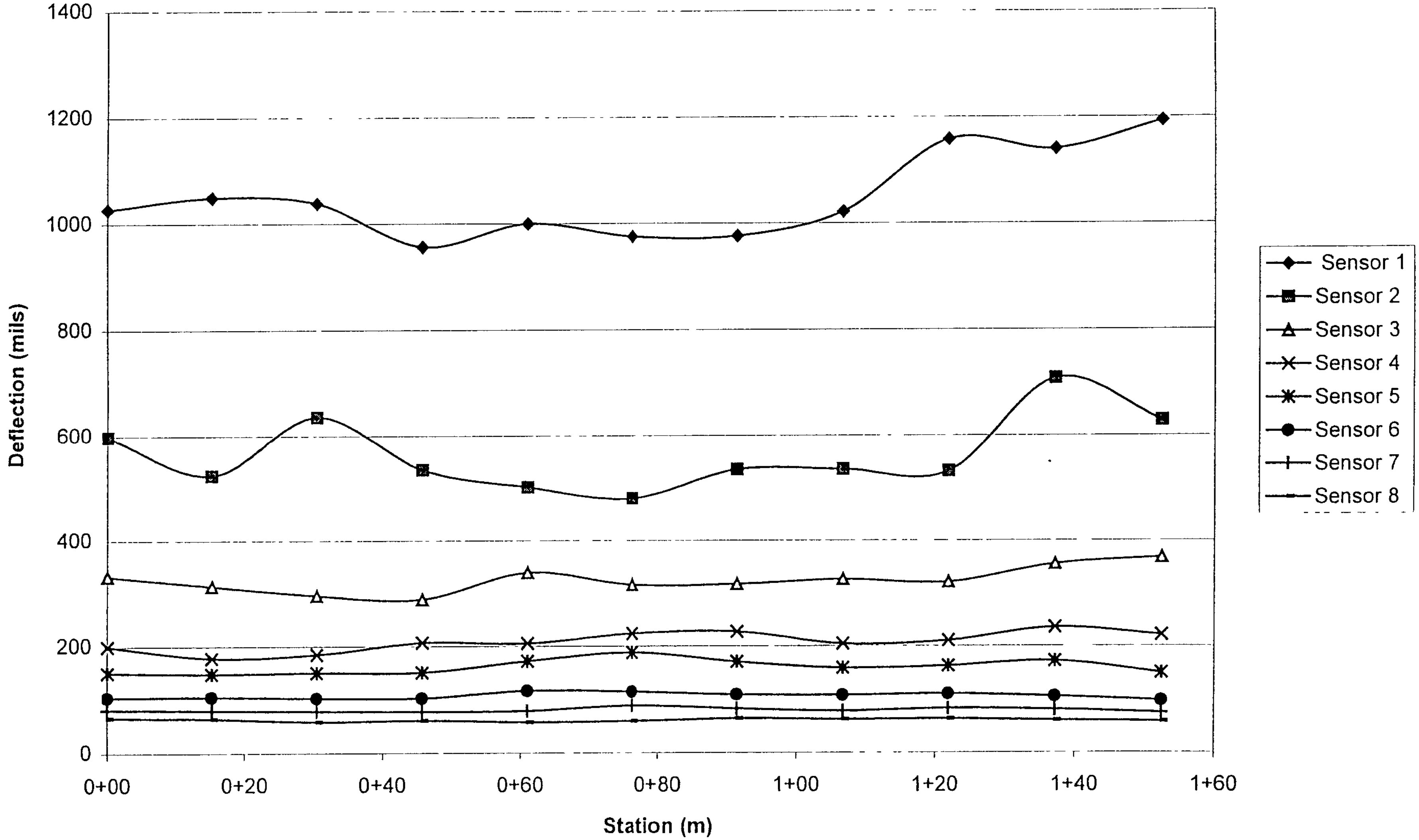


Figure 13. Section 060208 subgrade deflections averaged at 396 kPa.

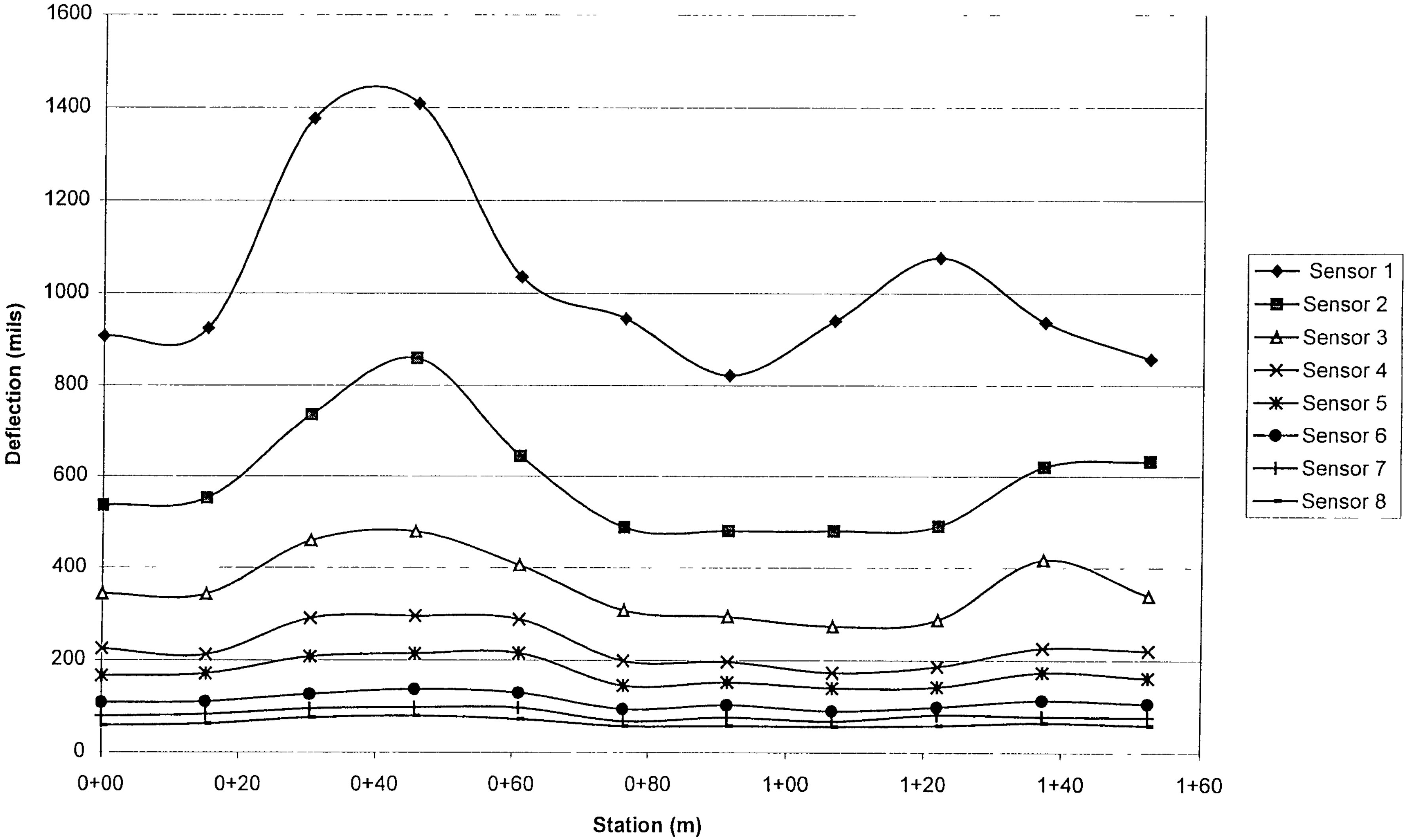


Figure 14. Section 060209 subgrade deflections averaged at 409 kPa.

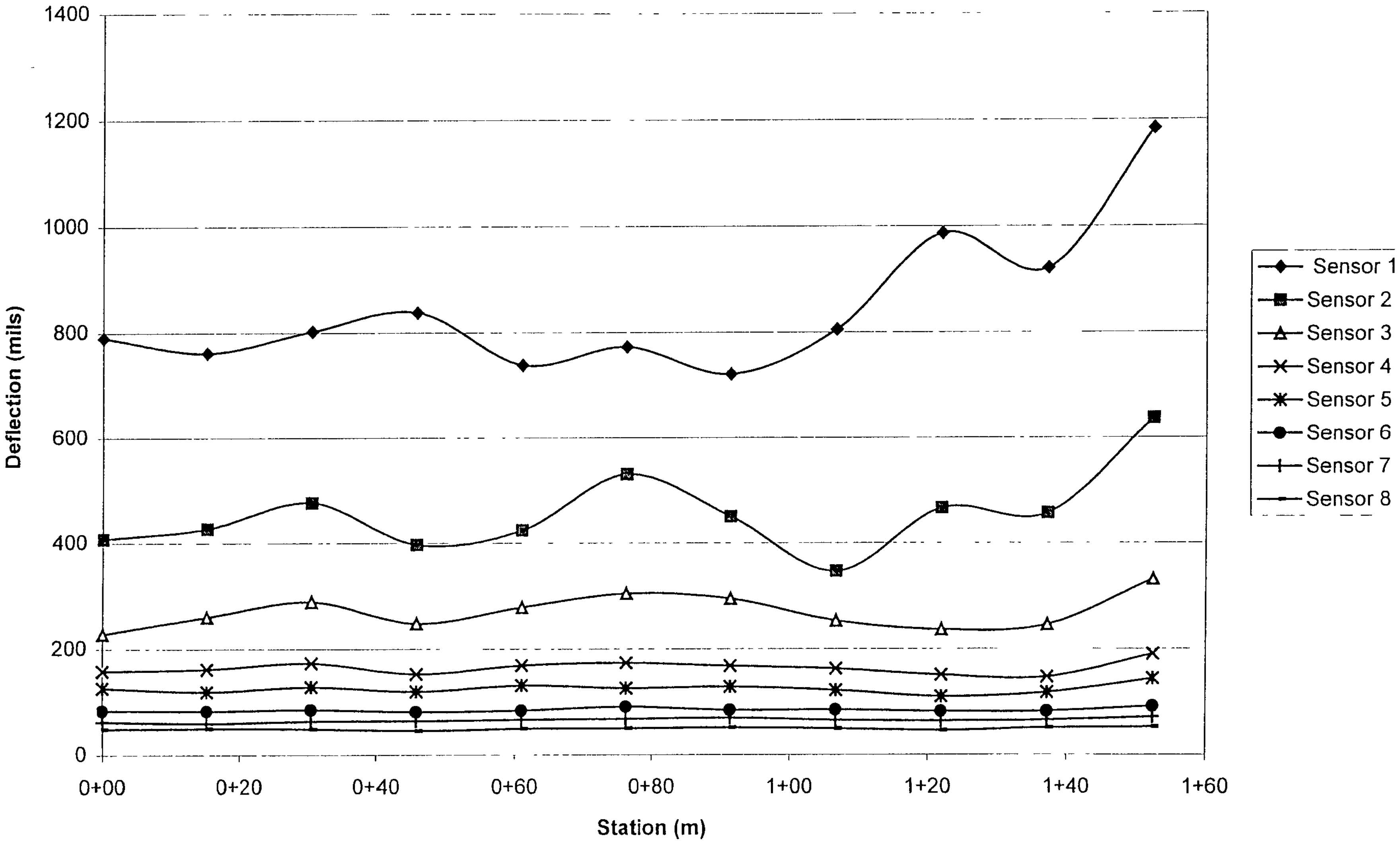


Figure 15. Section 060210 subgrade deflections averaged at 426 kPa.

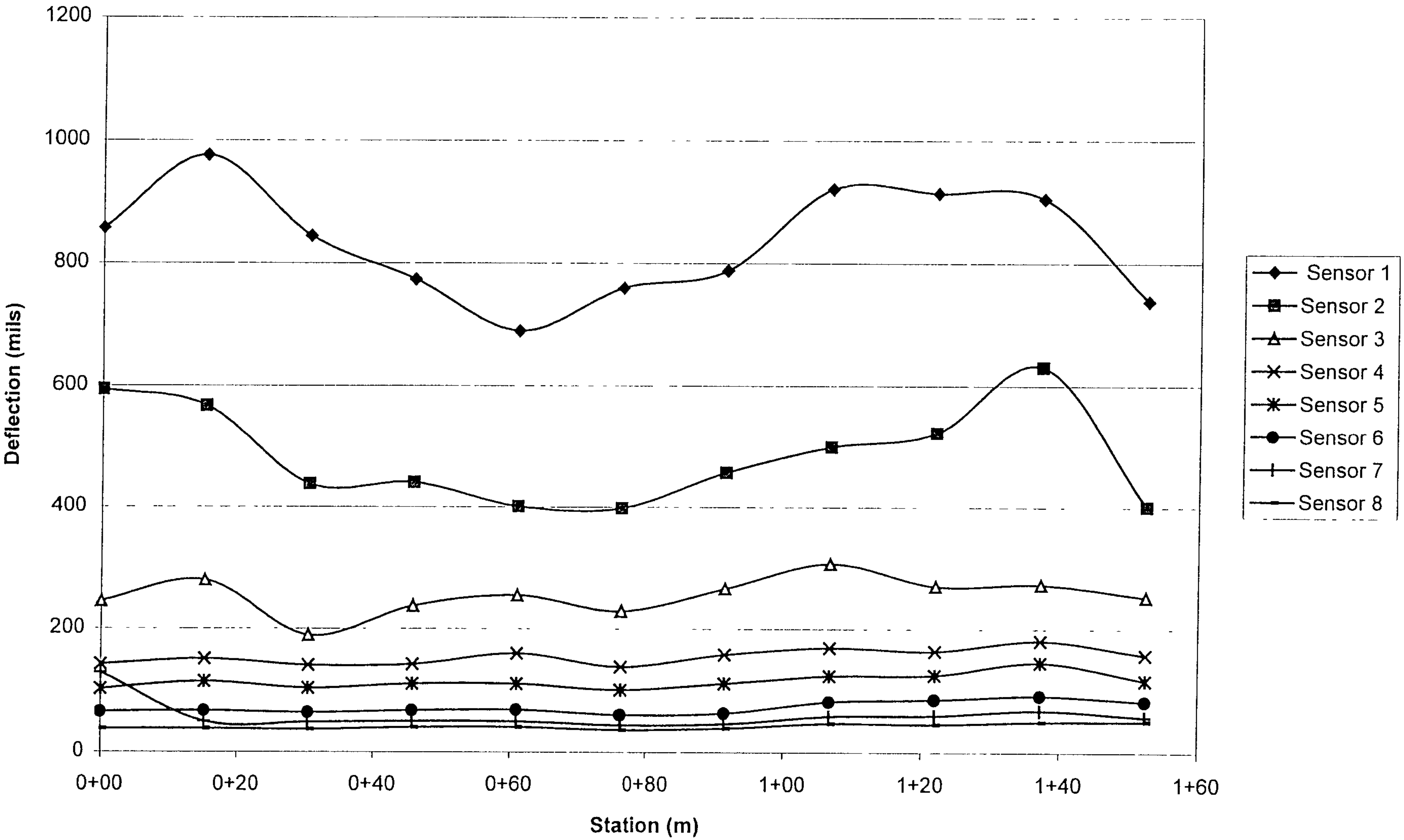


Figure 16. Section 060211 subgrade deflections averaged at 431 kPa.

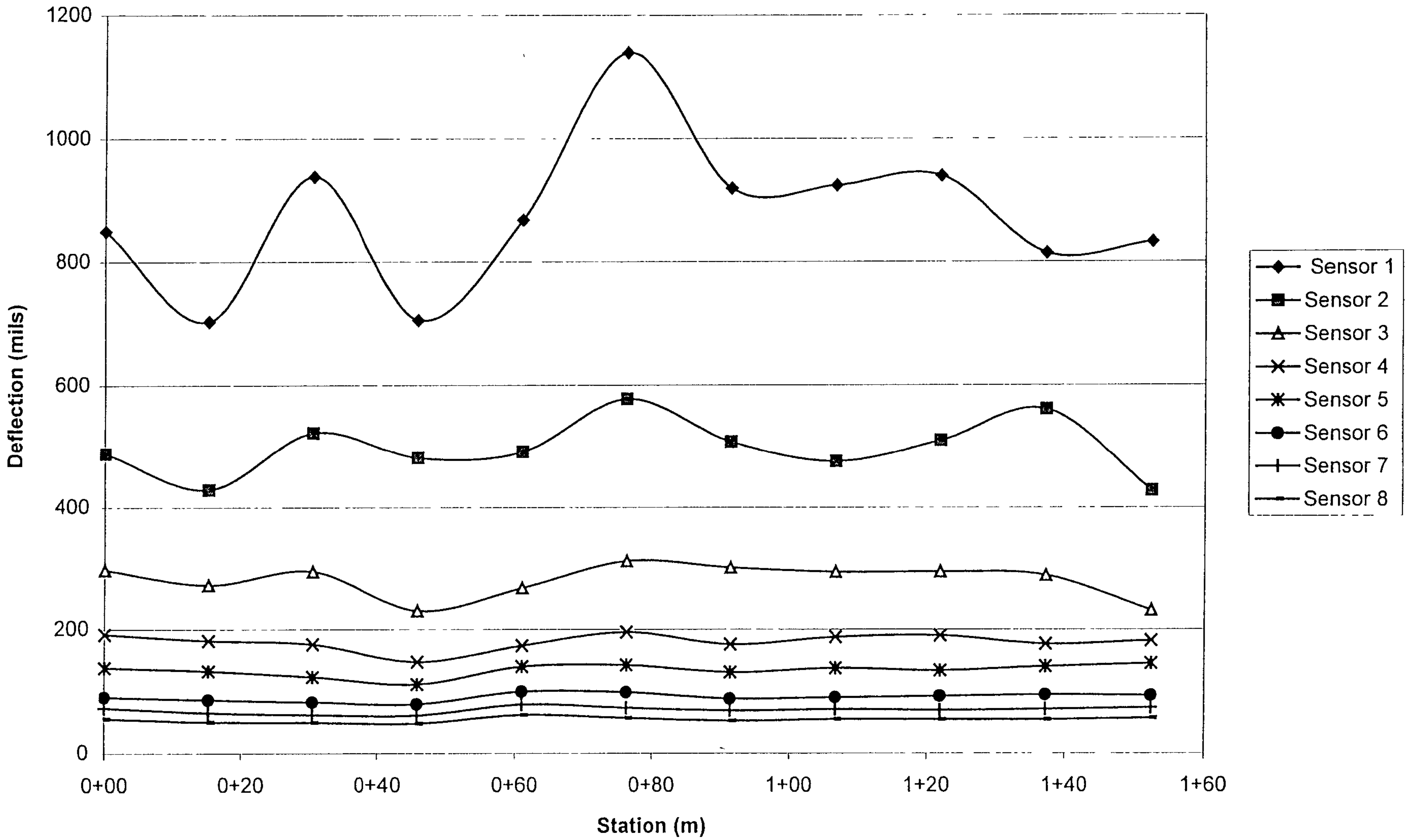


Figure 17. Section 060212 subgrade deflections averaged at 432 kPa.

compacted to the target density. Bulk sample numbers, locations, sections, and stationing information is presented in figure 18. An additional bulk sample was taken at station 0-10 of section 060203 and was labeled B40. Gradations of DGAB are presented in table 5.

Table 5. DGAB gradations, 060200 (waiting for test results from Braun).

Sieve Size (mm)	Percent Passing		
75.00			
50.00			
37.50			
25.00			
19.00			
12.50			
9.50			
4.75			
2.00			
0.425			
0.180			
0.075			

Field Density and Field Moisture Tests

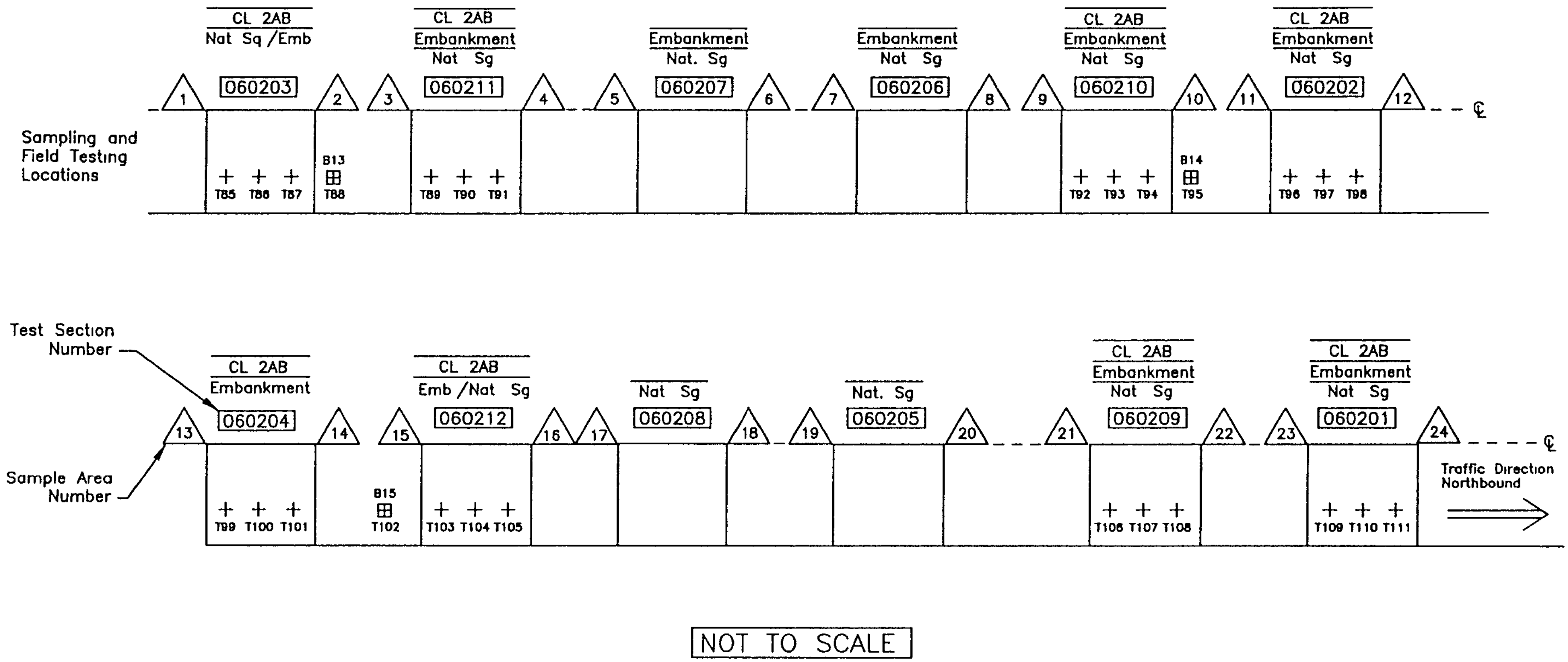
Field density and field moisture content tests were performed on the finished DGAB layer on April 4, 2000 (phase I) and August 14, 2000 (phase II) in accordance with AASHTO T 238-97 and T239-97 respectively at locations indicated in figure 5. An additional density test was performed at station 0-10 of section 060203 and was label T120.

Finished DGAB Surface Elevations

Elevation surveys on the surface of prepared DGAB surface were carried at locations indicated in figure 6. The purpose of the elevation surveys is to obtain a profile of prepared DGAB surface and to determine the thickness of DGAB layers. The actual in-place thickness of DGAB layers determined from elevation surveys are given in table 6.

Table 6. Summary of DGAB layer thicknesses.

Section	Avg. Thickness (mm)	Min. Thickness (mm)	Max. Thickness (mm)	Std. Deviation (mm)	Design Thickness (mm)
060201	151	127	173	11	150
060202	153	130	178	11	150
060203	146	119	252	17	150
060204	156	120	181	15	150
060209	103	71	150	15	100
060210	102	83	120	9	100
060211	98	72	134	13	100
060212	107	76	159	18	100



□ 0.6m x 0.6m bulk Class 2 Aggregate Base Samples (B13–B15)

\+ Location of nuclear moisture–density tests (T85–T111)

△ Sample areas

Nat. Sg. – Natural Subgrade

Cl 2AB – Class 2 Aggregate Base

Figure 18. Overview of material sampling and testing on Class 2 aggregate base course, SPS-2 California.

FWD Testing

FWD testing of the DGAB layer was performed on April 5, 2000 (phase I) and August 14, 2000 (phase II) by the WRCOC. The testing was performed in accordance with the procedures and guidelines outlined in SPS Directive Number S-4, "Deflection Testing of Subgrade and Base Layers for SPS-1, -2 and -8 Experiments." The results of the FWD testing are presented in figures 19 through 26. These deflections are not normalized and are plotted for an average loading indicated in each figure. There was a higher variability in the deflection measurements taken on the DGAB than there was on the subgrade layer.

PERMEABLE ASPHALT TREATED BASE (PATB)

Equipment

The following equipment was used in the material processing and construction work of permeable asphalt treated base on the test sections:

1998 Cedar Rapids CR551 pneumatic tired paver with hydraulic extendable screed and a smooth trac ultra sound 30' ski
1 Cedar Rapids pickup machine
1 Caterpillar CB634C double drum 12 ton vibratory roller
1 Ingersoll Rand DD70 double drum 12 ton vibratory roller
Double trailer bottom dump trucks

Edge Drains:
1 Caterpillar Excavator/backhoe
2 transit concrete mixer trucks
1 hand held whacker

Overview

Four drainable sections (060209, 060210, 060211, and 060212) were constructed which required placing 100mm of PATB on 100 mm of the DGAB. The PATB serves as a drainage layer in the pavement structure. The DGAB is used below the PATB to prevent the contamination of the PATB by the migration of fines from the subgrade.

Edge drains were constructed longitudinally along the outside edge of the travel lane to collect drainage water from the PATB. To construct the edge drains, a trench was excavated to a depth and width of 0.3m. The trench was lined with filter fabric before placement of the 75mm perforated PVC pipe. Lean permeable cement concrete was used as backfill and was compacted in one pass with a hand operated mechanical tamper. Photographs 7 and 8 in appendix A shows the construction of edge drains.

The PATB was placed on April 10, 2000 (sections 060209, 060210, and 060212) and on August 29, 2000 (section 060211). The single pass laydown width of the PATB was 4.3m. PATB was

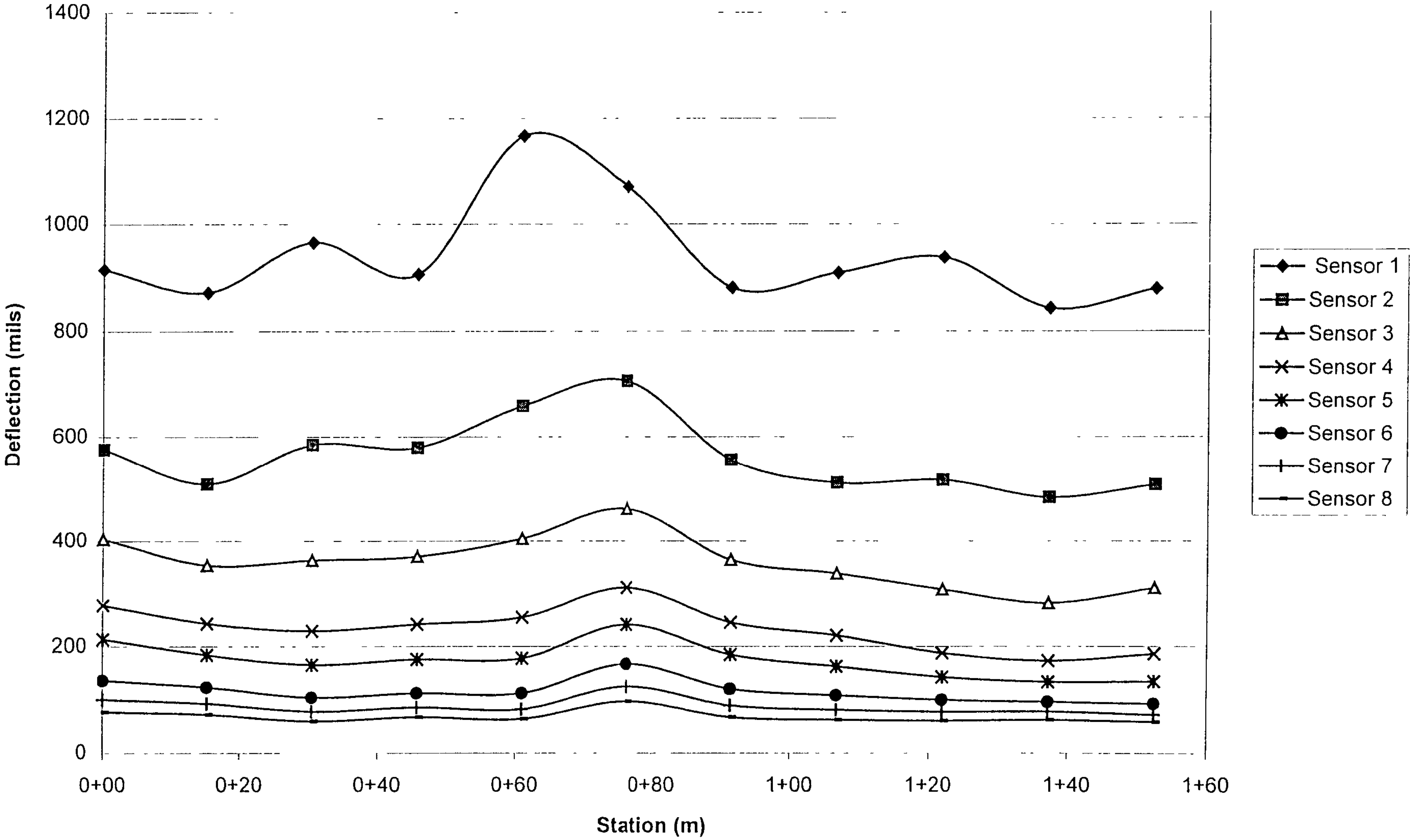


Figure 19. 060201 DGAB deflections averaged at 550 kPa.

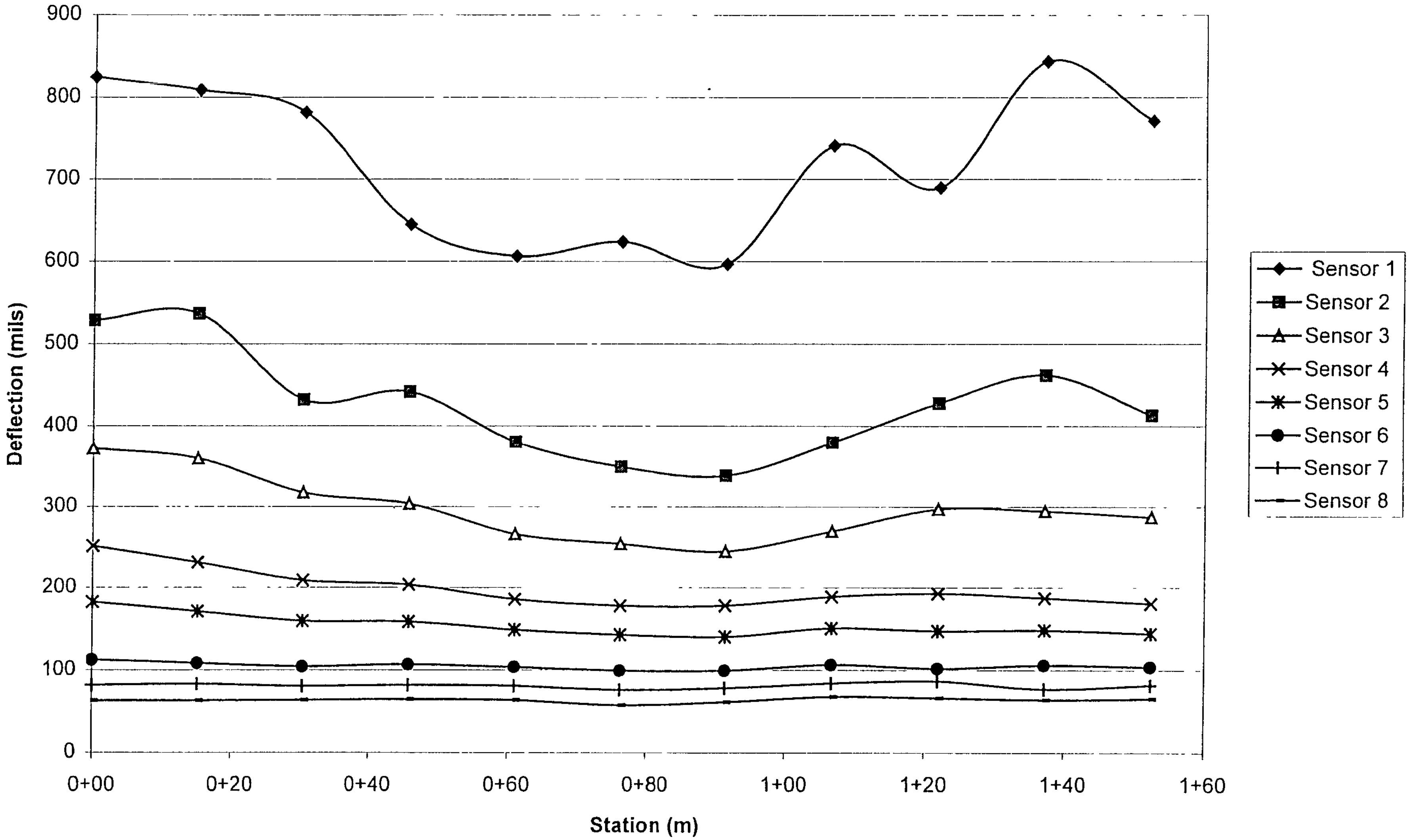


Figure 20. 060202 DGAB deflections averaged at 571 kPa.

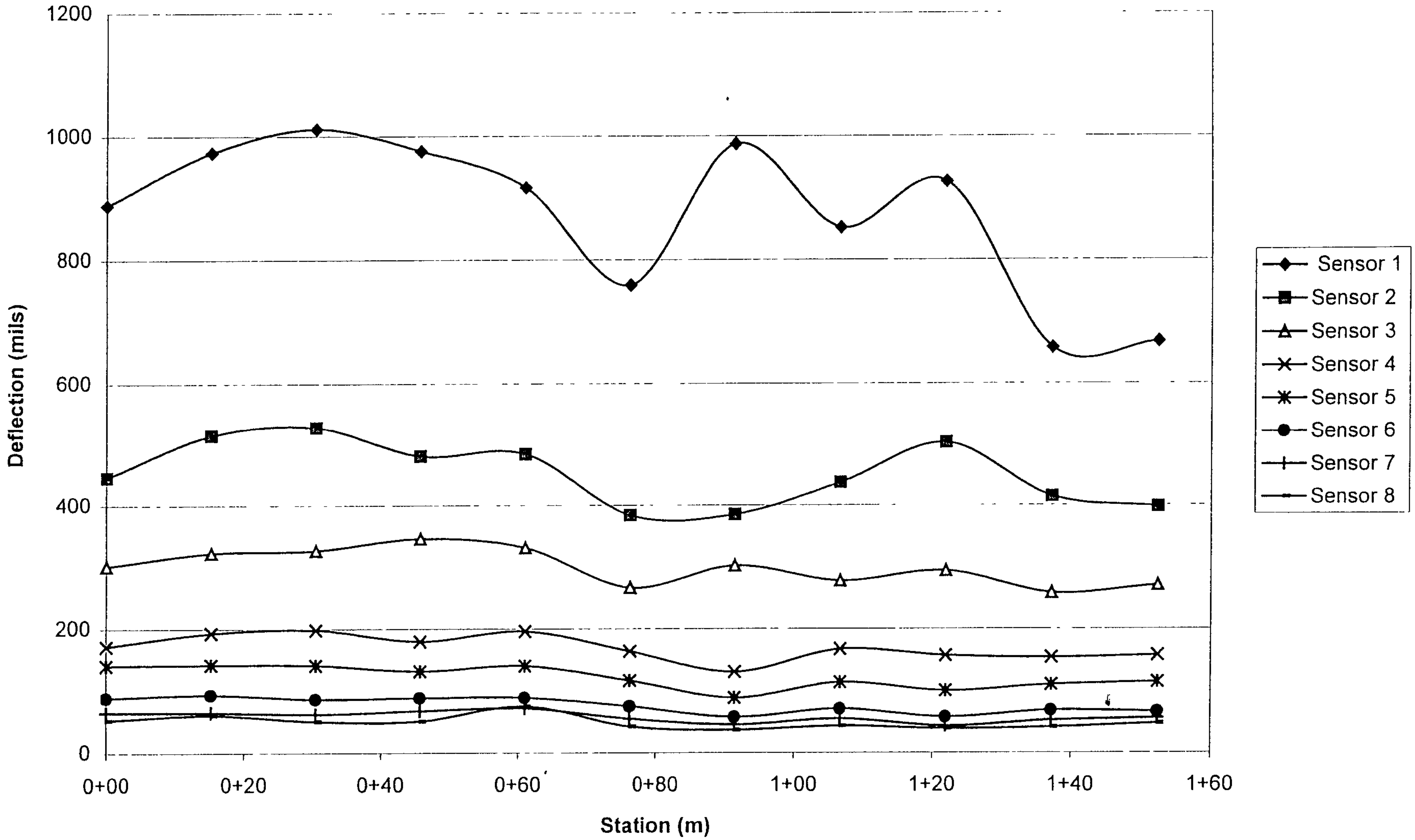


Figure 21. 060203 DGAB deflections averaged at 588 kPa

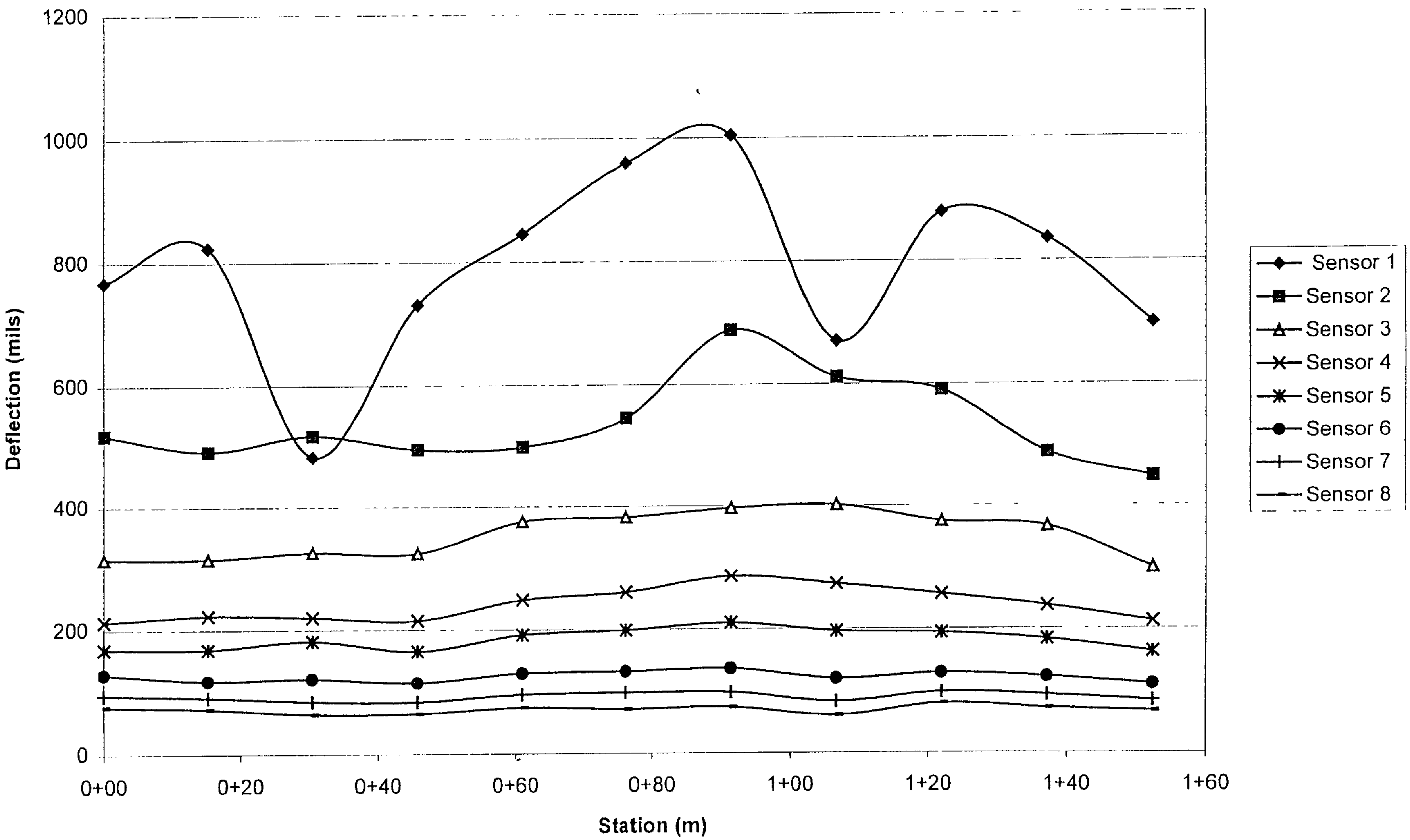


Figure 22. 060204 DGAB deflections averaged at 582 kPa.

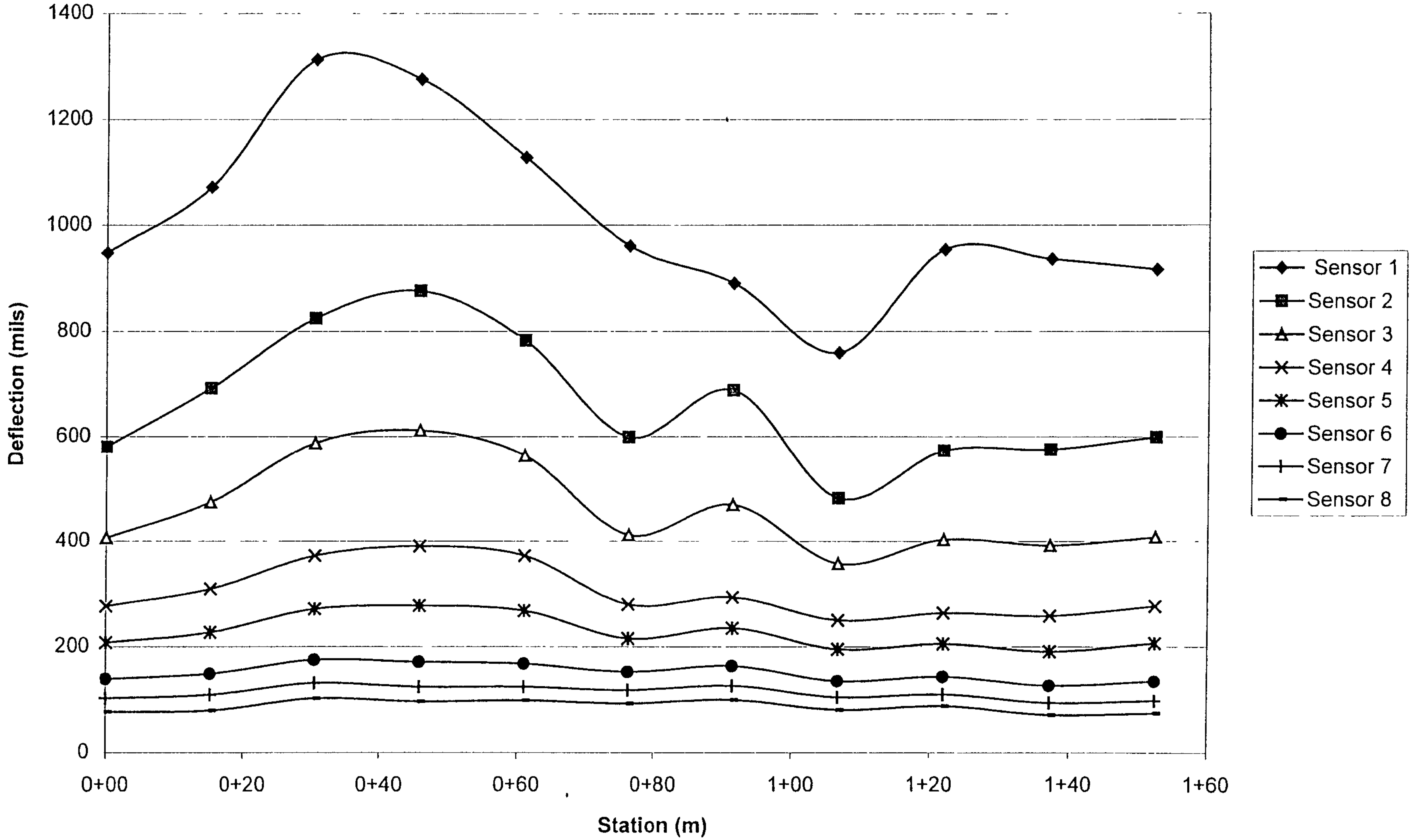


Figure 23. 060209 DGAB deflections averaged at 564 kPa.

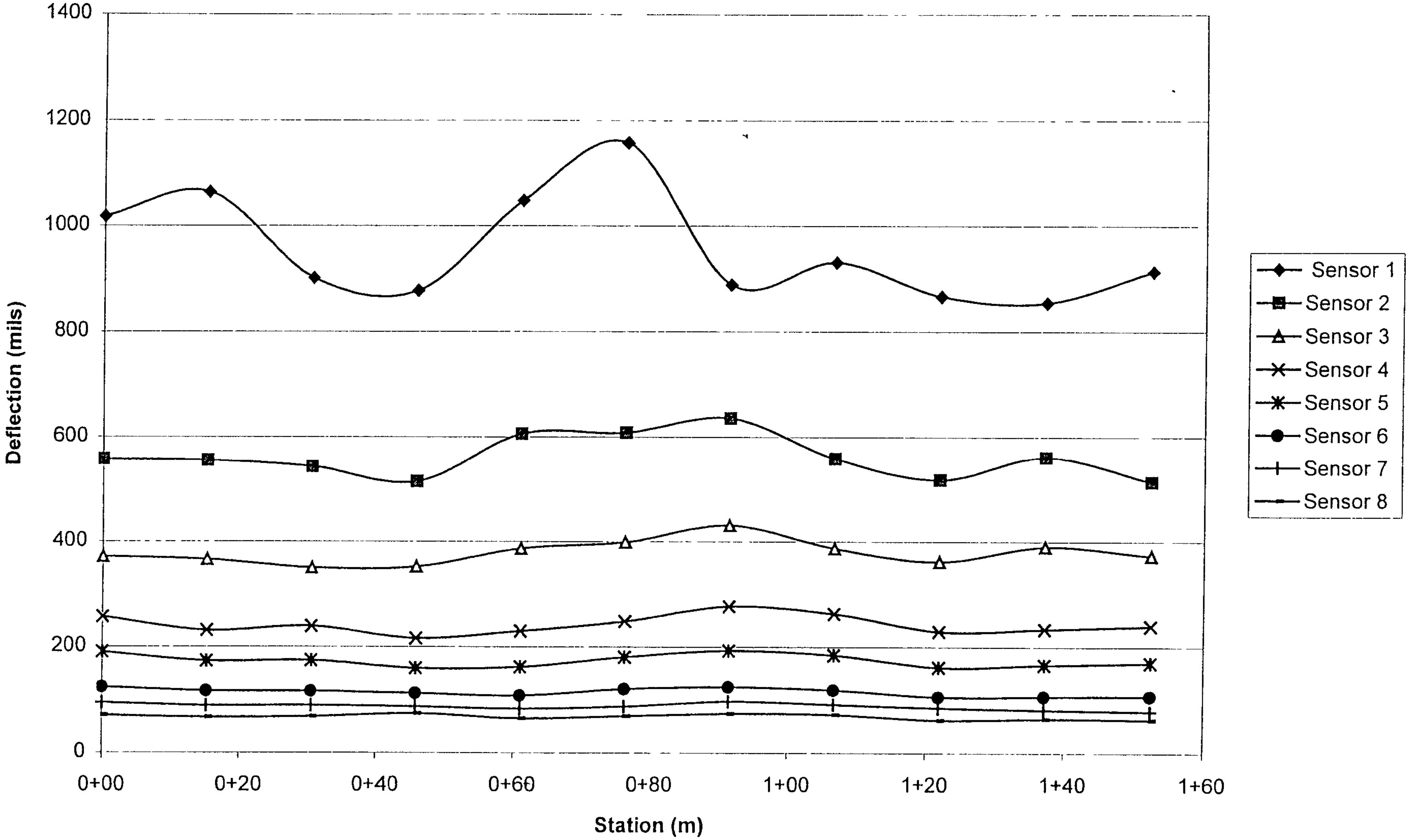


Figure 24. 060210 DGAB deflections averaged at 569 kPa.

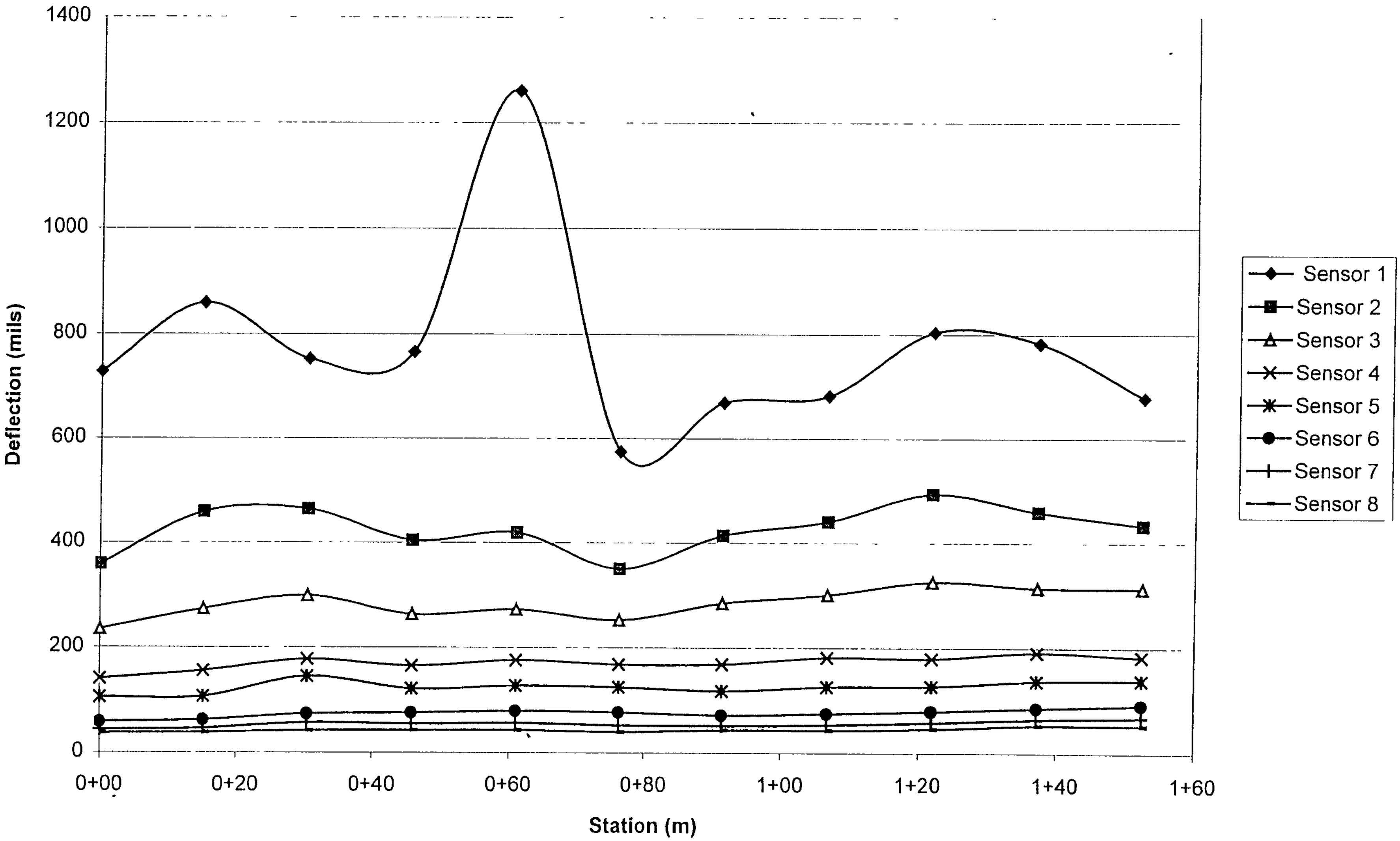


Figure 25. 060211 DGAB deflections averaged at 406 kPa.

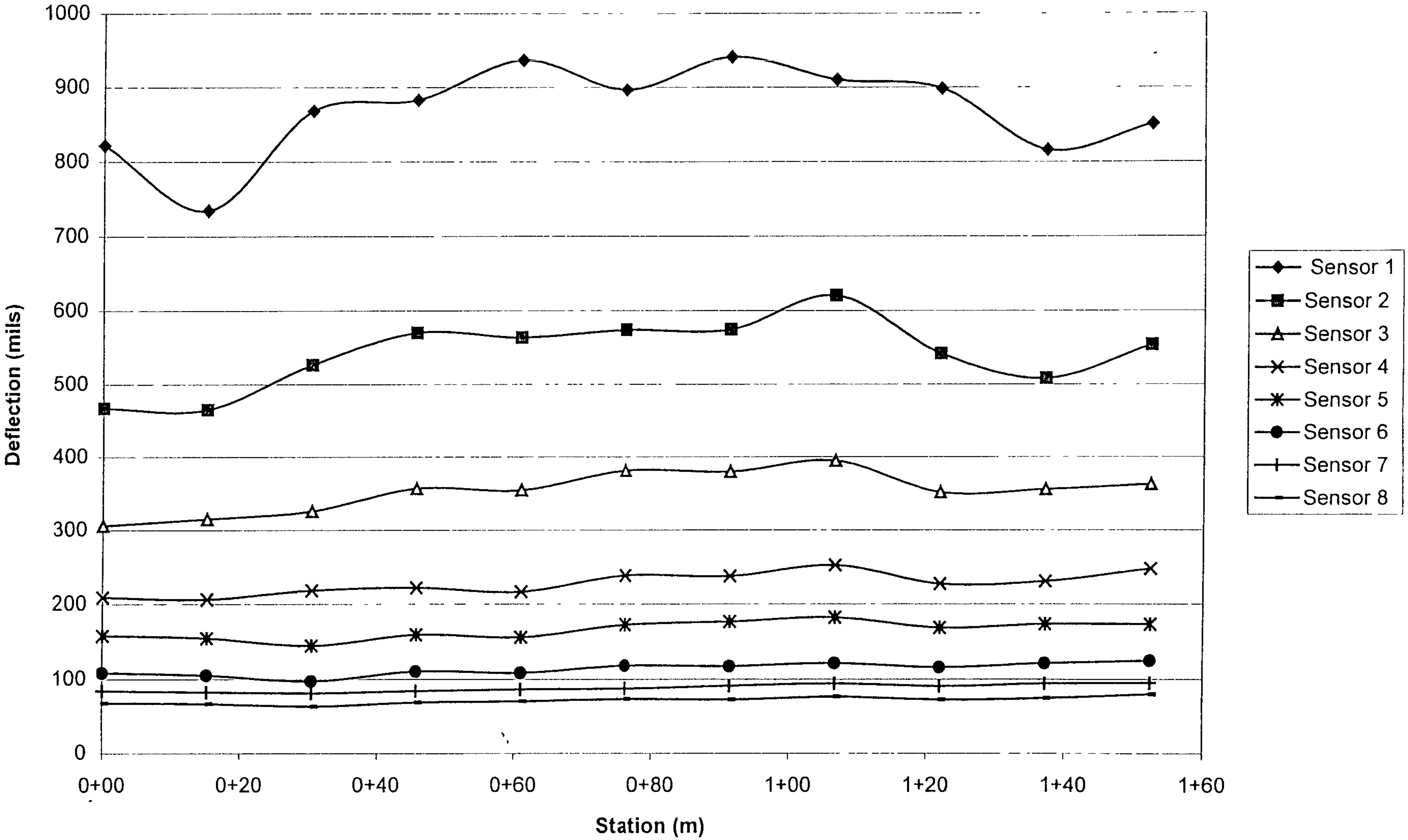


Figure 26. 060212 DGAB deflections averaged at 589 kPa.

delivered in bottom dump trucks from a batch plant approximately 34 kilometers from the site. The haul time from the plant to the site averaged 35 minutes. Two 12-ton vibratory steel drum rollers were used to achieve adequate compaction. The PATB was allowed to cool to the proper temperature before compaction. Therefore, compaction efforts did not cause any pushing or shoving. Photograph 9 in appendix A shows the PATB paving operation.

Inspection

The finished PATB layer was visually inspected for problems. The thickness of the PATB varied considerably due to problems with the amount of material placed in the windrow in front of the paver. The PATB layer was bladed in order to produce a more consistent thickness.

Bulk Sampling

Bulk sampling of PATB material was performed on April 10, 2000 (phase I) and August 29, 2000 (phase II) by excavating a test pit in the finished layer that would provide the required quantity of material. After the bulk sampling, the pits were backfilled with similar material and compacted to the target density. Bulk sample numbers, locations, sections, and stationing information is presented in figure 27.

Finished PATB Surface Elevations

Elevation surveys on the surface of the prepared PATB surface were carried at locations indicated in figure 6. The purpose of the elevation surveys is to obtain a profile of the PATB surface and to determine the thickness of PATB layers. The actual in place thickness of PATB layers determined from elevation surveys are given in table 7.

Table 7. Summary of PATB layer thicknesses.

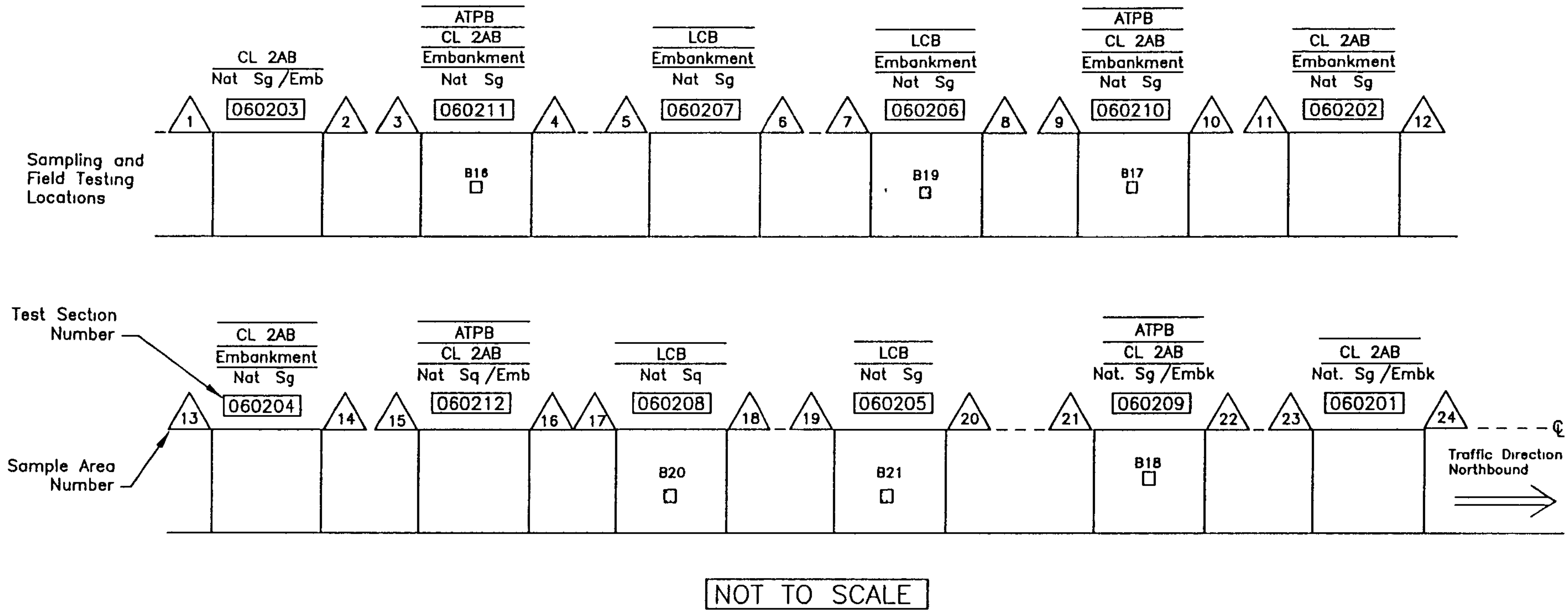
Section	Avg. Thickness (mm)	Min. Thickness (mm)	Max. Thickness (mm)	Std. Deviation (mm)	Design Thickness (mm)
060209	90	65	115	10	100
060210	97	79	113	8	100
060211	85	50	106	12	100
060212	94	74	119	11	100

LEAN CONCRETE BASE (LCB)

Equipment

The following equipment was used in the material processing and construction work of lean concrete base on the test sections:

A Gunnert 1970 vintage paver
12 transit concrete mixer trucks



□ Bulk ATPB samples (B16–B18)

□ Bulk LCB samples (B19–B21)

△ Sample areas

Nat. Sg. – Natural Subgrade

LCB – Lean Concrete Base

Cl 2AB – Class 2 Aggregate Base

ATPB – Asphalt Treated Permeable Base

Figure 27. Overview of material sampling & testing on asphalt treated permeable base and lean concrete base, SPS-2 California.

Overview

Four non-drainable sections (060205, 060206, 060207, and 06208) were constructed which required placing 150mm of LCB on the subgrade. LCB was placed and finished on April 7, 2000. The LCB mix design, LCB mixture properties, and the aggregate gradation results can be found in tables 8 through 10, respectively.

Table 8. LCB mix design.

Cement (Type II modified)	93.7 kg/m³
Coarse Aggregate (38.1 mm x 19 mm)	238.2 kg/m³
Coarse Aggregate (25.4 mm x 4.75 mm)	476.8 kg/m³
Fine Aggregate	476.8 kg/m³
Air Entraining Admixture (Darex II)	22.6 ml/m³
Water	94.3 kg/m³

Table 9. LCB mixture properties.

Air Content	3.0%
Slump	25-75 mm
Unit Weight	2360 kg/m³
W/C+F	1.01 kg/kg

Table 10. LCB aggregate gradation.

Sieve Size (mm)	Percent Passing		
	38.1 mm x 19 mm	25.4 m x 4.75 mm	Fine Aggregate
50	100		
37.5	95	100	
25	41	95	
19	5	78	
12.5			
9.5	1	22	100
4.75		5	98
2.36		1	83
1.18			65
600			46
300			20
150			3
75			1

Photograph 10 in appendix A shows the construction of the LCB. The LCB was placed using a slip form paver that paved an 8.6m pass. Two plants provided the material: one 19 kilometers away and the other onsite. The material was hauled using transit concrete mixer trucks. The trucks backed up in front of the paver and unloaded the material. Each truck hauled 9.5 cubic yards of material per haul. Machine troweling was used to finish the LCB.

Inspection

The mix coming from the on-site plant appeared to have a larger amount of coarse aggregate compared with the other mix. Considerable aggregate segregation resulted from this mix.

The LCB was not properly covered with curing compound. Therefore, the LCB cracked at several locations. When the cracking was discovered, additional curing compound was applied before placement of the PCC layer.

Bulk Sampling

Bulk sampling of LCB material was performed on April 7, 2000 by excavating a test pit in the finished layer that would provide the required quantity of material. After the bulk sampling, the pits were backfilled with similar material and compacted to the target density. Bulk sample numbers, locations, sections, and stationing information is presented in figure 27. Sampling and field testing of the fresh LCB is shown in photograph 11 in appendix A.

Finished LCB Surface Elevations

Elevation surveys on the surface of the prepared LCB surface were carried at locations indicated in figure 6. The purpose of the elevation surveys is to obtain a profile of the LCB surface and to determine the thickness of LCB layers. The actual in place thickness of LCB layers determined from elevation surveys are given in table 11.

Table 11. Summary of LCB layer thicknesses.

Section	Avg. Thickness (mm)	Min. Thickness (mm)	Max. Thickness (mm)	Std. Deviation (mm)	Design Thickness (mm)
060205	145	124	166	12	150
060206	146	104	173	13	150
060207	148	123	204	19	150
060208	160	138	265	19	150

PORTLAND CEMENT CONCRETE (PCC) PAVEMENT

Equipment

The following equipment was used in the material processing and construction work of the PCC on the test sections:

1 Gunnert 1970 vintage paver
20 transit concrete mixer trucks
1 CAT backhoe for transporting dowel baskets

Overview

This project had two design thicknesses for the PCC layer. Sections 060201, 060202, 060205, 060206, 060209, and 060210 had a design thickness of 205mm. Sections 060203, 060204, 060207, 060208, 060211, and 060212 had a design thickness of 280mm. In addition, the PCC layer had two design strengths. Sections 06203, 060211, 060207, 060205, 060209, and 060201 were constructed with a 3.8 MPa flexural strength concrete. Sections 060206, 060210, 060202, 060204, 060212, and 060208 were constructed with a 6.2 MPa flexural strength concrete. Phase I construction of PCC took place between April 12, 2000 and April 20, 2000. Construction of the phase II PCC layer was performed on September 5, 2000. Photograph 12 in appendix A presents an overview of PCC paving operations. PCC for this SPS-2 paving was supplied from a batch plant about 19 km from the project. Both the travel lanes were paved in one pass using a Gunnert paver. Phase I shoulder construction was performed after paving the travel lanes and was completed on May 2, 2000. Phase II shoulder construction was completed prior to construction of the travel lanes and was completed on September 1, 2000.

The design and construction specifications called for placement of dowel bars across the transverse joints of the test sections. The transverse joint locations were marked beforehand using spray paint. Dowel baskets were used to maintain the proper spacing and proper depth of dowels. The dowel baskets were nailed to the grade (shown in photographs 13 and 14, appendix A) to ensure proper placement. Both the baskets and the dowels were epoxy coated before placement on the grade to prevent any sort of bonding between the concrete and the dowels. The dowel diameters were 31.75mm and 38.1mm for the 205mm PCC sections and the 280mm PCC sections, respectively.

Tie bars were installed mechanically by the concrete paver. The tie bars had a diameter of 16mm, and a length of 760mm. Spacing of the tie bars were 760mm on center.

Finishing the fresh PCC was achieved by a float trailing the paver. Burlap finishing and tining of PCC was carried out with an approximate time lag of 1.5 hours. The sawing of joints took place about 10 hours later. The joints were sealed with an average sealant reservoir 12.7mm in width and 12.7mm in depth.

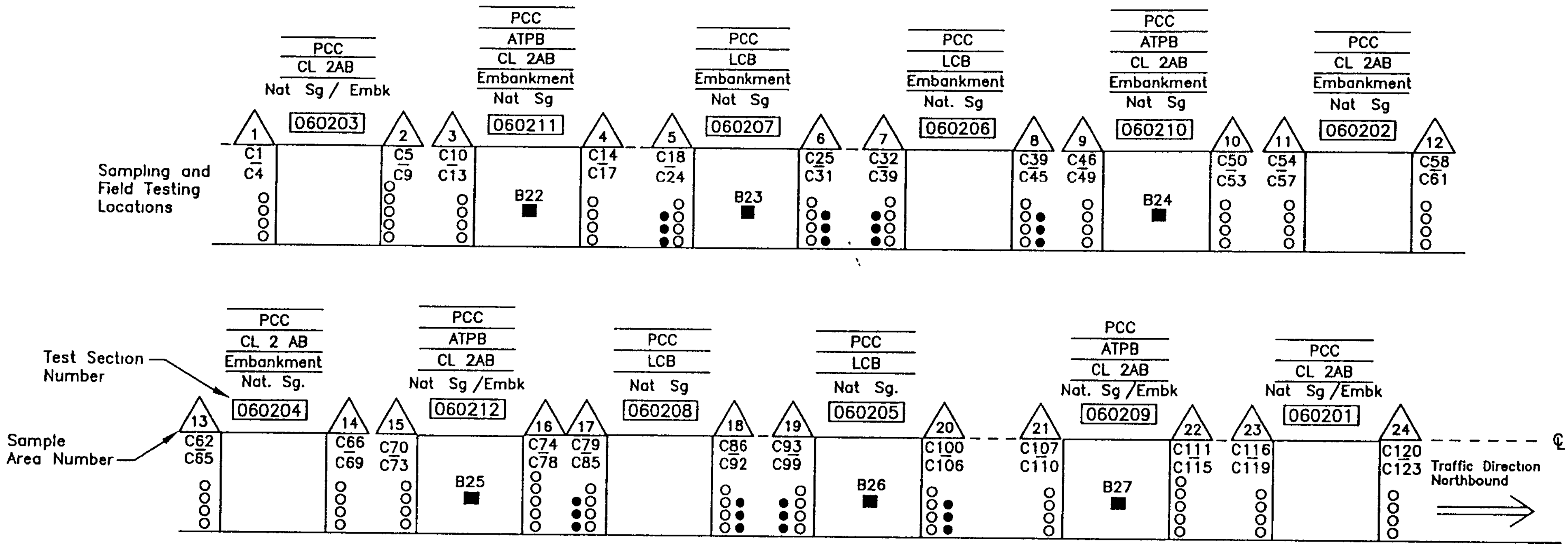
Bulk Sampling of PCC

Bulk sampling of fresh PCC was performed at the locations shown in figure 28. This PCC was used to cast in situ cylinder and beam samples of PCC to determine the properties of the as-delivered concrete.

The detailed PCC mix design is included in appendix E. A brief description of the mix design is presented in tables 12 through 14.

Inspection

During PCC paving, the paver was having trouble with the tie bar inserter not inserting the bars. This was not a major problem other than temporarily stopping the operation to fix the problem. While paving, voids in the surface of the PCC were occasionally left behind the paver. Material was shoveled to fill these voids while the operation continued.



NOT TO SCALE

- ● 4" core of finished LCB layers (C18–C20, C25–C27, C32–C34, C39–C41, C79–C81, C86–C88, C93–C95, C100–C102)
- o 4" core of finished PCC surface only (C1–C17, C21–C24, C28–C31, C35–C38,) (C42–C78, C82–C85, C89–C92, C96–C99, C103–C106, C107–C123)
- ■ Bulk PCC Samples (B22–B27)
- △ Sample areas

Nat. Sg. – Natural Subgrade
LCB – Lean Concrete Base
Cl 2AB – Class 2 Aggregate Base
ATPB – Asphalt Treated Permeable Base

Figure 28. Overview of sampling, testing, and coring plan for surface of test sections, SPS-2 California.

Table 12. PCC mix design.

3.8 MPa	
Cement (Type II modified)	122.1 kg/m^3
Boral Fly Ash	40.9 kg/m^3
Coarse Aggregate (38.1mm x 19mm)	432.1 kg/m^3
Coarse Aggregate (25.4mm x 4.75mm)	312.1 kg/m^3
Fine Aggregate	434.5 kg/m^3
Water	83.2 kg/m^3
6.2 MPa	
Cement (Type II modified)	277 1 kg/m^3
Coarse Aggregate (38.1mm x 19mm)	358.9 kg/m^3
Coarse Aggregate (25 4mm x 4.75mm)	259.4 kg/m^3
Fine Aggregate	339 2 kg/m^3
Air Entraining Admixture (Darex II)	927 0 ml/m^3
Water	121.0 kg/m^3

Table 13. PCC mixture properties.

3.8 MPa	
Air Content	1.0%
Unit Weight	1425.0 kg/m^3
Slump	Not Reported
W/C+F	0.51 kg/kg
6.2 MPa	
Air Content	3.5%
Unit Weight	1355 6 kg/m^3
Slump	25 to 75 mm
W/C+F	0.44 kg/kg

Table 14. PCC (3.8 MPa and 6.2 MPa) aggregate gradation.

	Percent Passing		
Sieve Size (mm)	38.1mm x 19mm	25.4m x 4.75mm	Fine Aggregate
50	100		
37 5	92	100	
25	25	95	
19	5	78	
12.5	1		
9.5		22	100
4.75		5	97
2.36		1	80
1.18			65
600			41
300			20
150			7
75			3

Core Sampling of PCC

Coring of the PCC pavement was performed by Caltrans at the locations identified in figure 28. The 14 days, 28 days, and 1 year coring were all collected on schedule.

Finished PCC Surface Elevations

Elevation surveys on the surface of the PCC surface were carried at locations indicated in figure 6. The purpose of the elevation surveys is to obtain a profile of prepared PCC surface and to determine the thickness of the PCC layers. The PCC layer thickness information is summarized in table 15. Plots of the layer thicknesses for each section are presented in figures 29 through 40. In addition, layer profiles are plotted in figures 41 through 52. These figures show that although there was some deviation within certain layers of a section, the final section thicknesses were very close to the design values.

Table 15. Summary of PCC layer thicknesses.

Section	Avg. Thickness (mm)	Min. Thickness (mm)	Max. Thickness (mm)	Std. Deviation (mm)	Design Thick-ness (mm)
060201	209	186	230	9	205
060202	196	171	213	8	205
060203	290	185	209	16	280
060204	293	258	331	16	280
060205	213	176	235	11	205
060206	205	180	245	14	205
060207	286	229	305	18	280
060208	272	174	291	19	280
060209	212	190	242	12	205
060210	208	192	230	9	205
060211	295	260	338	14	280
060212	283	262	325	12	280

FWD Testing

FWD testing of the PCC was performed between May 30, 2000 and May 31, 2000 (phase I) and on September 16, 2000 (phase II) by the WRCOC in accordance with the procedures and guidelines outlined in Directive FWD-19 "Manual for FWD Testing in the Long Term Pavement Performance Study." The PCC deflection profiles for all sections are presented in figures 53 through 64. These profiles are not normalized and are plotted for an average loading indicated in each figure. The figures show that compared to the embankment and DGAB layers, there is better uniformity. Sections 060205 and 060207 are the only two having significant variation.

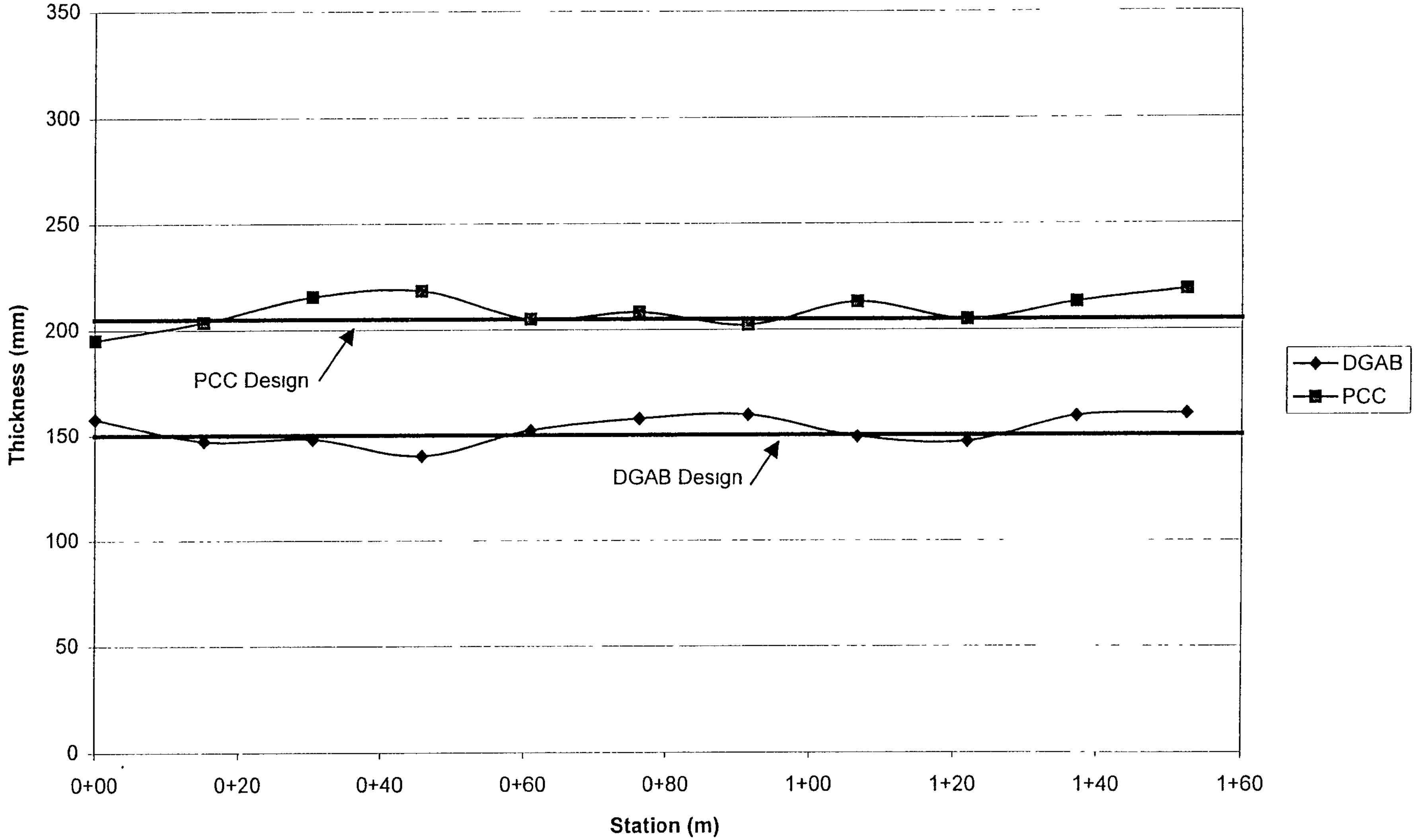


Figure 29. Section 060201 thicknesses from rod and level.

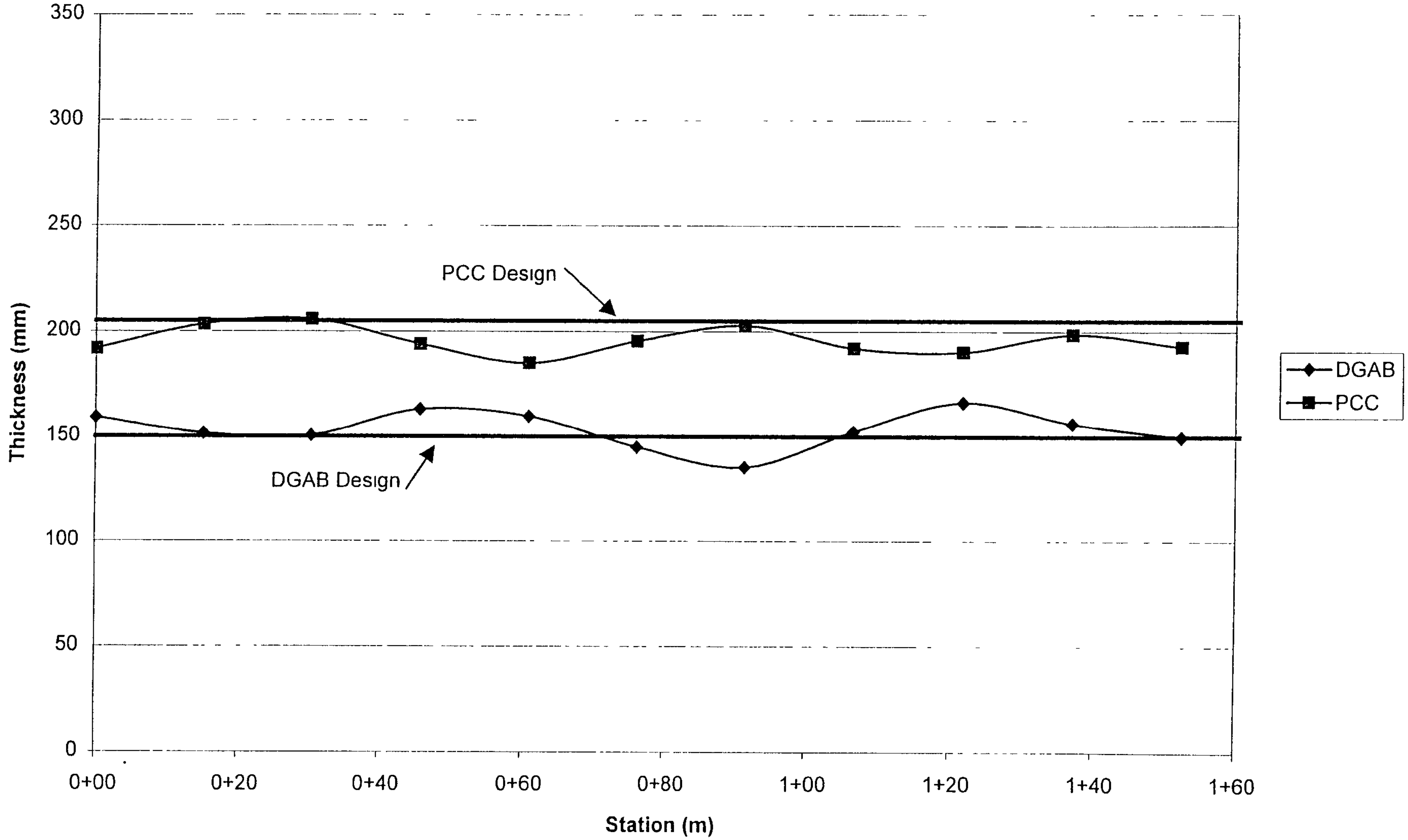


Figure 30. Section 060202 thicknesses from rod and level.

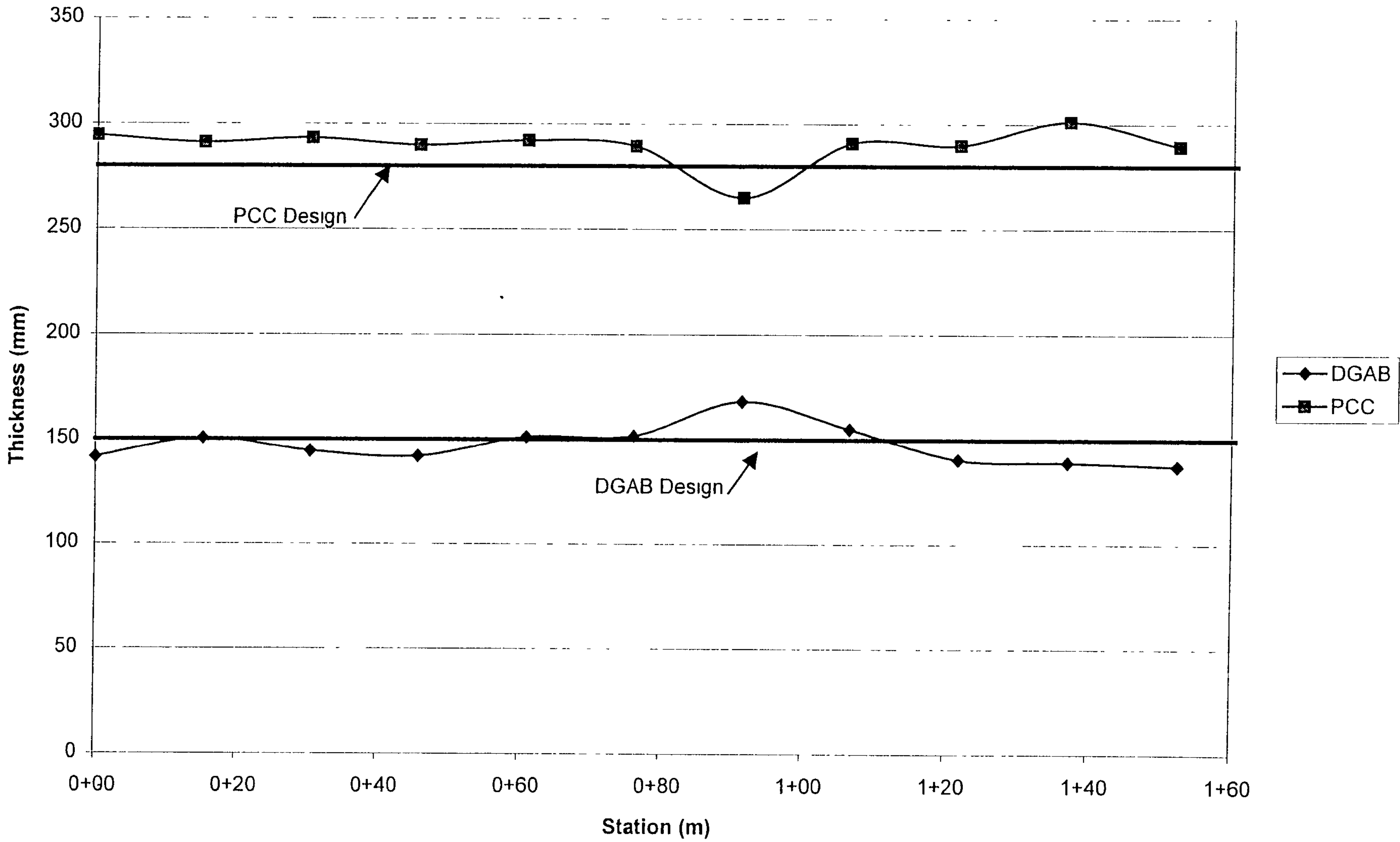


Figure 31. Section 060203 thicknesses from rod and level.

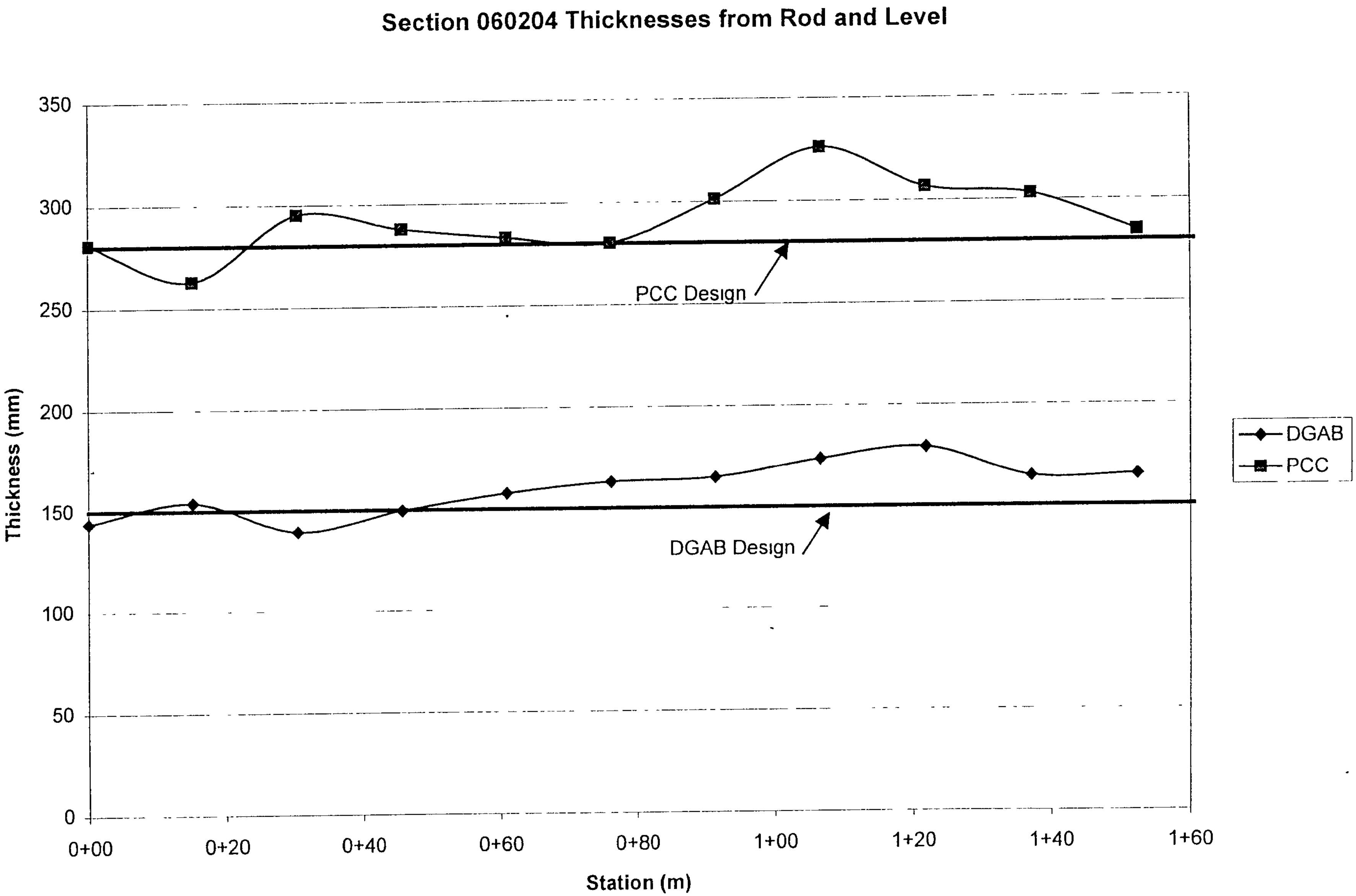


Figure 32. Section 060204 thicknesses from rod and level.

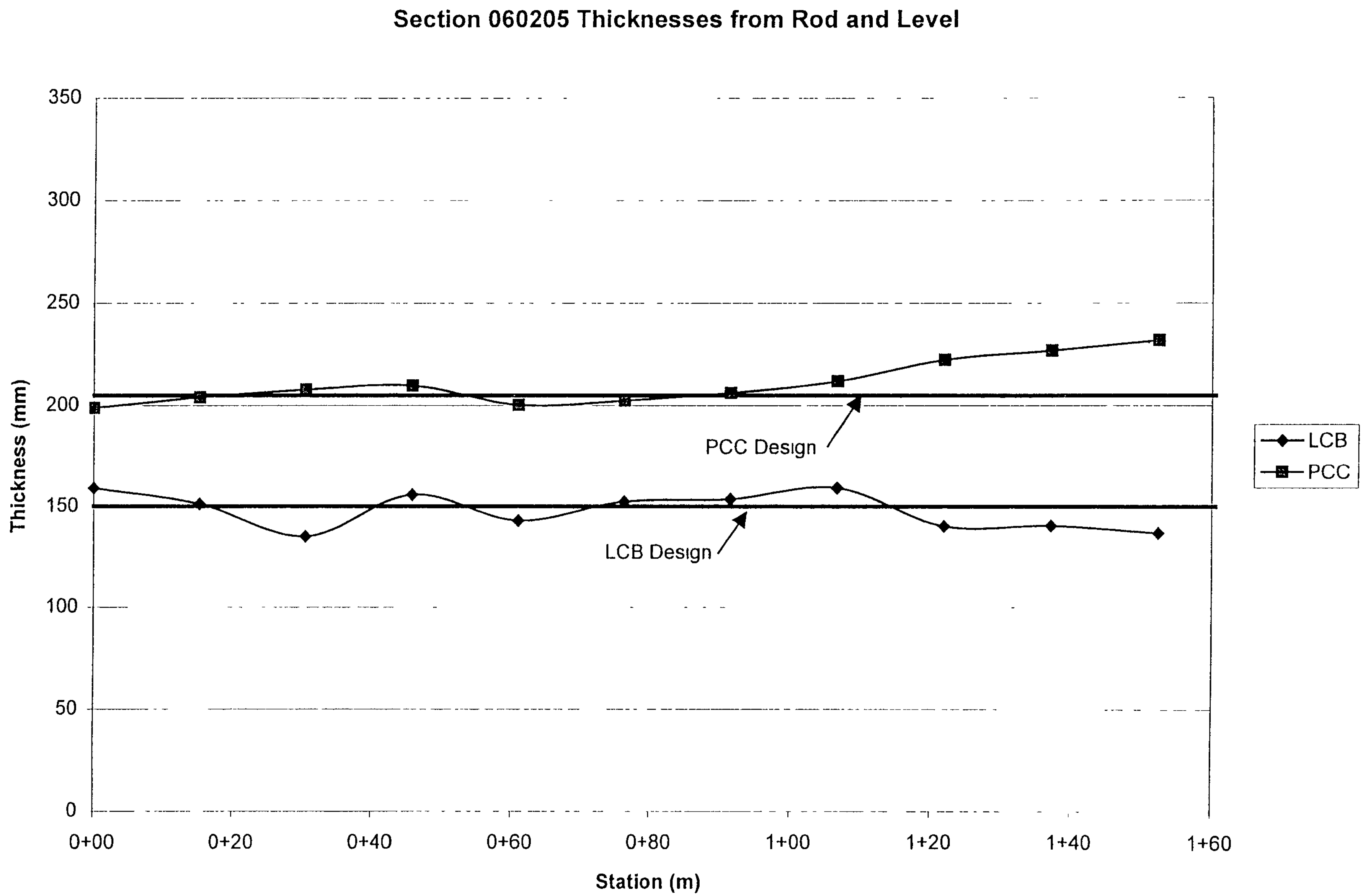


Figure 33. Section 060205 thicknesses from rod and level.

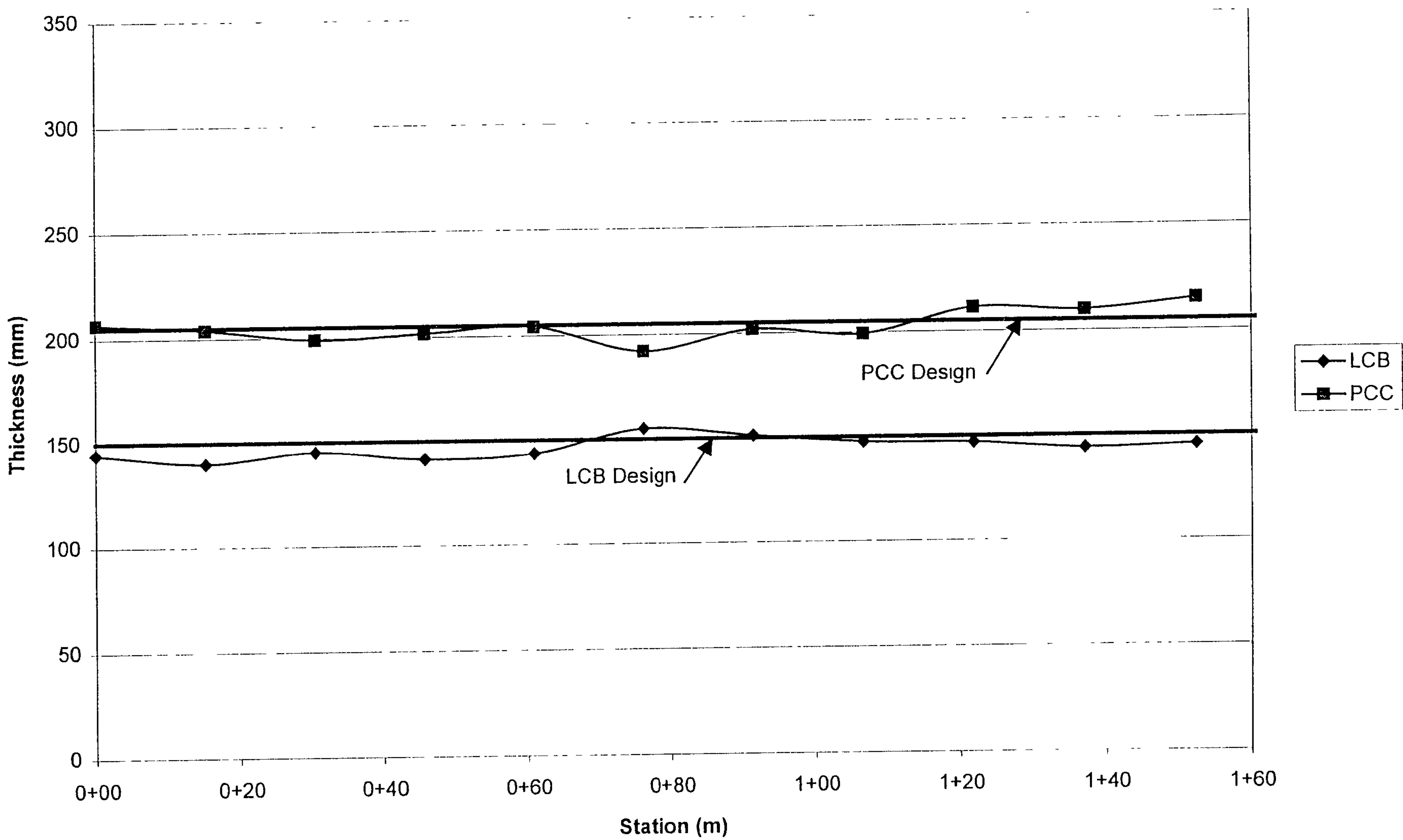


Figure 34. Section 060206 thicknesses from rod and level.

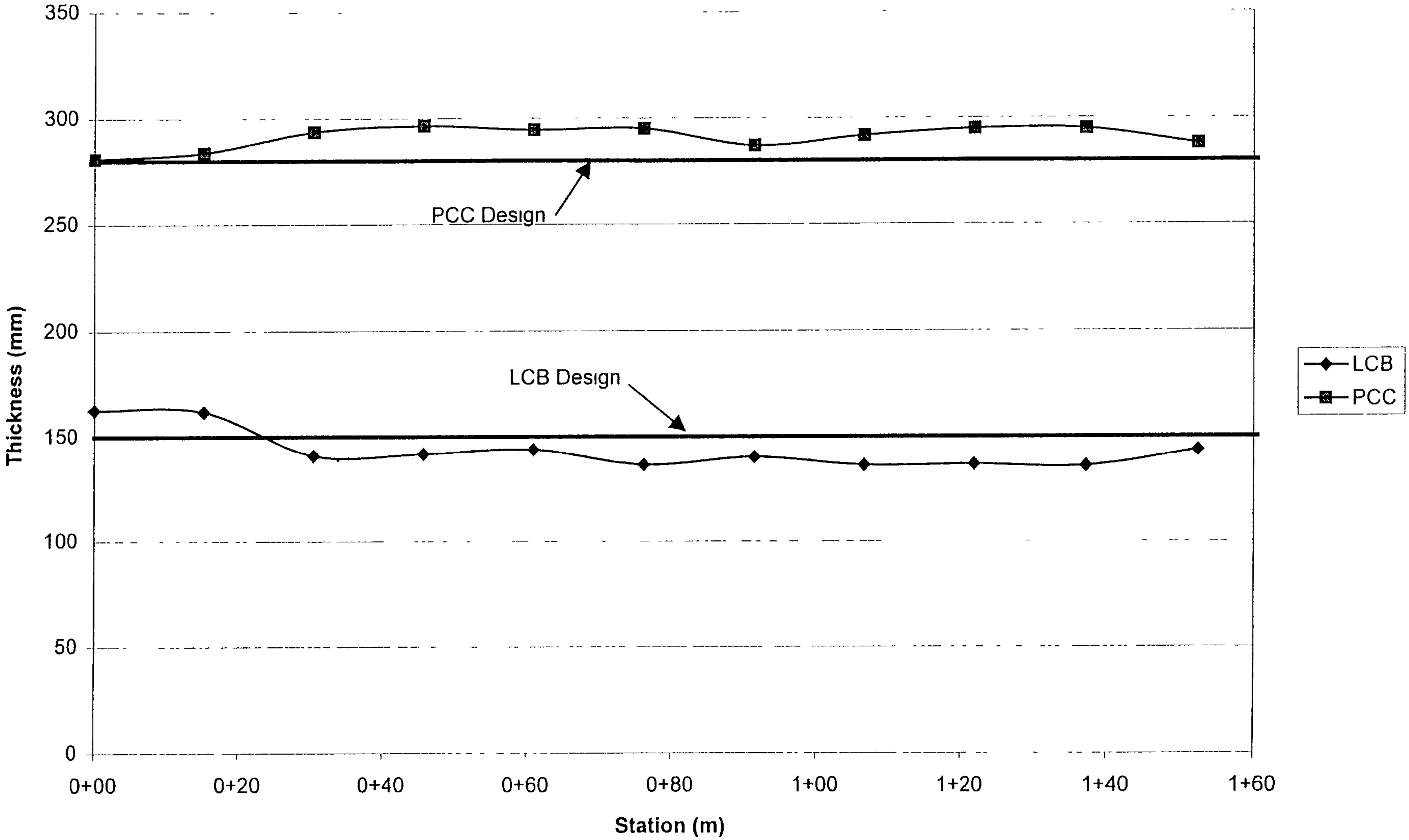


Figure 35. Section 060207 thicknesses from rod and level.

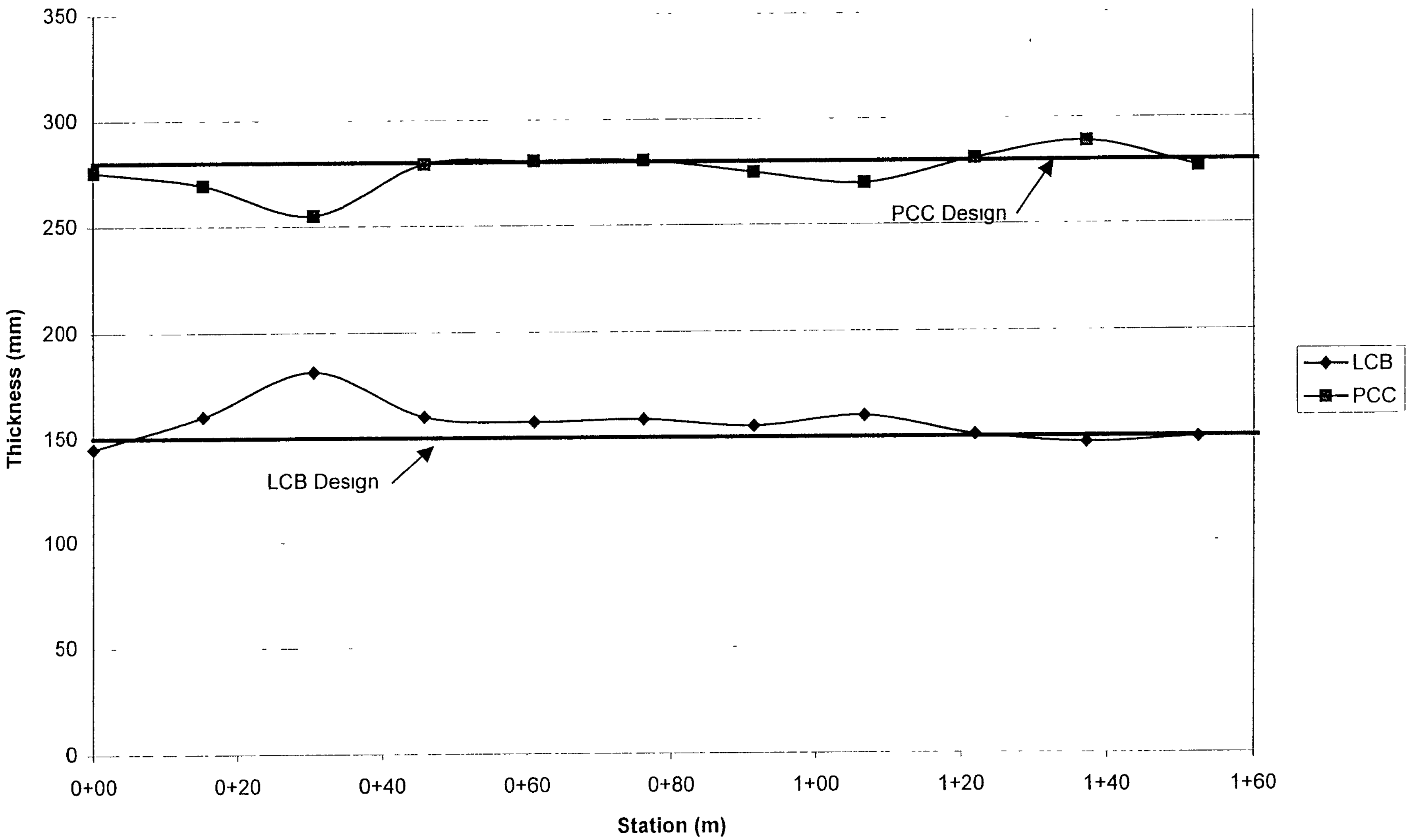


Figure 36. Section 060208 thicknesses from rod and level.

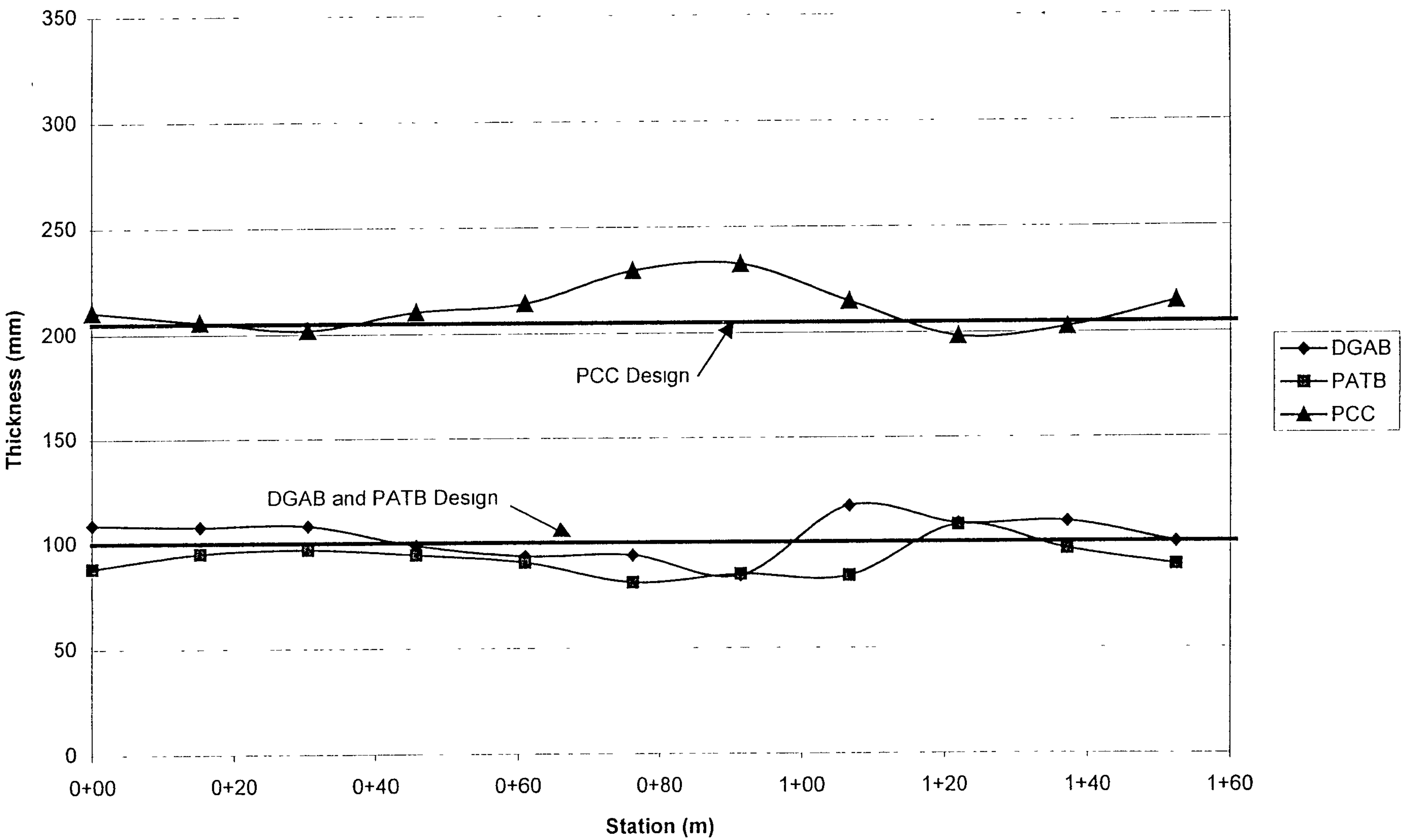


Figure 37. Section 060209 thicknesses from rod and level.

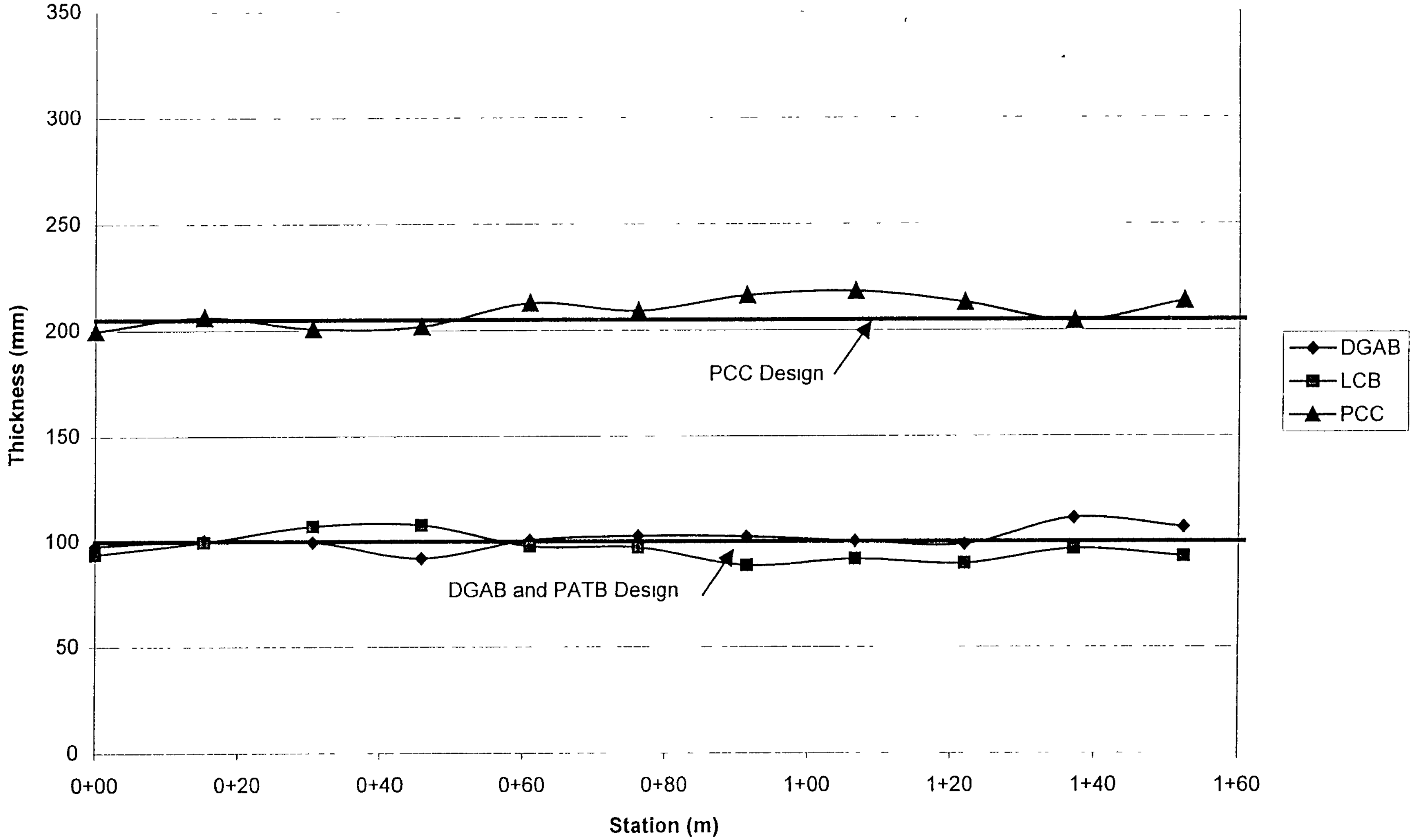


Figure 38. Section 060210 thicknesses from rod and level.

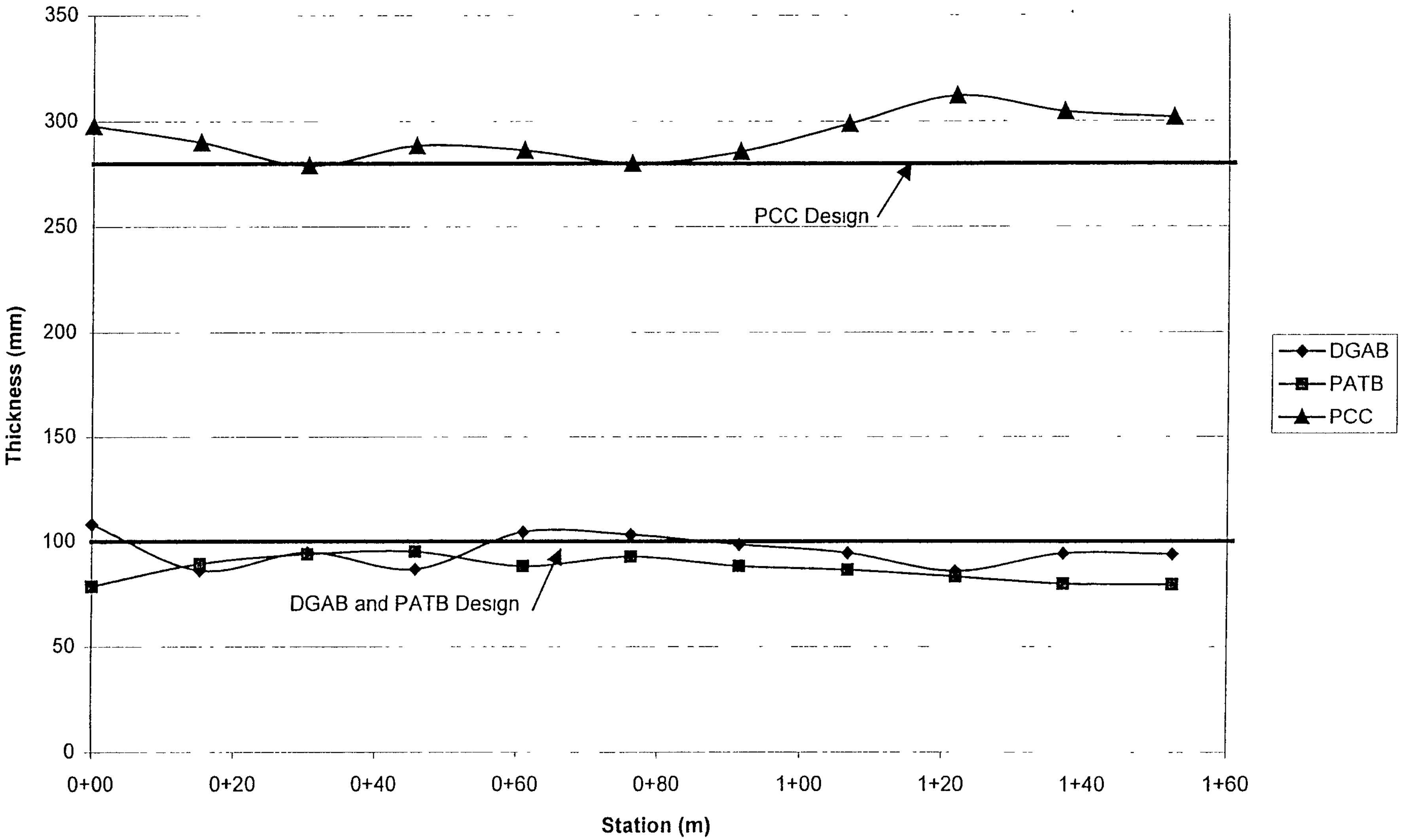


Figure 39. Section 060211 thicknesses from rod and level.

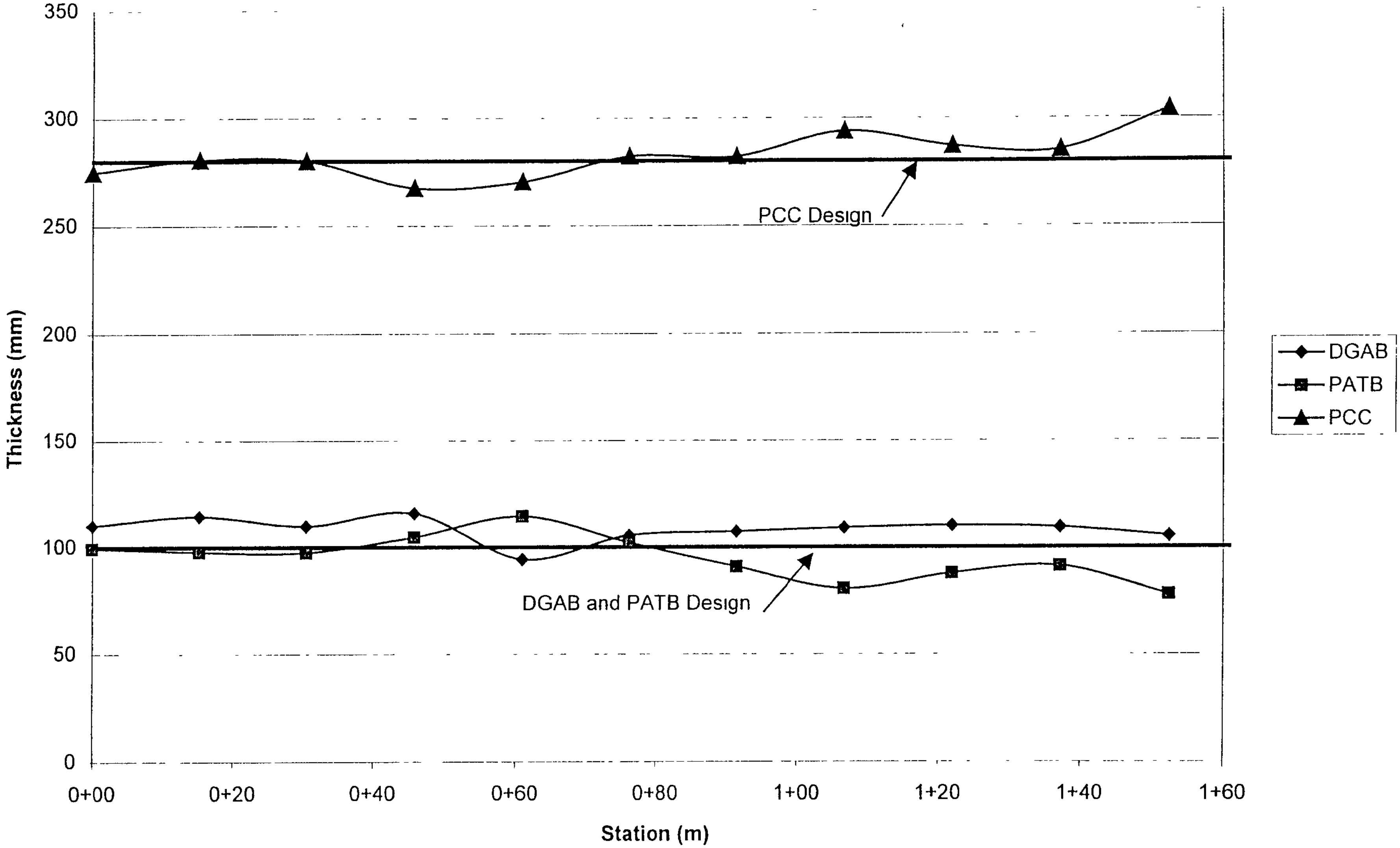


Figure 40. Section 060212 thicknesses from rod and level.

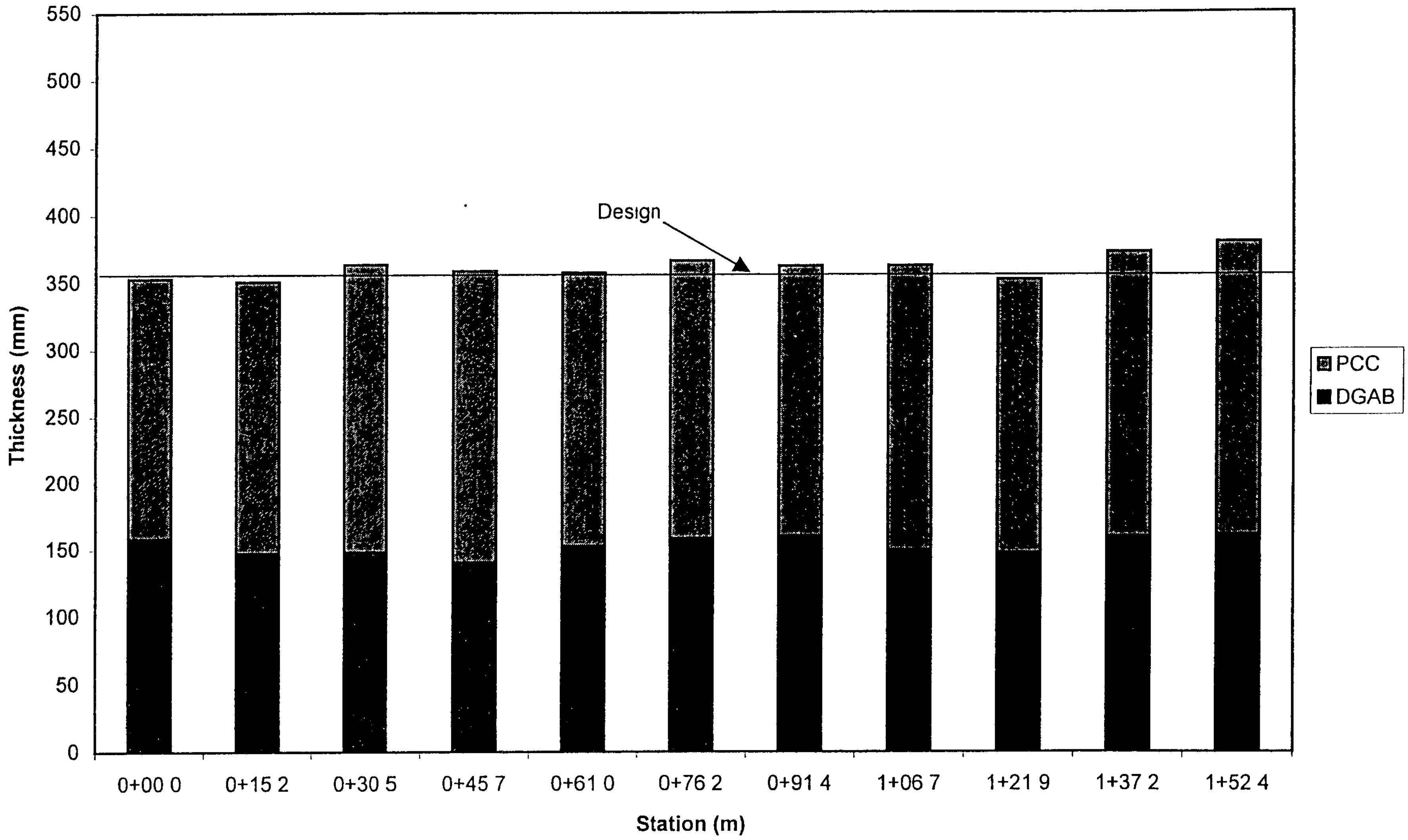


Figure 41. Section 060201 layer profile.

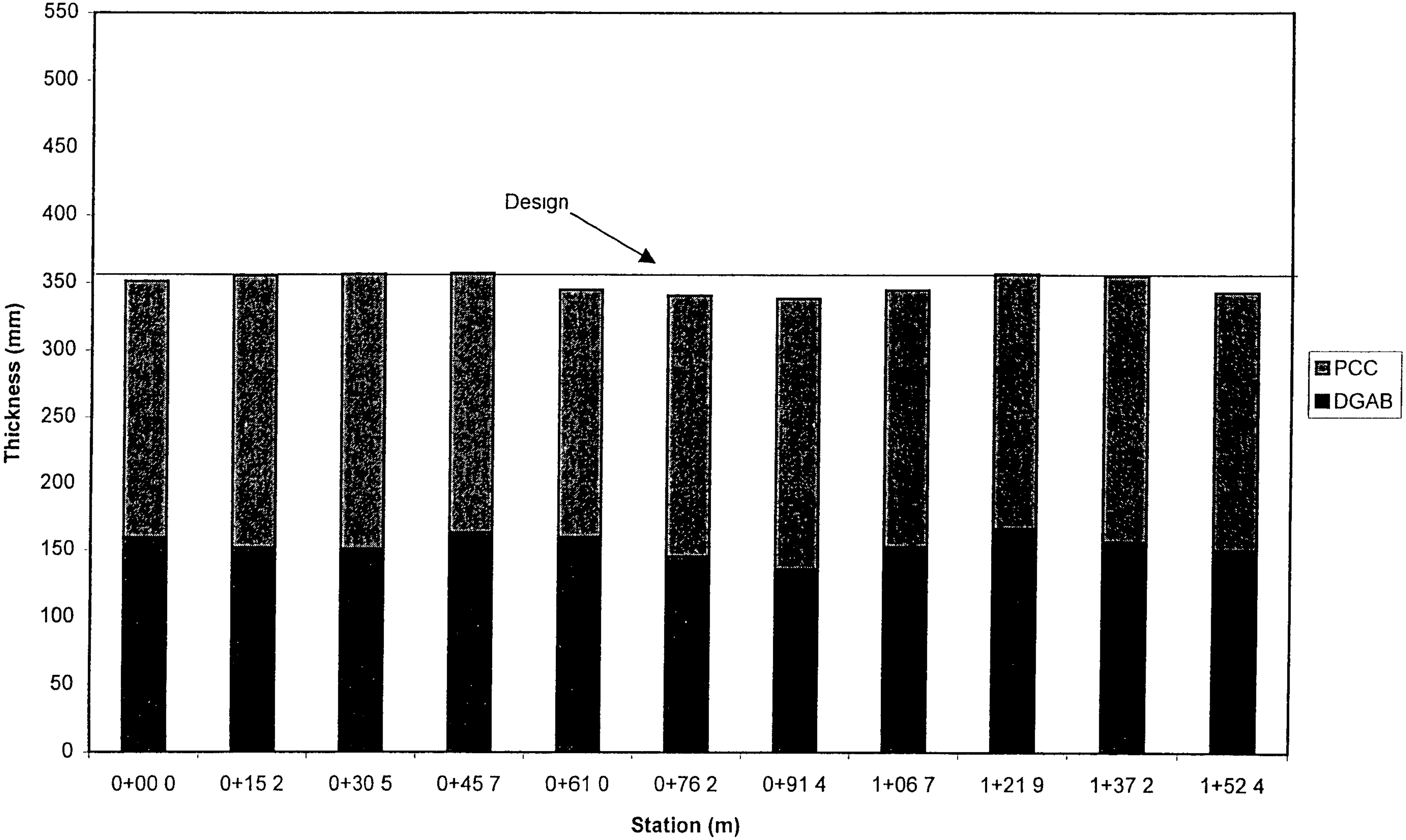


Figure 42. Section 060202 layer profile.

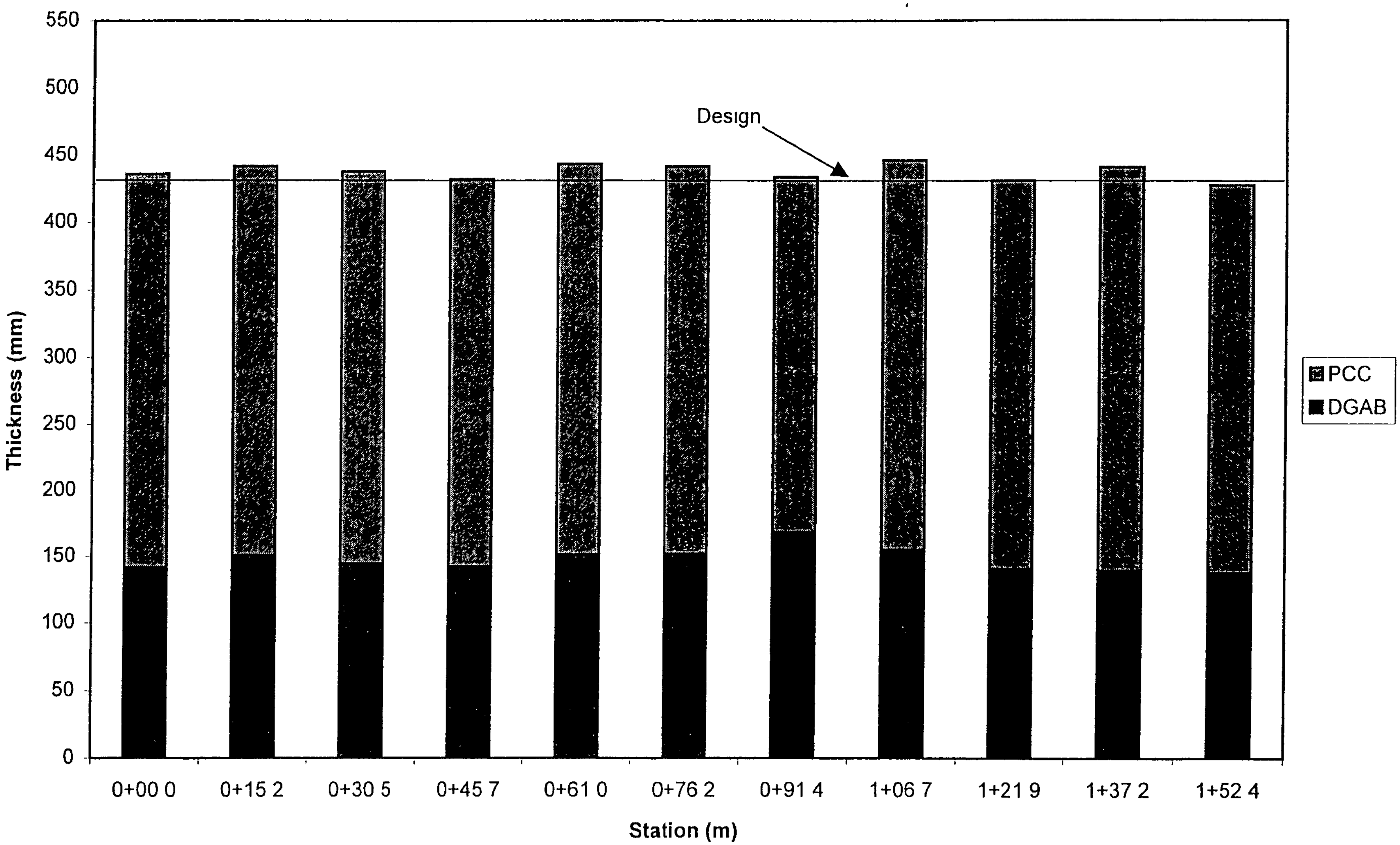


Figure 43. Section 060203 layer profile.

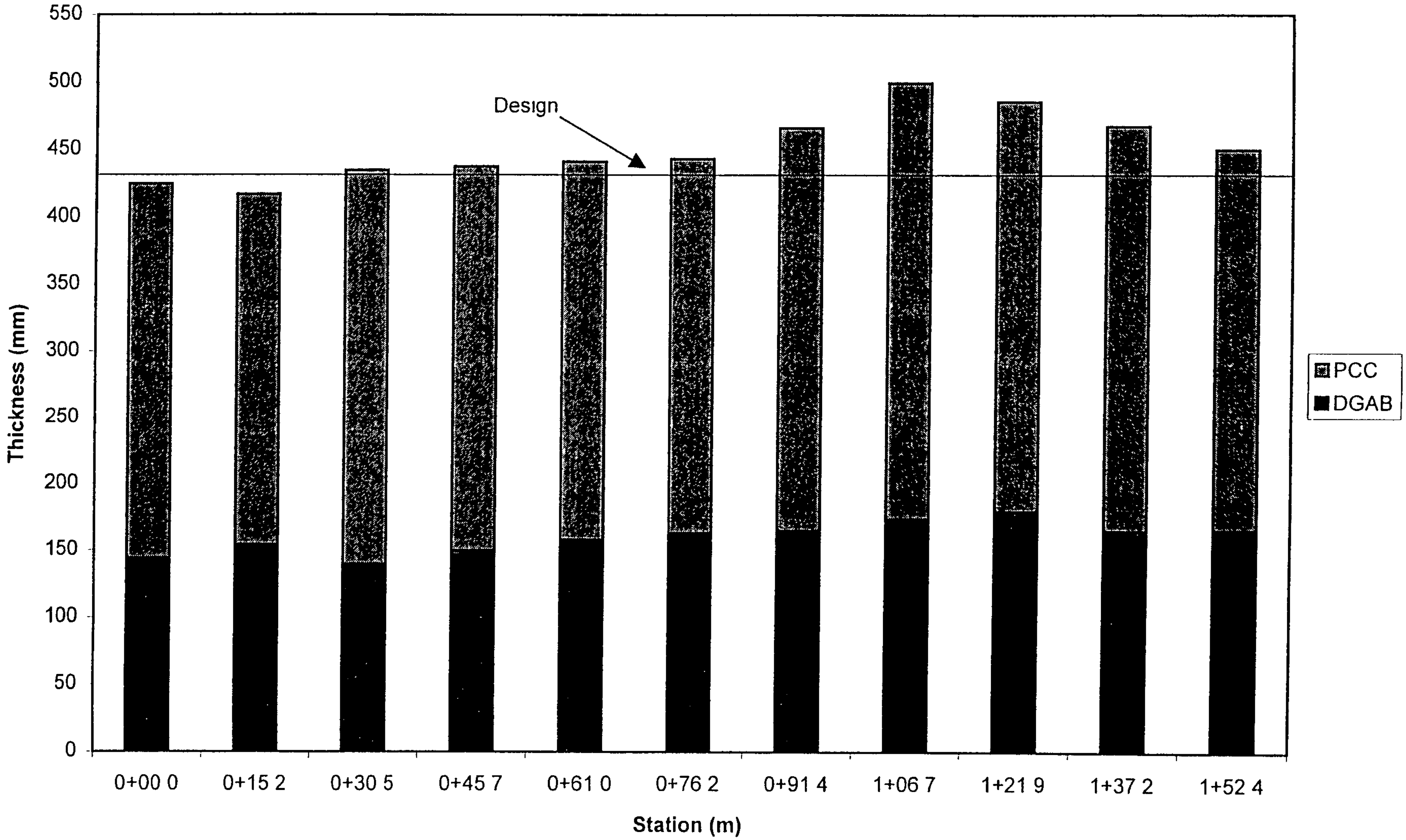


Figure 44. Section 060204 layer profile.

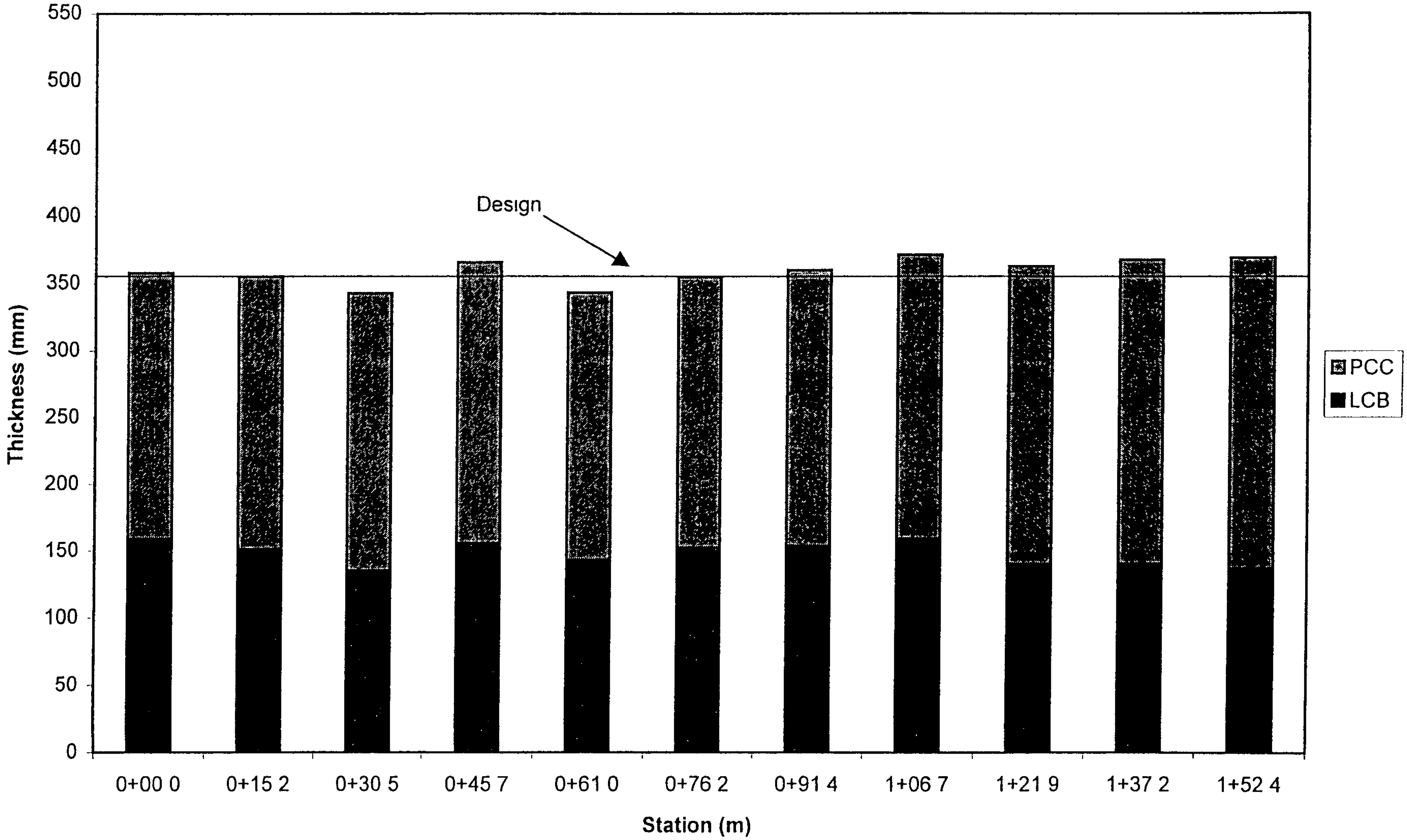


Figure 45. Section 060205 layer profile.

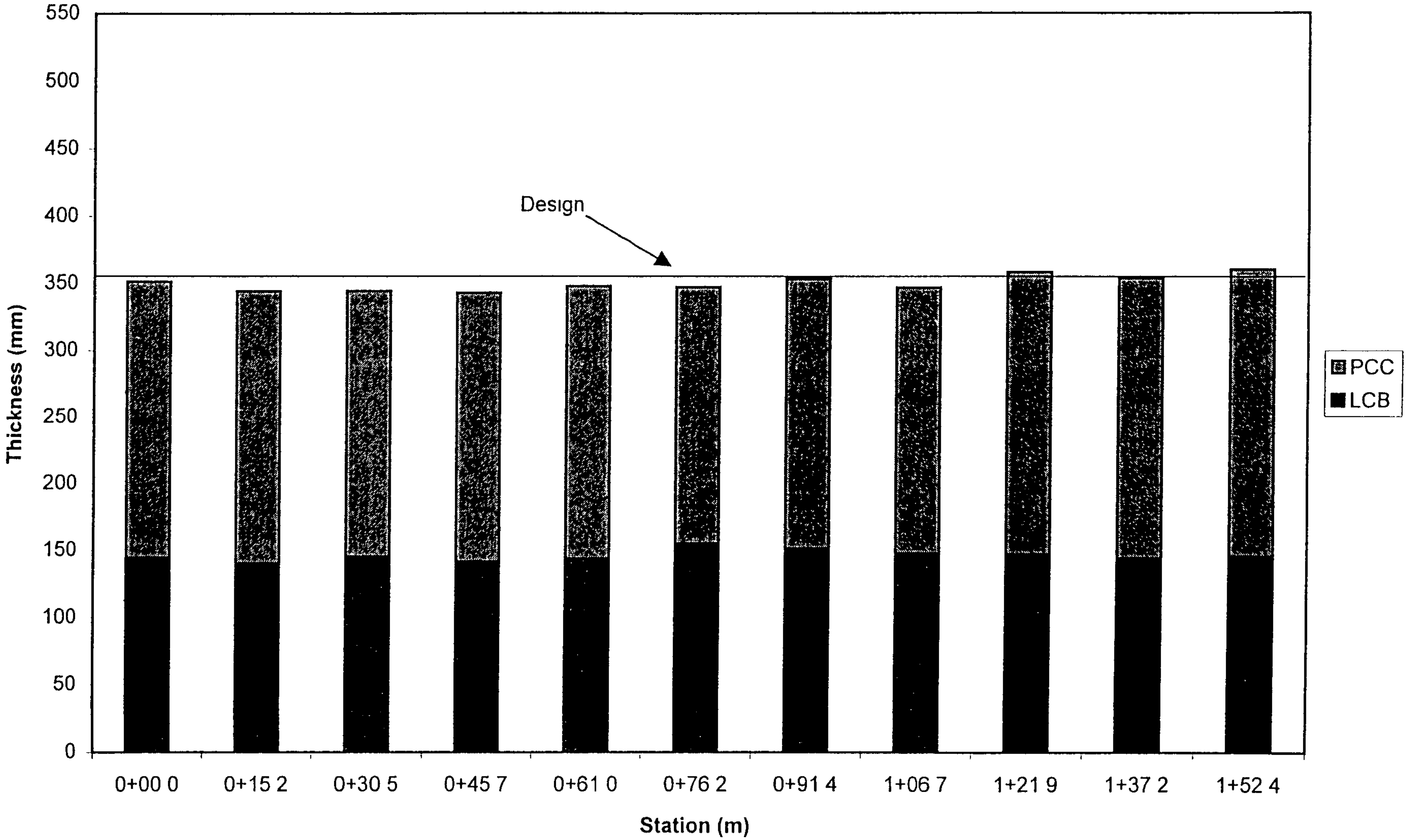


Figure 46. Section 060206 layer profile.

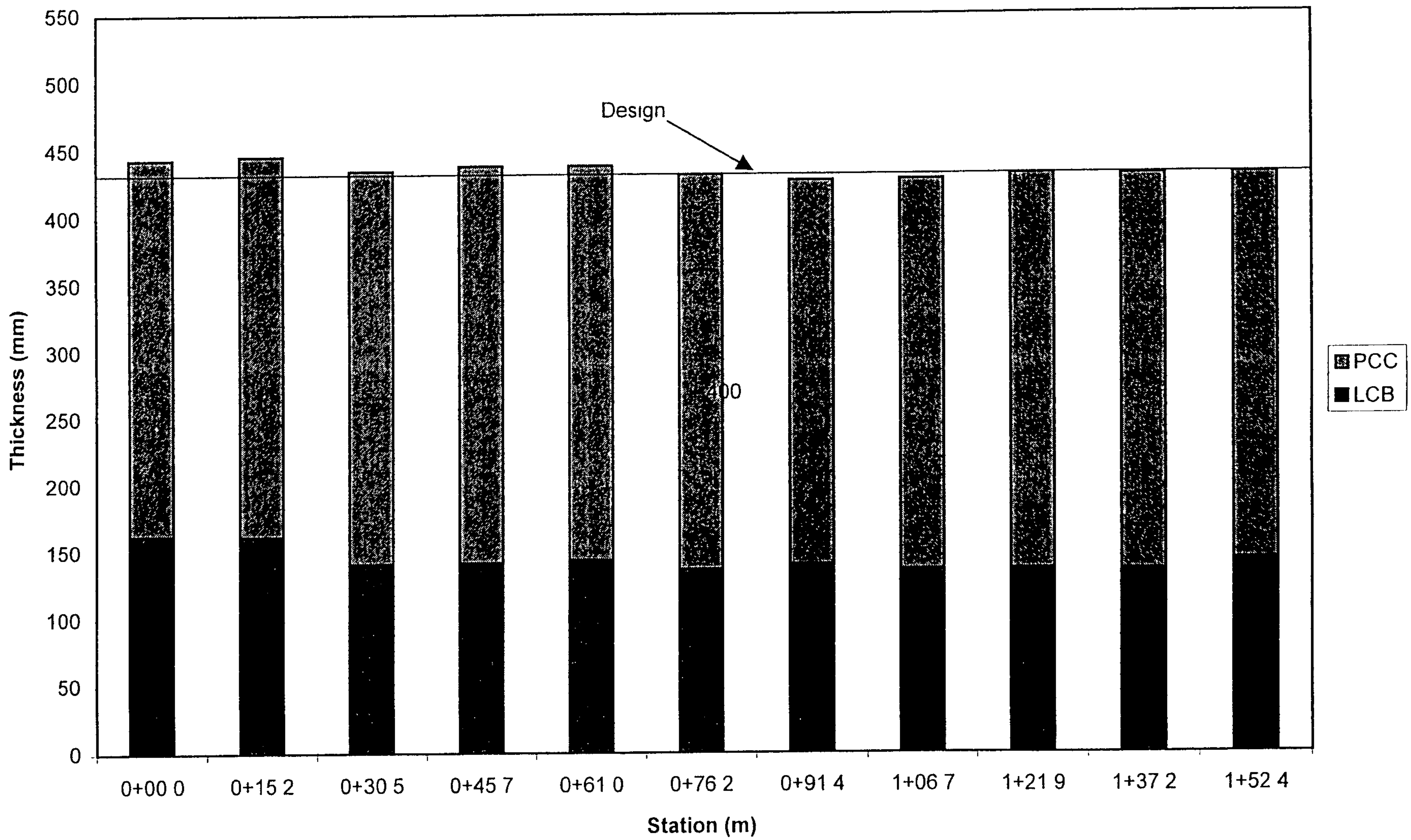


Figure 47. Section 060207 layer profile.

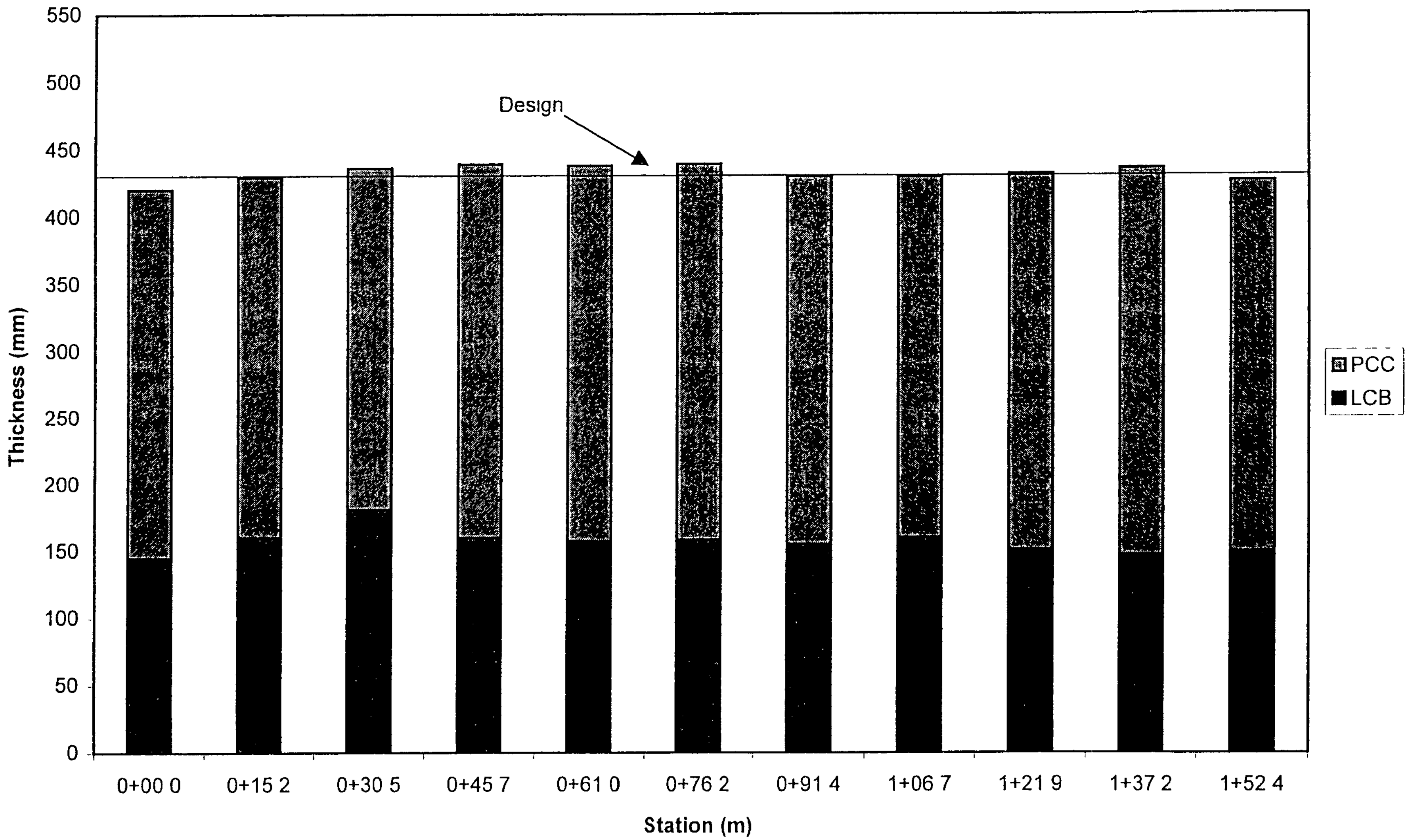


Figure 48. Section 060208 layer profile.

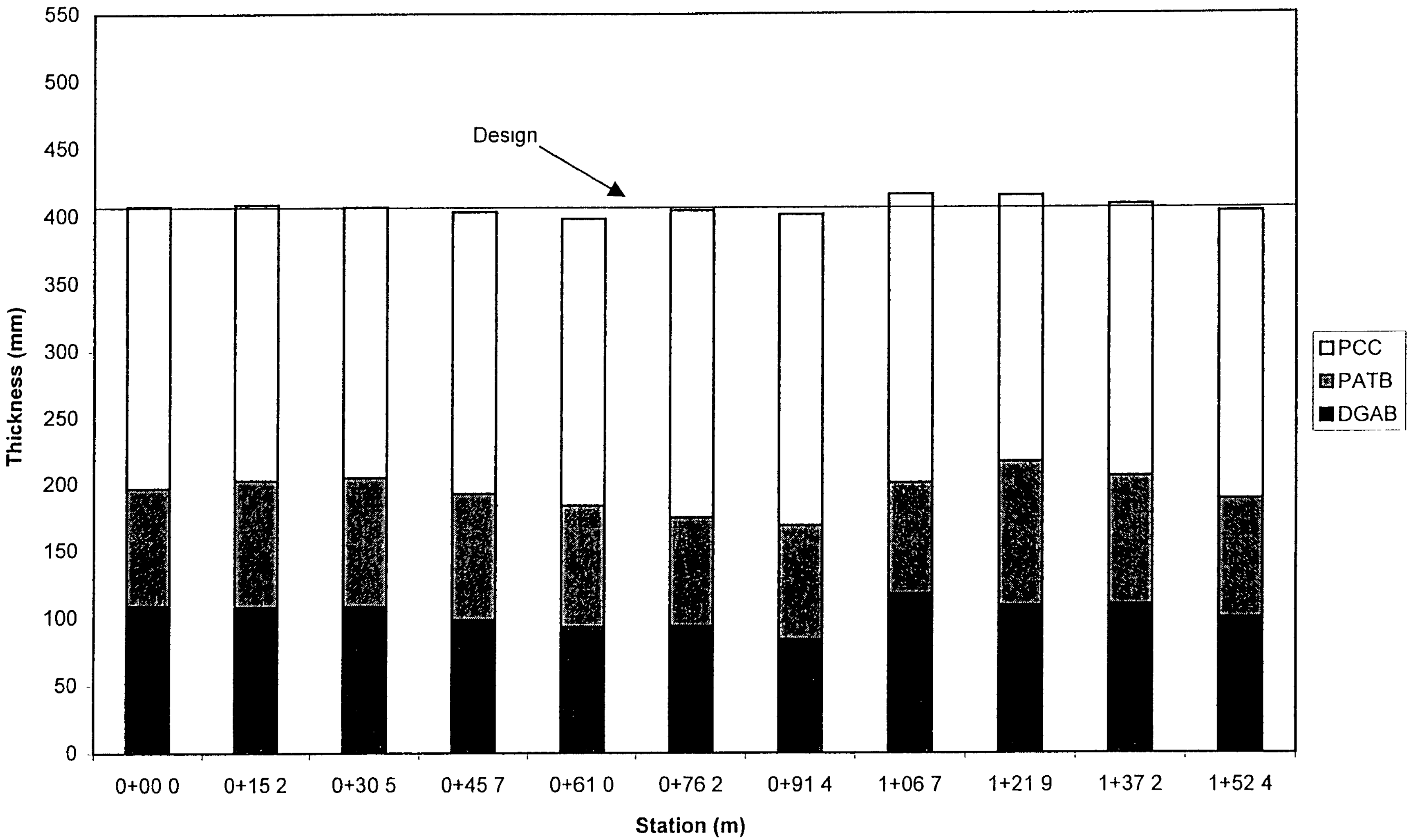


Figure 49. Section 060209 layer profile.

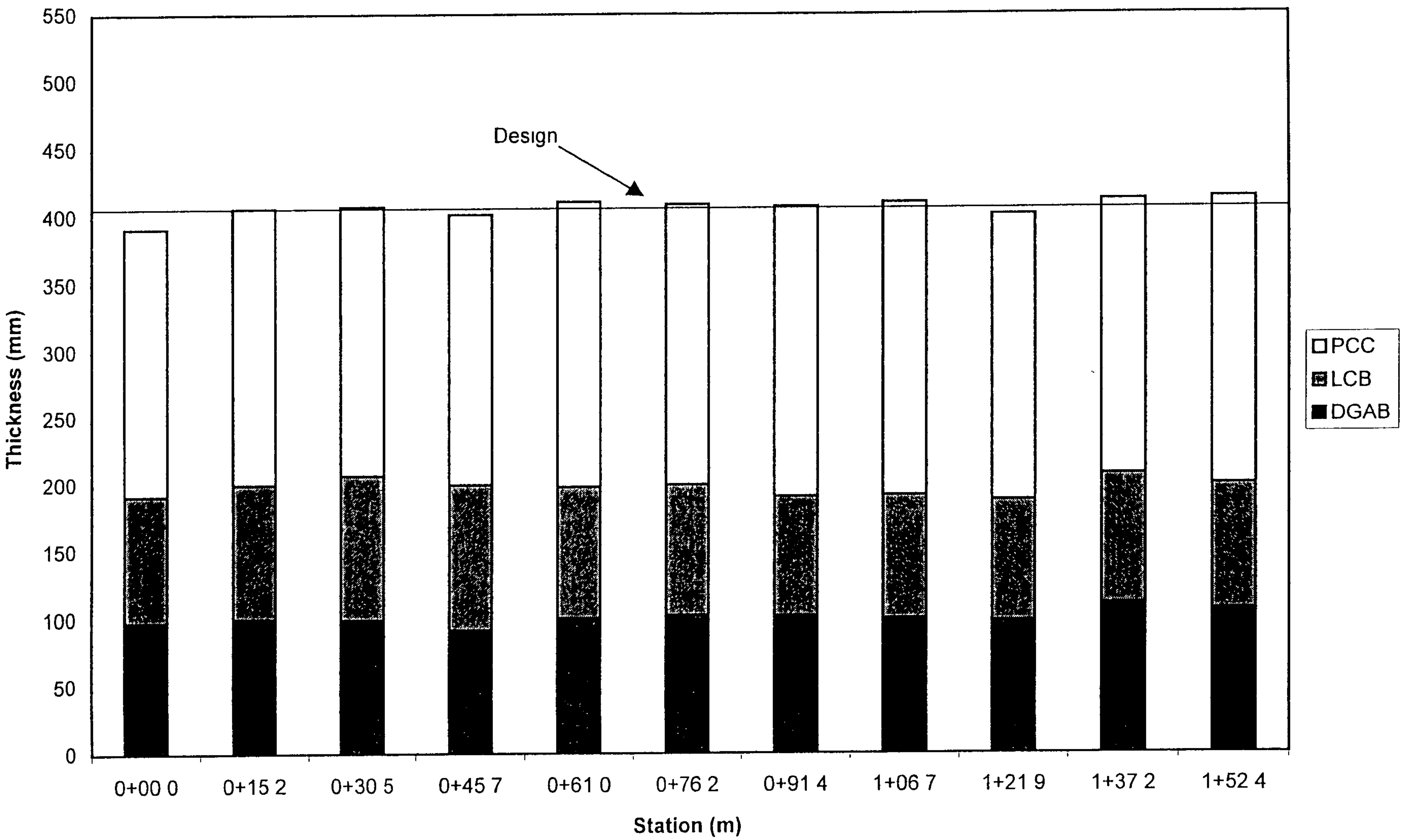


Figure 50. Section 060210 layer profile.

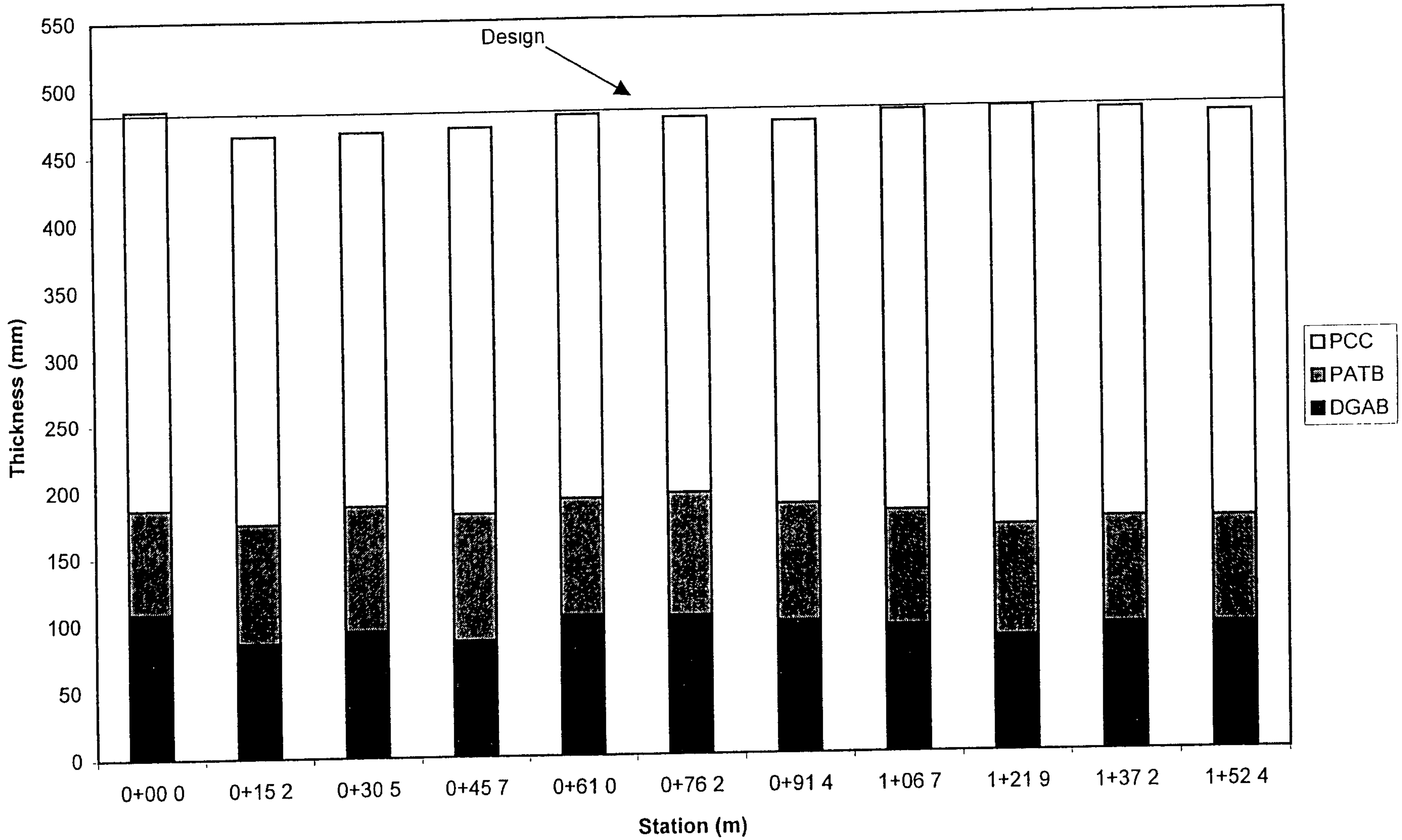


Figure 51. Section 060211 layer profile.

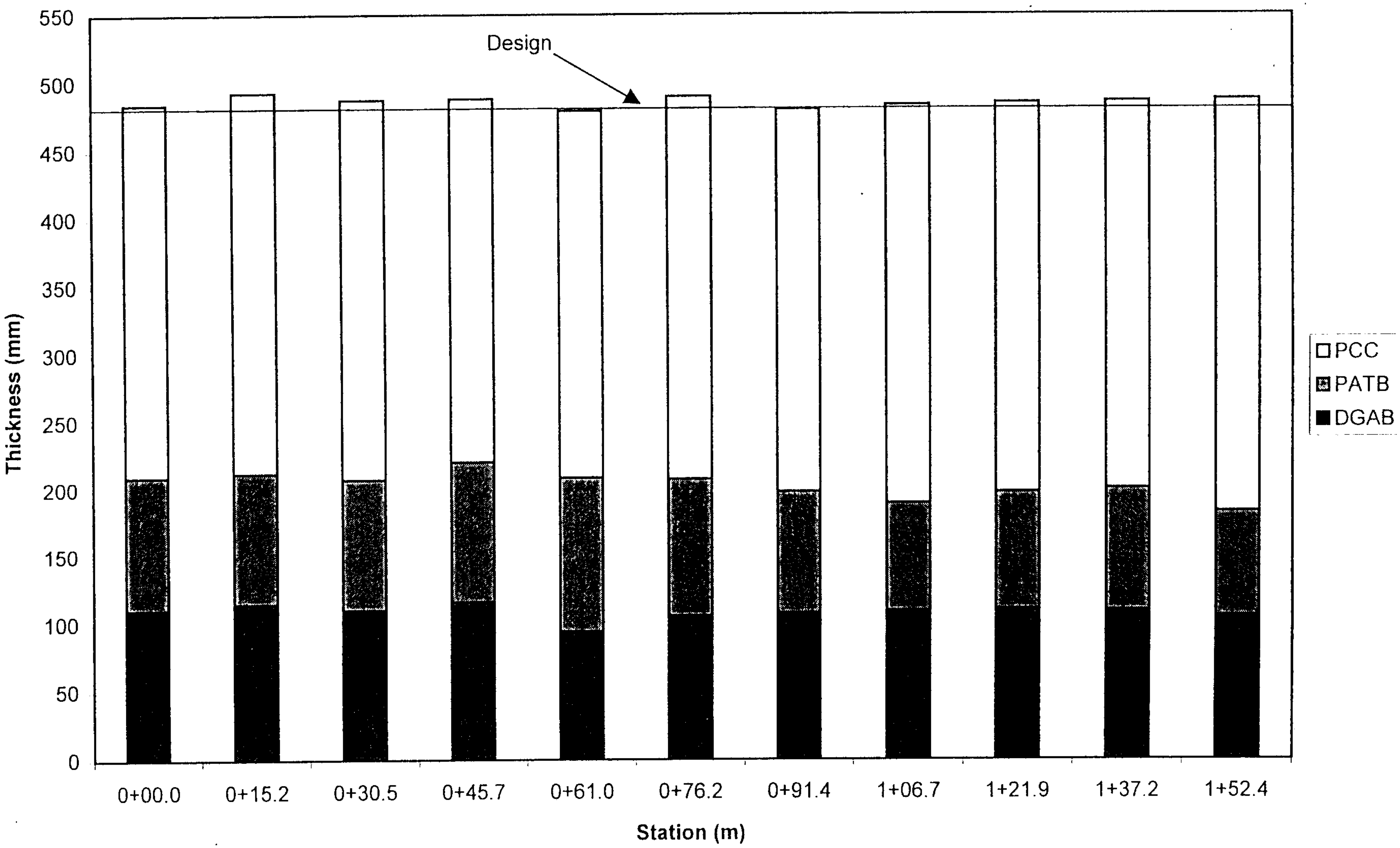


Figure 52. Section 060212 layer profile.

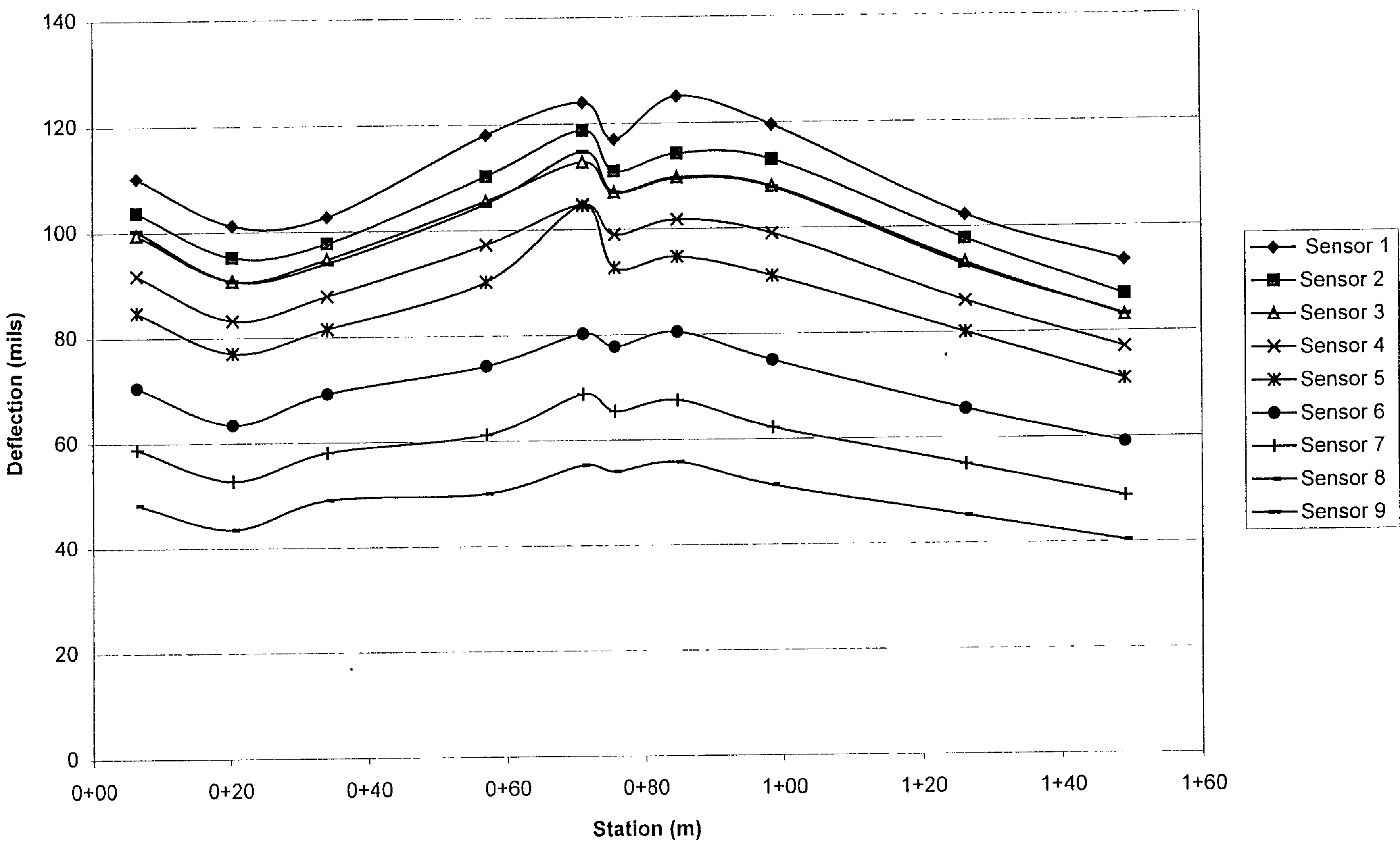


Figure 53. Section 060201 PCC deflections averaged at 558 kPa.

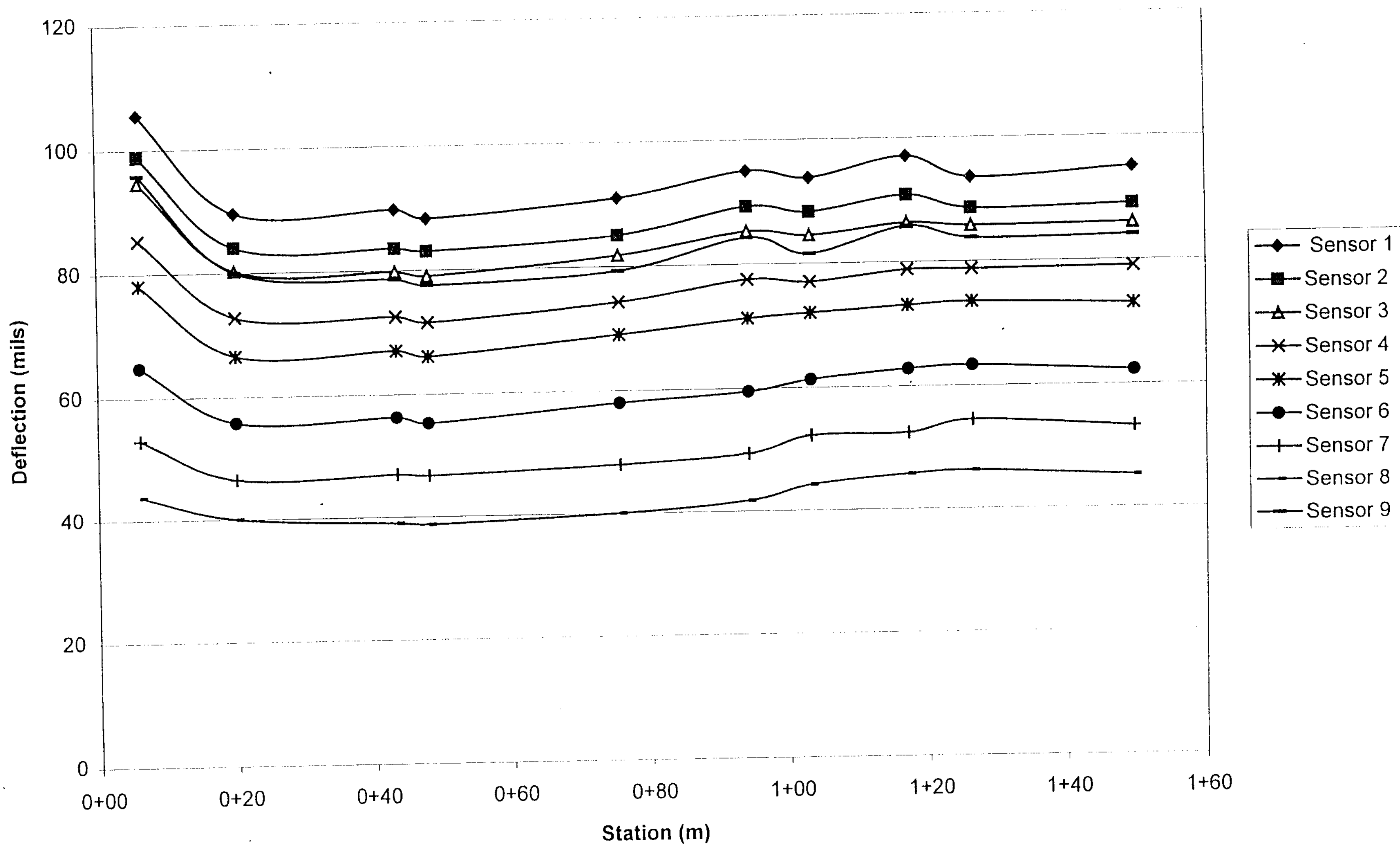


Figure 54. Section 060202 PCC deflections averaged at 602 kPa.

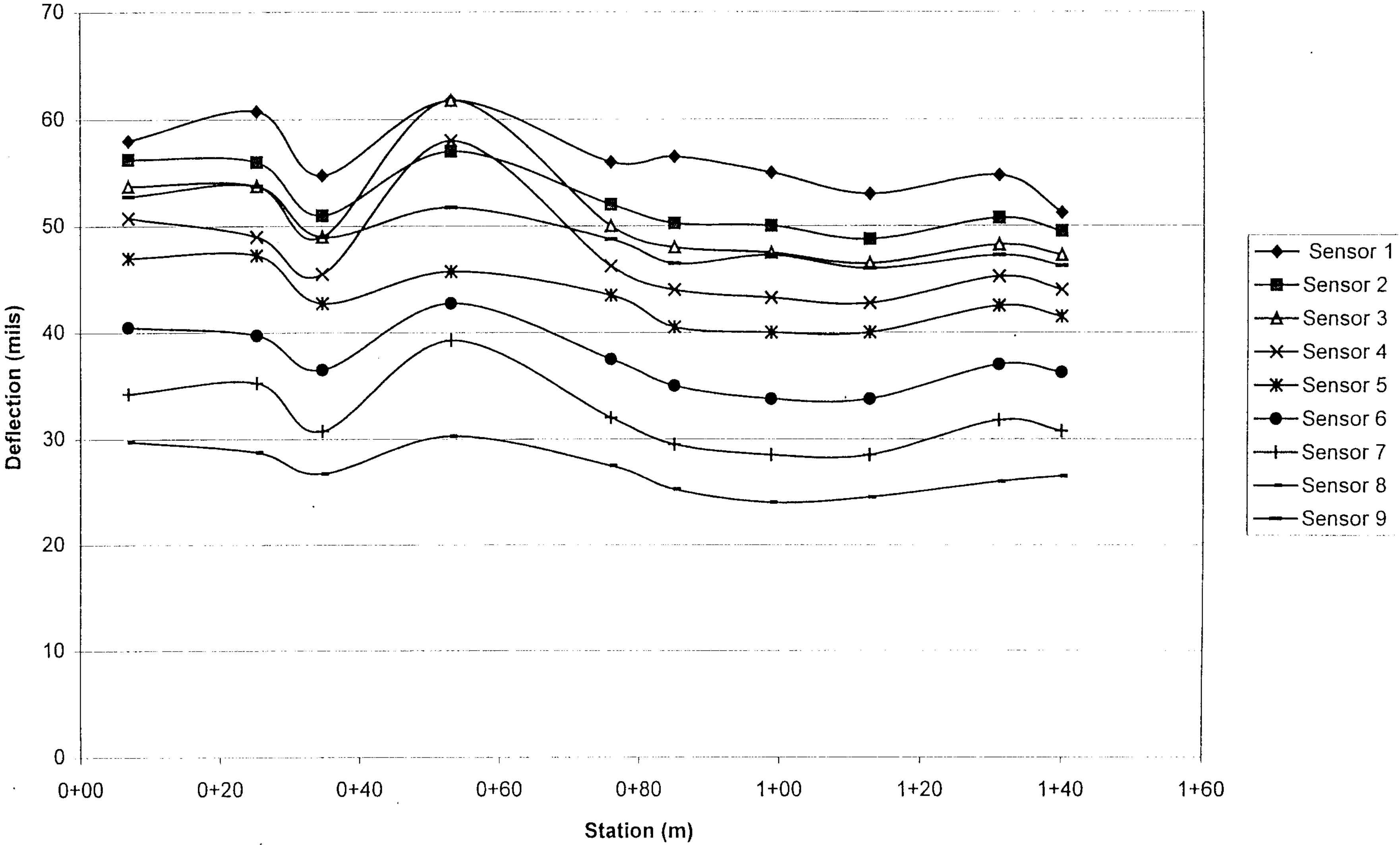


Figure 55. Section 060203 PCC deflections averaged at 590 kPa.

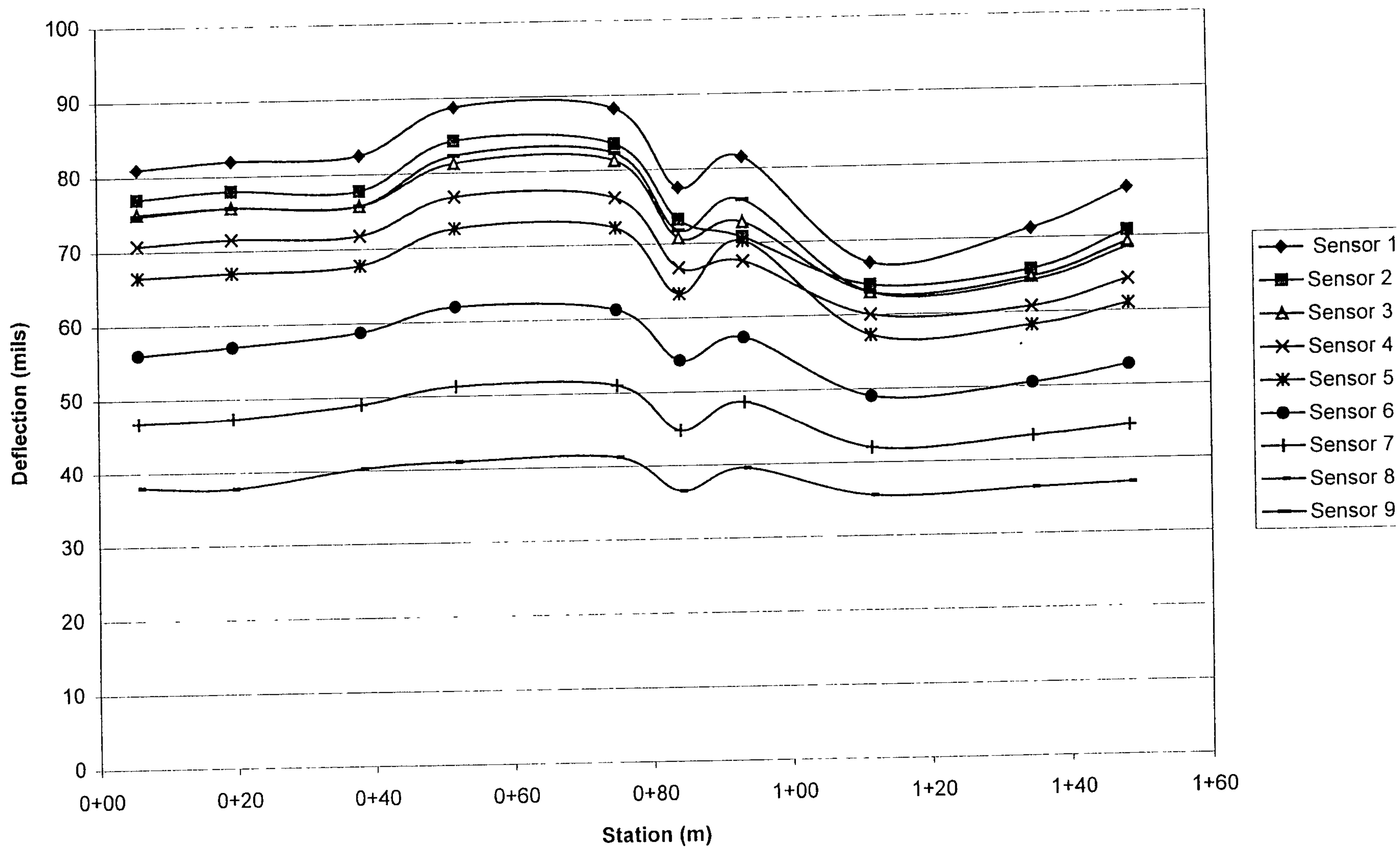


Figure 56. Section 060204 PCC deflections averaged at 589 kPa.

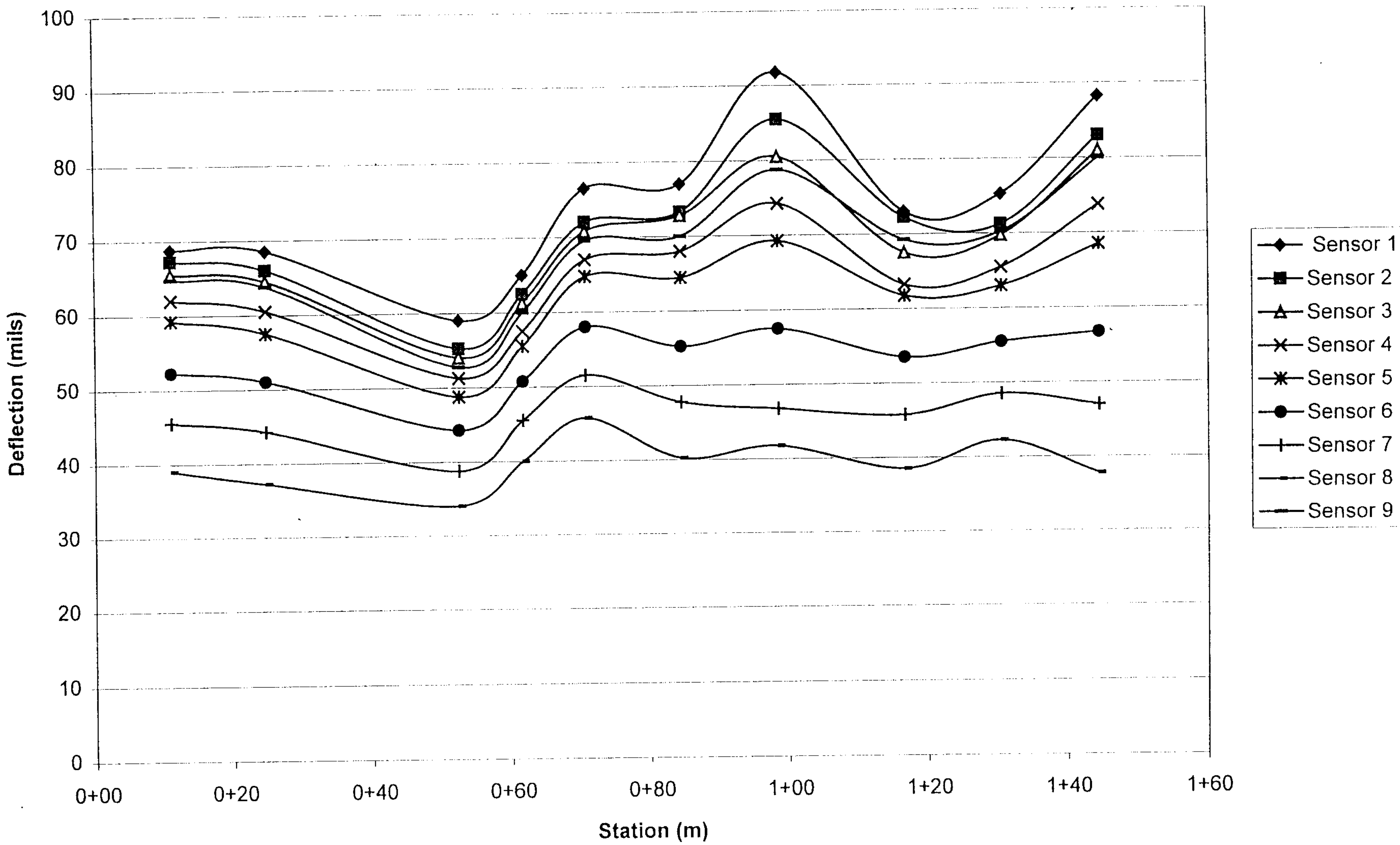


Figure 57. Section 060205 PCC deflections averaged at 597 kPa.

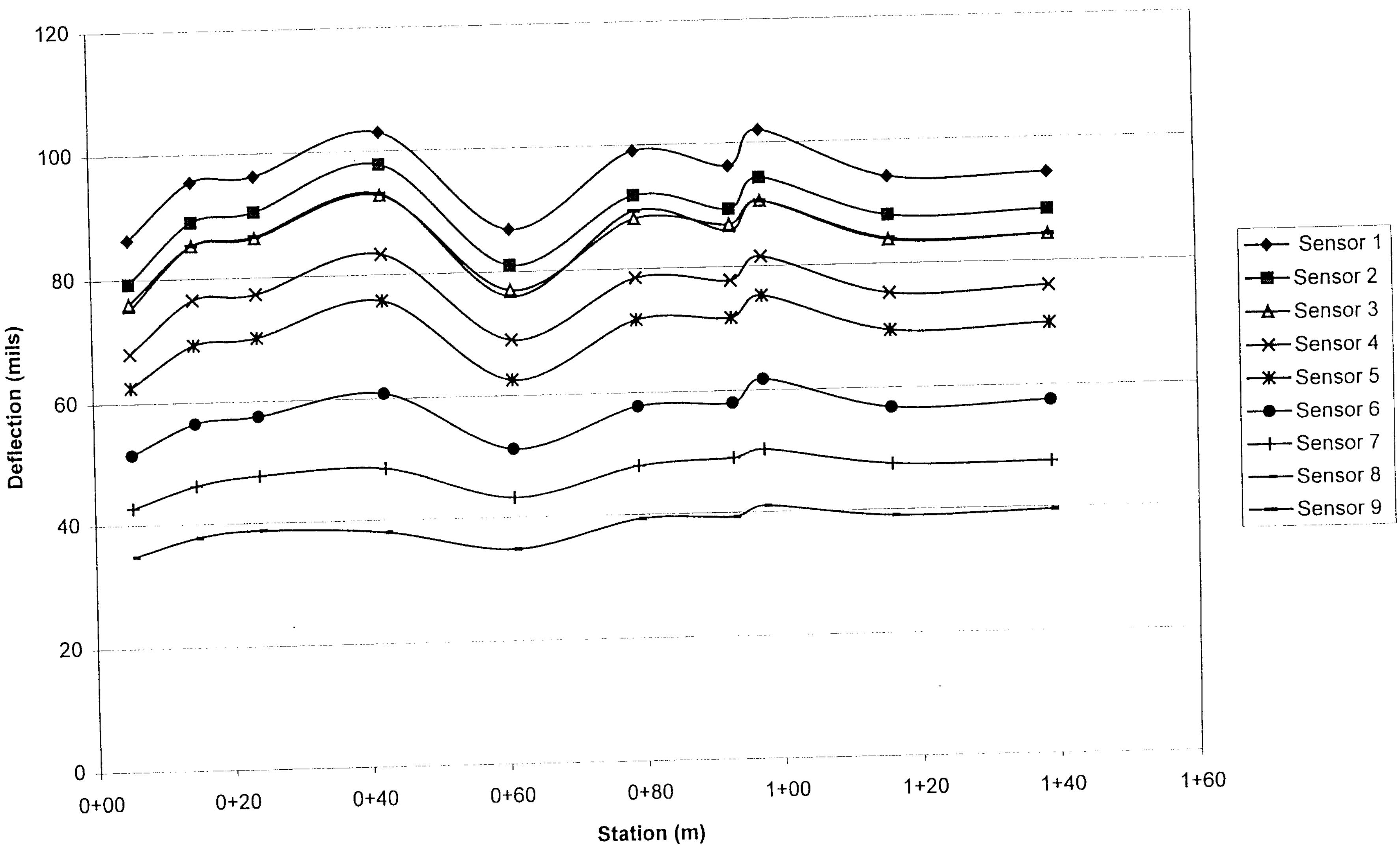


Figure 58. Section 060206 PCC deflections averaged at 603 kPa.

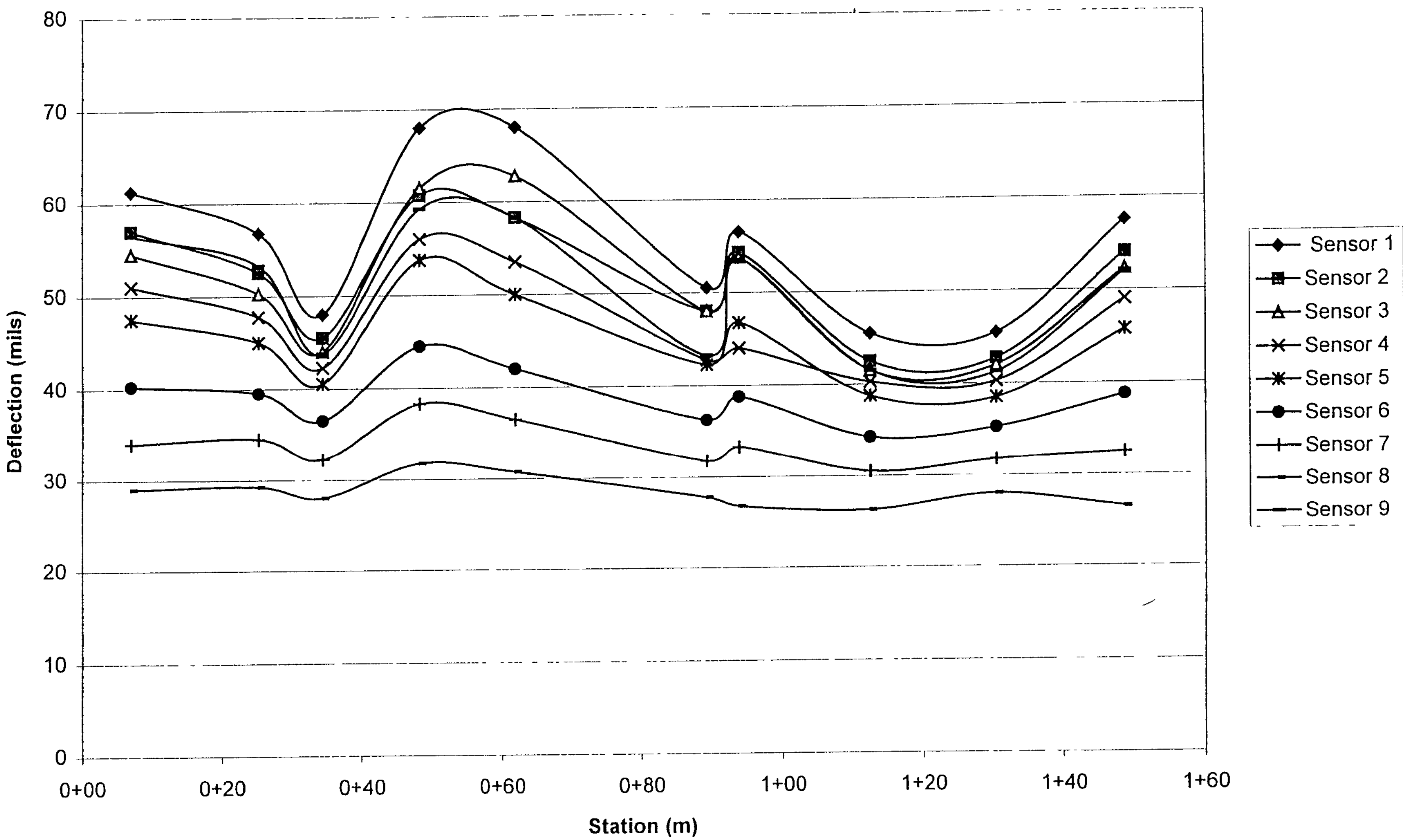


Figure 59. Section 060207 PCC deflections averaged at 604 kPa.

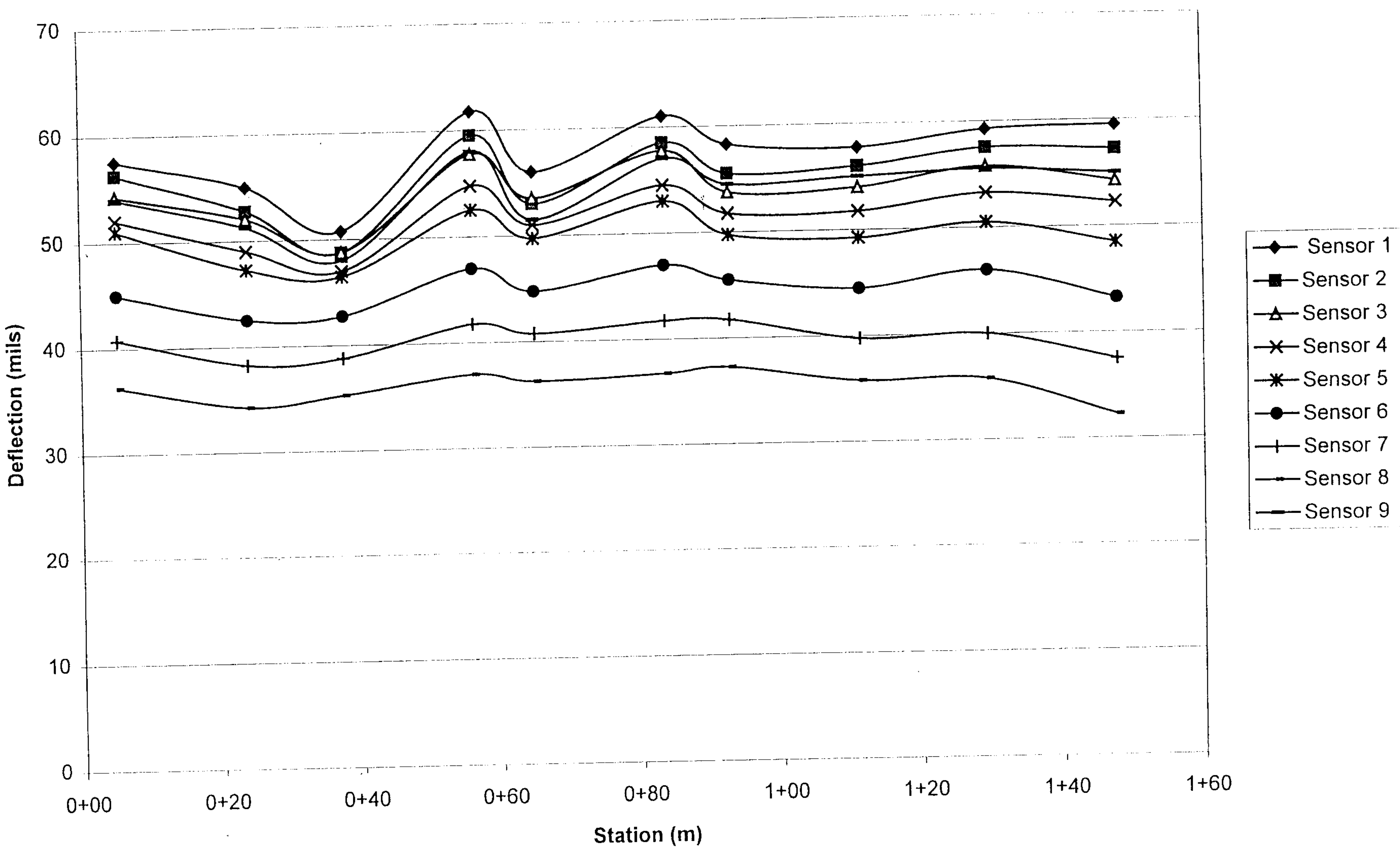


Figure 60. Section 060208 PCC deflections averaged at 588 kPa.

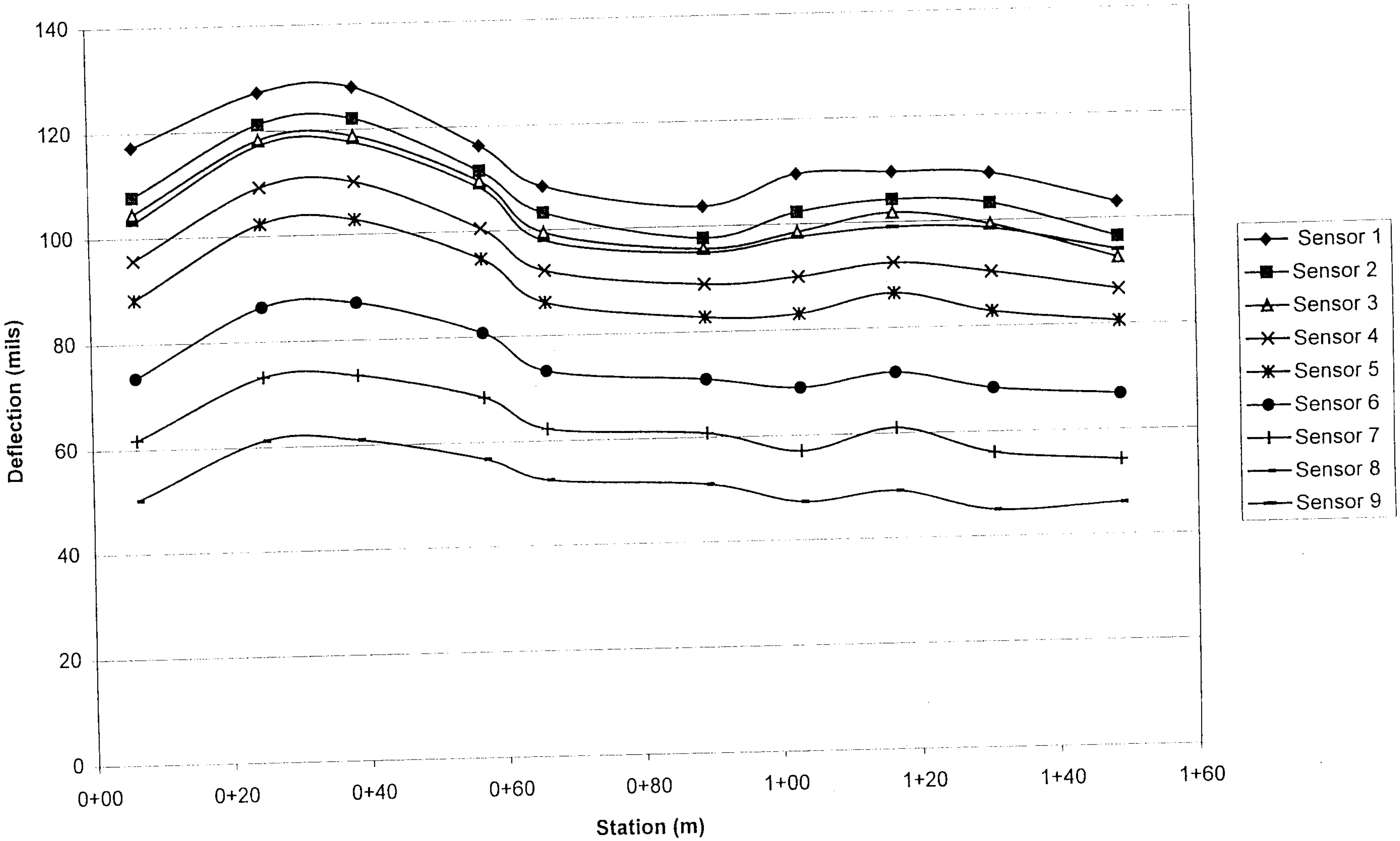


Figure 61. Section 060209 PCC deflections averaged at 589 kPa.

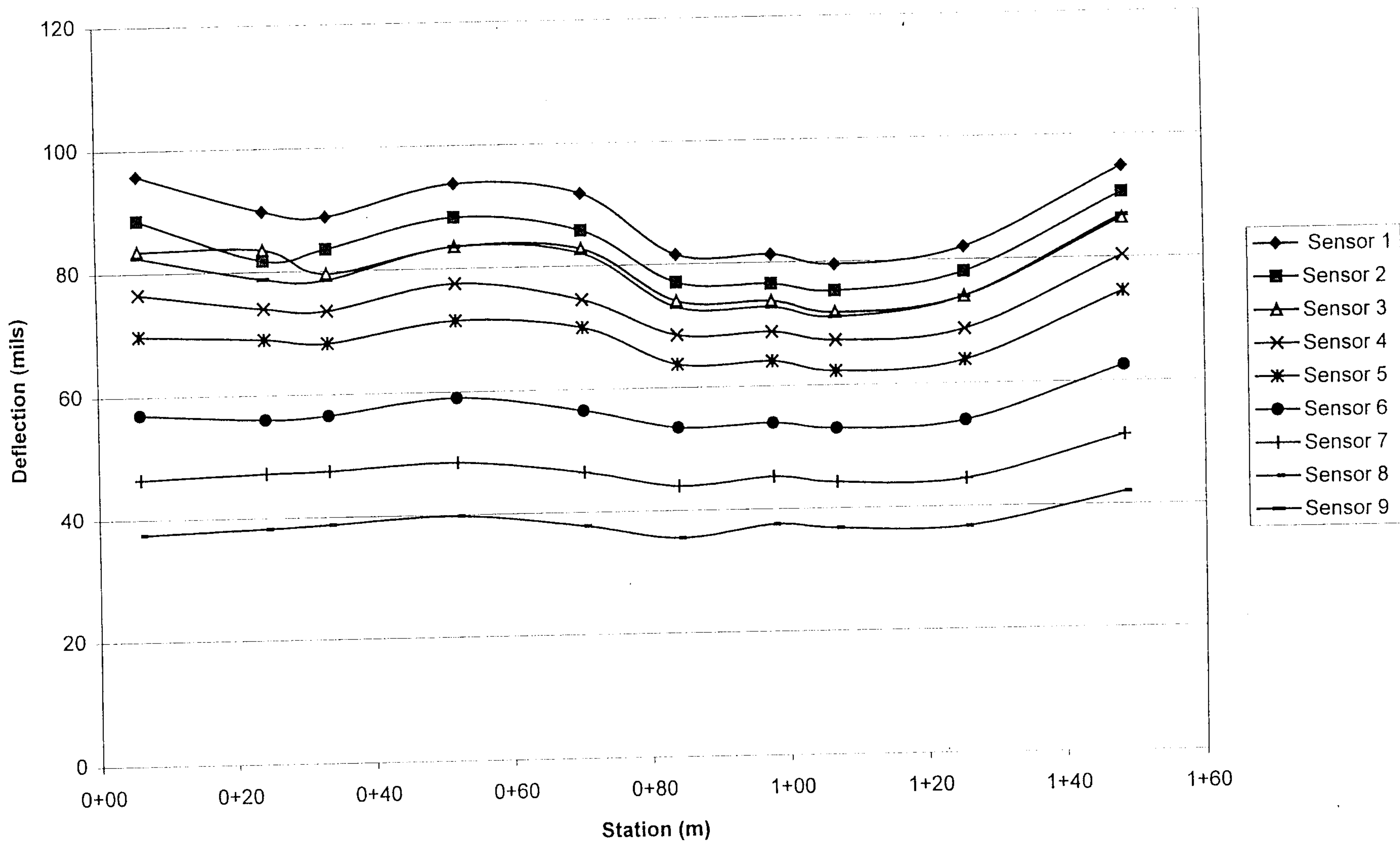


Figure 62. Section 060210 PCC deflections averaged at 590 kPa.

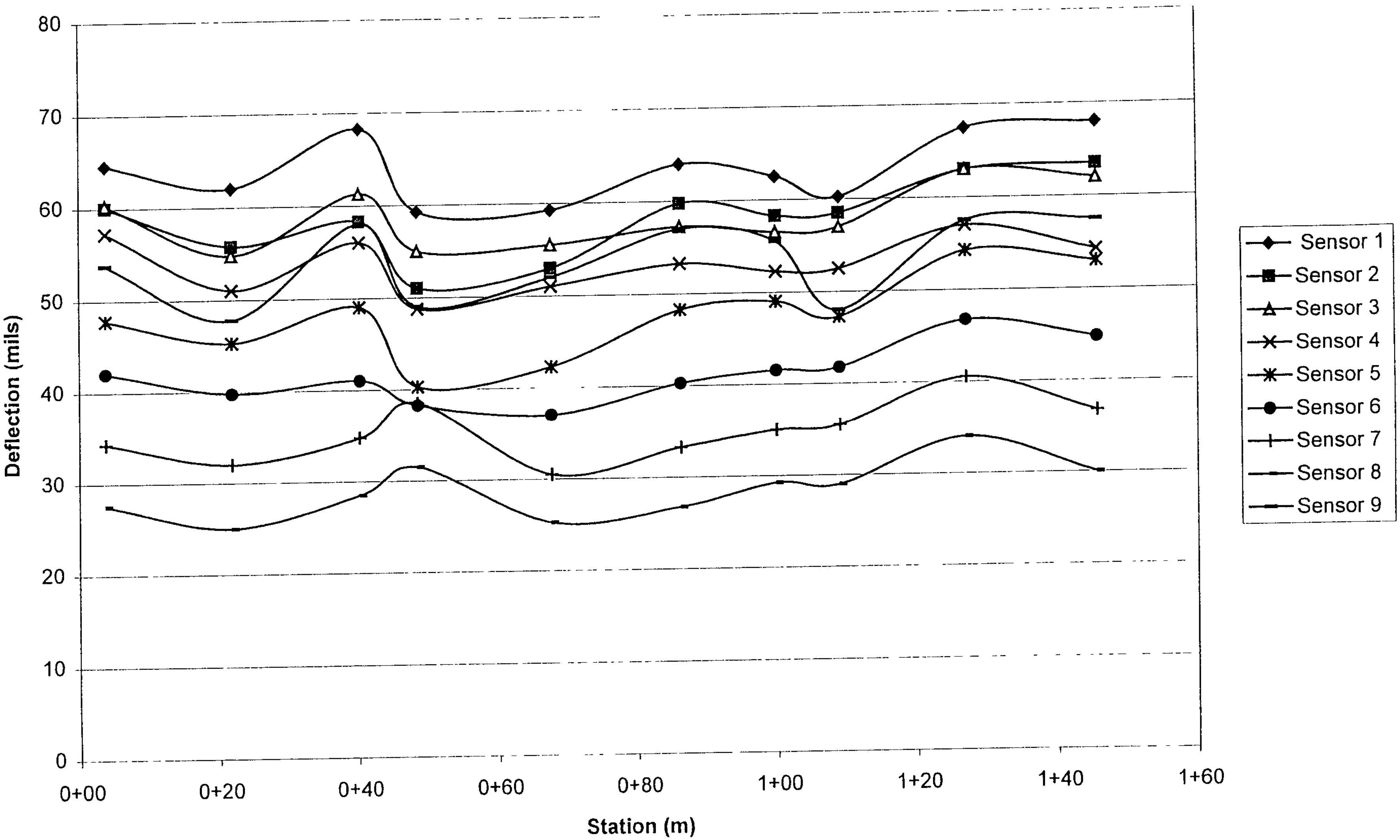


Figure 63. Section 060211 PCC deflections averaged at 583 kPa.

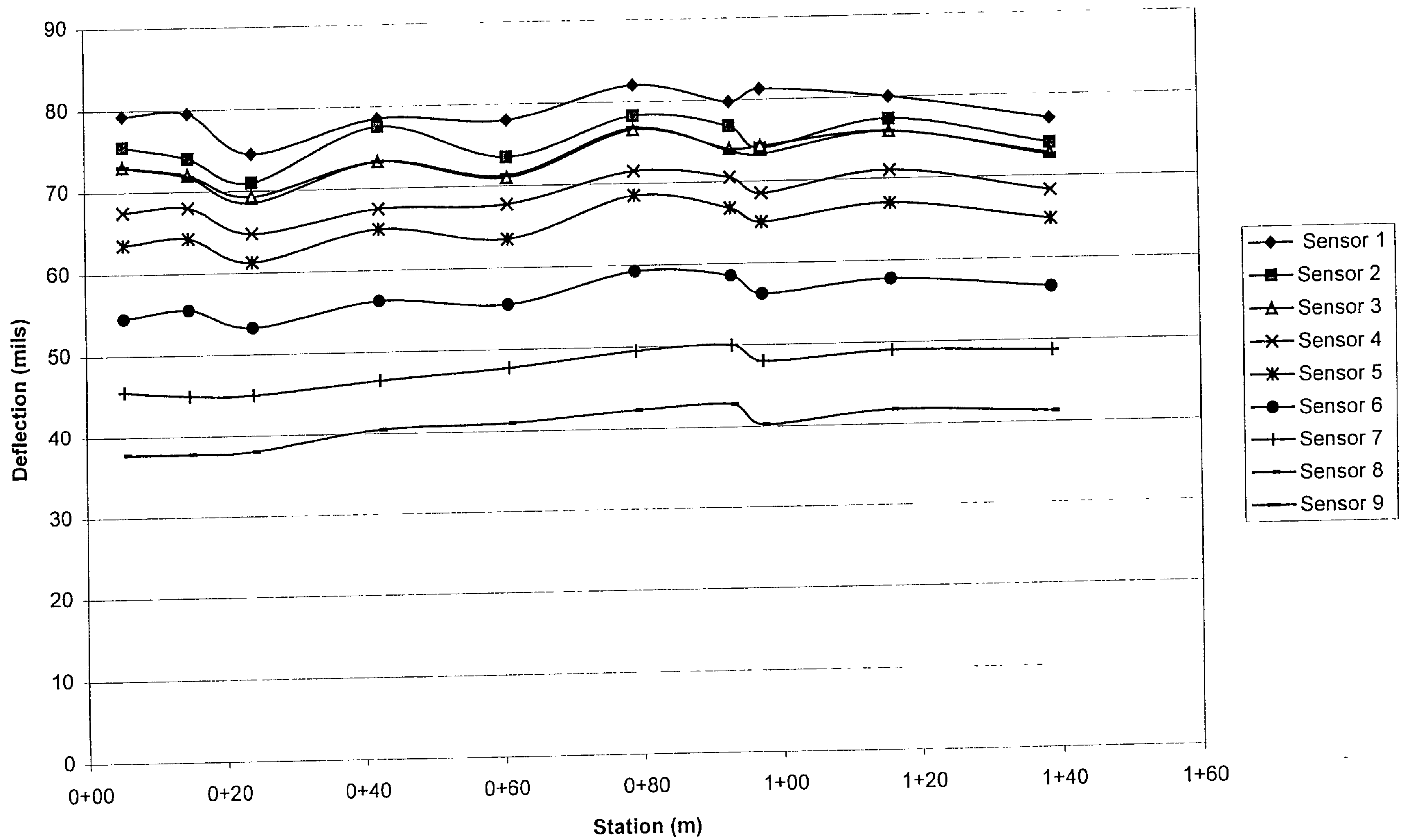


Figure 64. Section 060212 PCC deflections averaged at 603 kPa.

IV. SUMMARY

Twelve SPS-2 test sections were constructed on the northbound lane of California State Route 99 outside of Delhi, California. This project was constructed as part of the realignment of S.R. 99. The project was built in two phases. Construction on both phases began in January 1999. Work on phase I was completed on April 20, 2000 and opened to traffic on June 1, 2000. Phase II construction was completed on September 5, 2000 and opened to traffic on October 18, 2000.

Overall there were no major problems during any phase of construction of this project. Some minor problems/deviations that were observed and may affect pavement performance are recorded in section V.

V. KEY OBSERVATIONS

The subgrade under the South Avenue overpass appeared to have a layer of clay varying between 6 in to 12 in. During the concrete paving there was one small soft spot about 100mm deep in this vicinity.

The LCB had developed cracks after placement. The original curing compound coverage was not sufficient, so an additional coat of curing compound was applied. The location and extent of LCB cracking has been recorded on distress map sheets.

The shoulders were paved independent of the traffic lane paving for phase I and phase II construction. In phase I construction at one point there were concerns regarding the efficacy of ATPB layer as a drainable base, this was because the sides of ATPB layer were completely covered by the overlaying PCC material and cement paste rendering the ATPB almost ineffective. Upon notification of this issue, Caltrans had the outside shoulder side cleaned up sufficiently to render the ATPB permeable.

The phase I sections had shoulder auger probes performed May 30 and May 31, 2000. The locations of the shoulder auger probes were different than the locations indicated in the sampling and testing plan.

Shoulder auger probe drilling was not performed on the phase II sections (060211 and 060203) because of site conditions.

Key observations within each layer are discussed in this section.

SUBGRADE

The subgrade material was a silty sand. Elevation surveys were performed at the points defined in figure 6. When attempting to perform FWD testing on the subgrade material, the deflections were outside of the allowable range for the sensors

DENSE GRADED AGGREGATE BASE (DGAB)

Construction of the DGAB layer went very smoothly with no deviations. All appropriate sampling and testing was performed. There were a few soft spots caused by the haul trucks during PCC paving that were repaired by the placement of additional base material and then rolling the area. The rolling was enough to set the new gravel but not so much as to add to the pumping problem. The soft spots were quite minor and it is not anticipated to have an adverse affect on the final product.

PERMEABLE ASPHALT TREATED BASE (PATB)

Placement of the PATB layer went well with no deviations. Sampling and testing was performed in accordance with sampling and testing guidelines. One problem was encountered during the paving operation. The thickness of the PATB layer varied considerably due to the inconsistent amount of material in front of the paver. The problem was reasonably corrected by using a grader to make the thickness more consistent.

LEAN CONCRETE BASE (LCB)

The LCB was constructed with only a few minor problems. The mix coming from the onsite plant appeared to have a larger amount of coarse aggregate compared with the other mix. Considerable aggregate segregation resulted from this mix. It was also discovered that the LCB was not properly covered with curing compound. Therefore, the LCB cracked at several locations. When the cracking was discovered, additional curing compound was applied.

PORTLAND CEMENT CONCRETE (PCC)

Overall, the PCC paving went well. However, there were two minor problems that are worth mentioning. The first was a temporary stoppage of paving to repair the tie bar inserter. The other problem was a few voids that were left behind the paver. These voids were shoveled full of material and the problem was repaired.

APPENDIX A

CALIFORNIA SPS-2 CONSTRUCTION PHOTOGRAPHS

APPENDIX A - CALIFORNIA SPS-2 CONSTRUCTION PHOTOS

Appendix A consists of the following construction photos:

Photo 1. Site conditions prior to construction.
Photo 2. Subgrade work.
Photo 3. Bulk sampling of subgrade.
Photo 4. Density test performed on subgrade.
Photo 5. Finished subgrade.
Photo 6. Work on DGAB.
Photo 7. Edge drain construction.
Photo 8. Backfilling edge drain trench with permeable concrete base.
Photo 9. PATB paving operation.
Photo 10. LCB paving operation.
Photo 11. Field sampling of LCB.
Photo 12. Overview of PCC construction.
Photo 13. Dowel basket placement.
Photo 14. PCC construction.

Photo 1. Site conditions prior to construction.

Photo 2. Subgrade work.

Photo 3. Bulk sampling of subgrade.

Photo 4. Density test performed on subgrade.

Photo 5. Finished subgrade.

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Photo 7. Edge drain construction.

Photo 8. Backfilling edge drain trench with permeable concrete base.

Photo 9. PATB paving operation.

Photo 10. LCB paving operation.

Photo 11. Field sampling of LCB.

Photo 12. Overview of PCC construction.

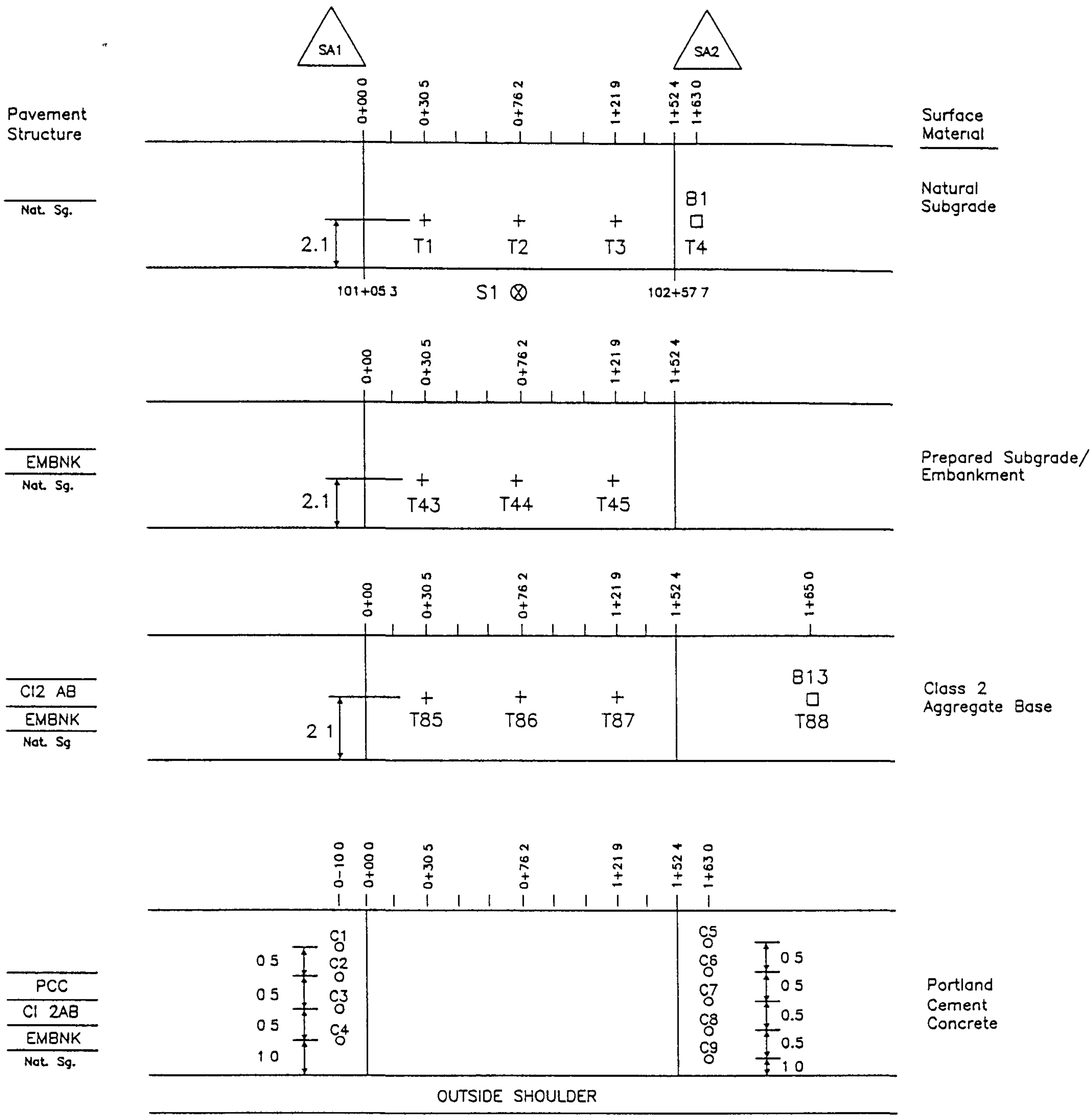
Photo 13. Dowel basket placement.

Photo 14. PCC construction.

APPENDIX B

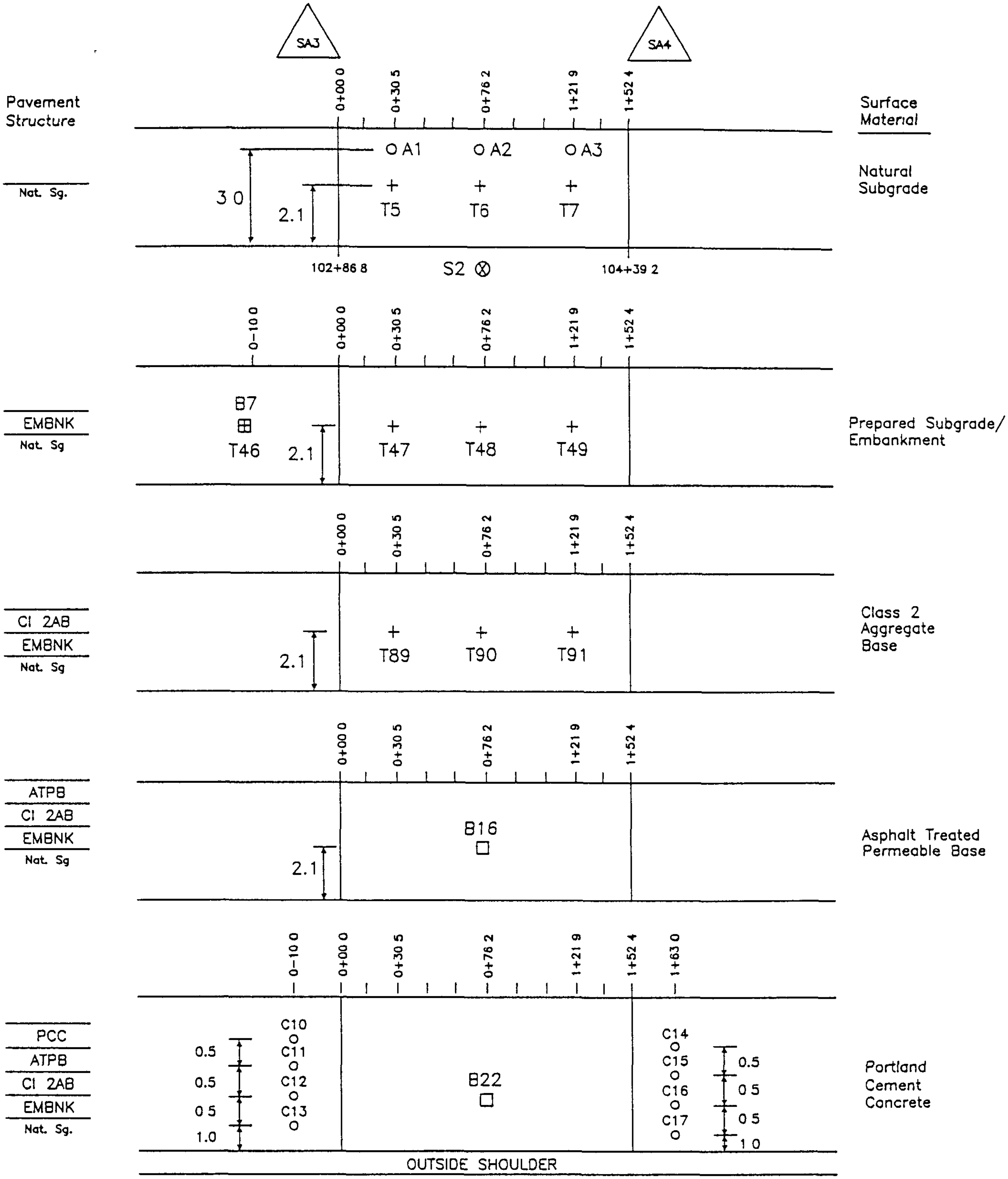
SAMPLING PLAN

Pending the results of laboratory testing, there does not appear to be an embankment layer.



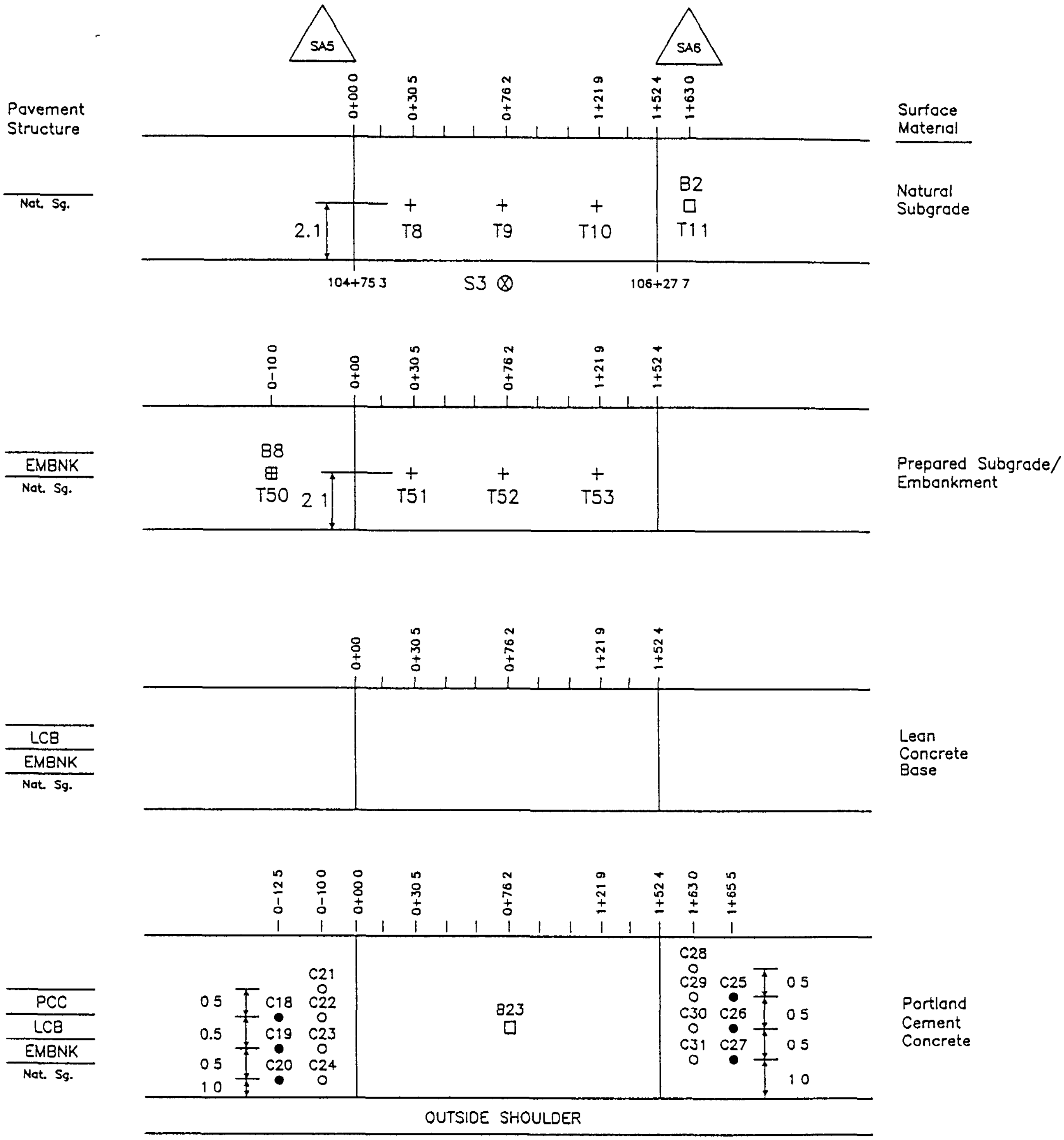
⊗ S1 – 6.1m Shoulder probe
+ T1–T4 – Nuclear moisture-density tests on Natural Subgrade
□ B1 – Bulk sample of Natural Subgrade
+ T43–T45 – Nuclear moisture-density tests on Embankment (T43–T45)
+ T85–T88 – Nuclear moisture-density tests on Cl 2AB
□ B13 – Bulk sample of Cl 2AB
o C1–C9 – Cores of PCC surface

Sampling and test plan for test section 060203, SPS-2 California



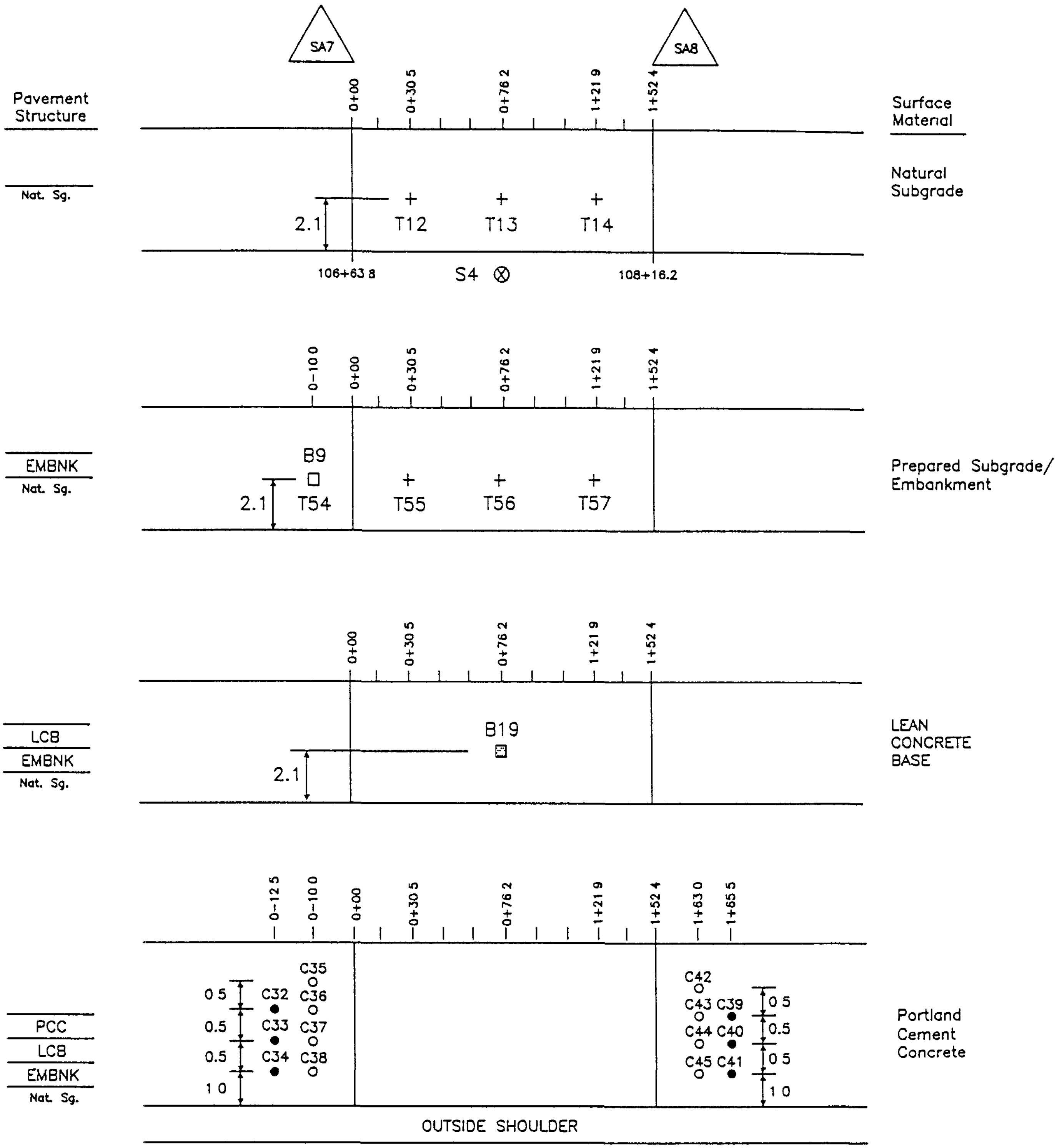
⊗ S2 – 6.1m Shoulder probe
○ A1 to A3, Split Spoon/Shelby tube sampling of Natural Subgrade
\+ T5–T7 – Nuclear moisture-density tests on Natural Subgrade
\+ T46–T49 – Nuclear moisture-density tests on Embankment
\+ T89–T91 – Nuclear moisture-density tests on Cl 2AB
□ B7 – Bulk sample of embankment
□ B16 – Bulk sample of ATPB
□ B22 – Bulk sample of PCC
° C10–C17 – Cores of PCC surface

Sampling and test plan for test section 060211, SPS-2 California



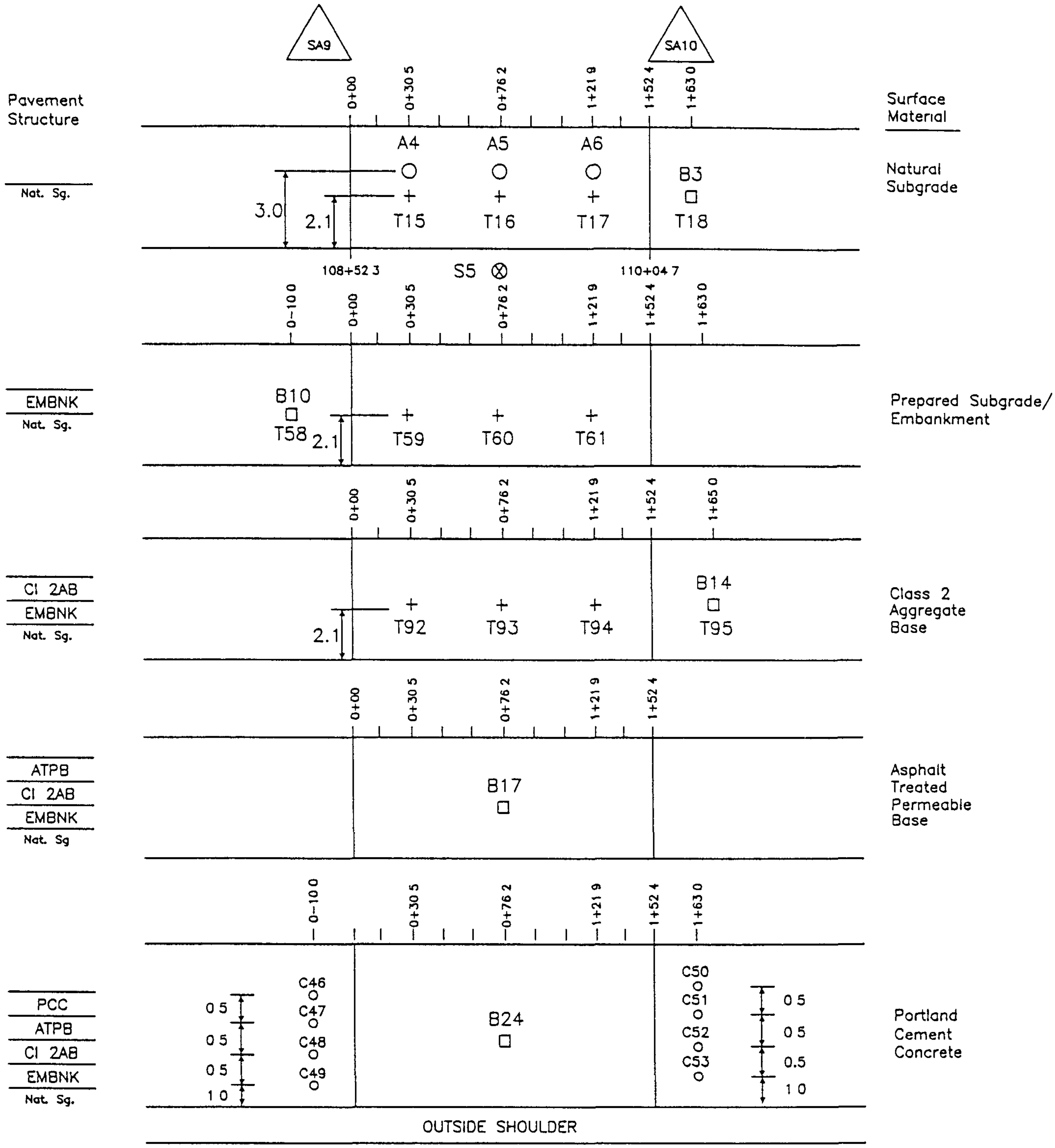
⊗ S3 – 6.1m Shoulder probe
\+ T8–T11 – Nuclear moisture–density tests on Natural Subgrade
⊞ B2 – Bulk sample of Natural Subgrade
\+ T50–T53 – Nuclear moisture–density tests on Embankment
□ B8 – Bulk sample of Embankment
□ B23 – Bulk sample of PCC
● C18–C20, C25–C27 – Cores of LCB
○ C21–C24, C28–C31 – Cores of PCC surface

Sampling and test plan for test section 060207, SPS–2 California



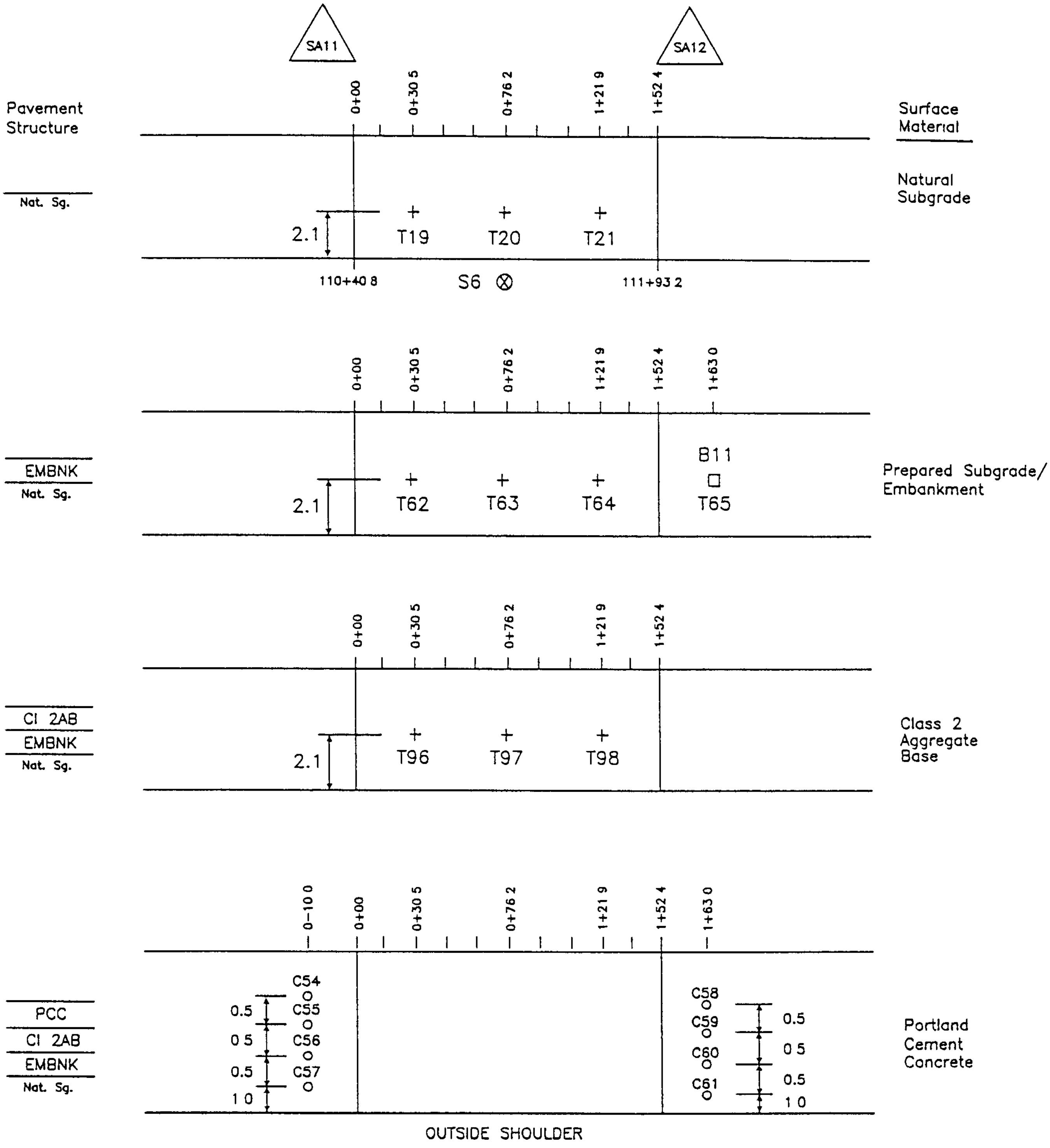
⊗ S4 – 6.1m Shoulder probe
+ T12–T14 – Nuclear moisture–density tests on Natural Subgrade
+ T54–T57 – Nuclear moisture–density tests on Embankment
□ B9 – Bulk sample of Embankment
⊡ B19 – Bulk sample of LCB
• C32–C34, C39–C41 – Cores of LCB
○ C35–C38, C42–C45 – Cores of PCC surface

Sampling and test plan for test section 060206, SPS–2 California.



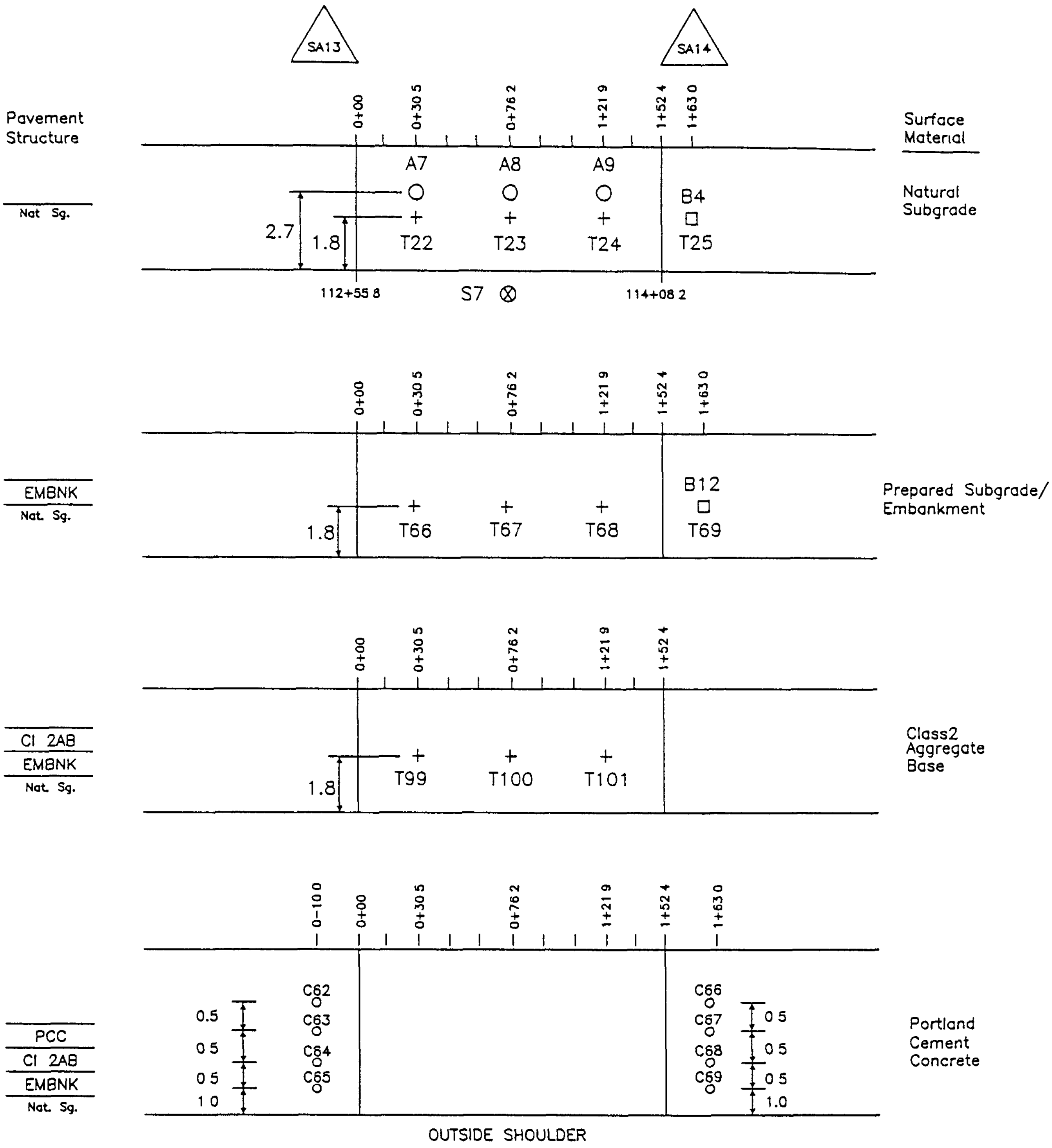
⊗ S5 – 6.1m Shoulder probe
□ B3 – Bulk sample of Natural Subgrade
\+ T15–T18 – Nuclear moisture–density tests on Natural Subgrade
○ A4–A6 – Thin wall sampling of Natural Subgrade
\+ T58–T61 – Nuclear moisture–density tests on Embankment
□ B10 – Bulk sample of Embankment
\+ T92–T95 – Nuclear moisture–density tests on Cl 2AB
□ B14 – Bulk sample of Cl 2AB
□ B17 – Bulk sample of ATPB
□ B24 – Bulk sample of PCC Surface
o C46–C53 – Cores of PCC surface

Sampling and test plan for test section 060210, SPS–2 California



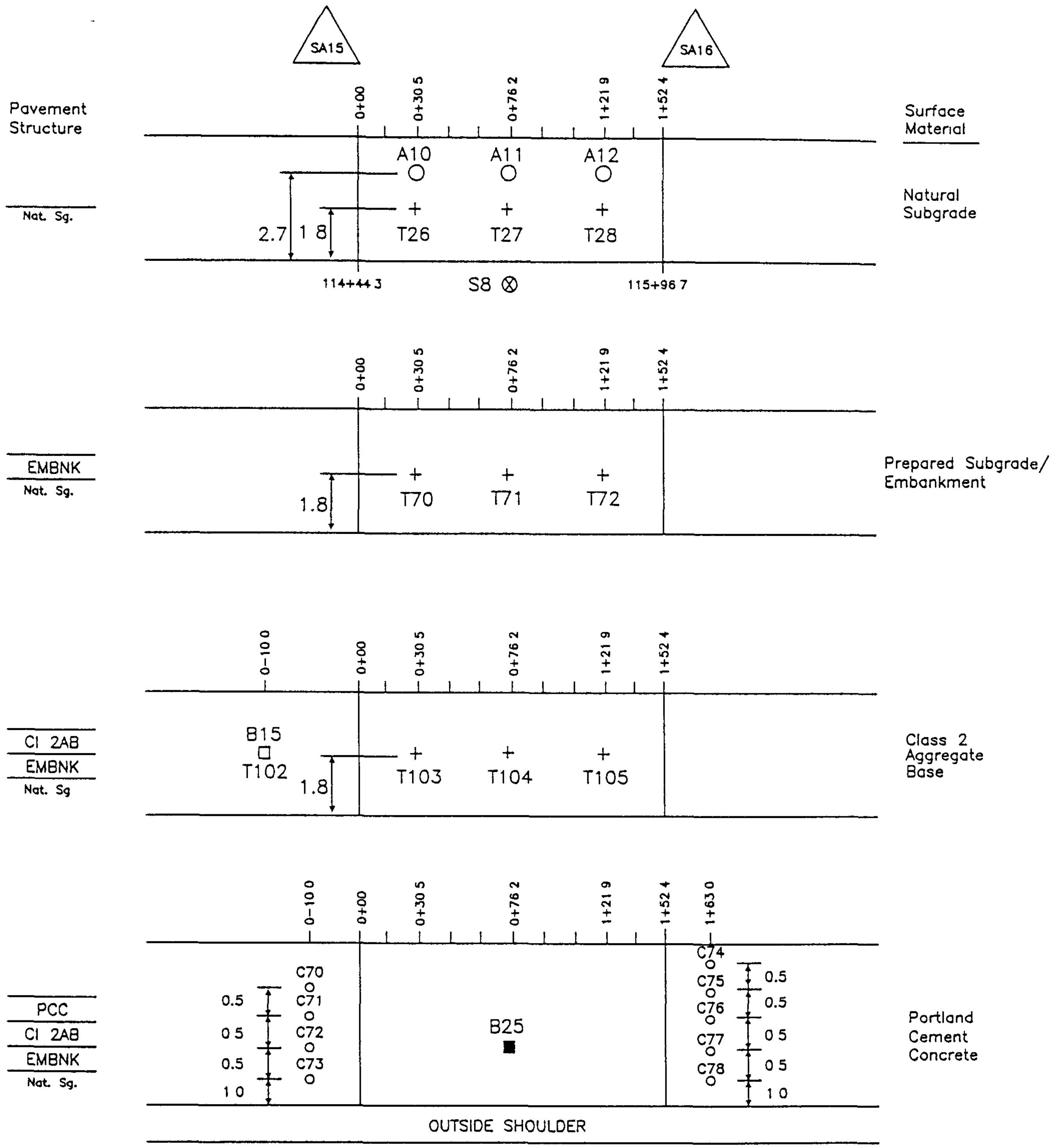
⊗ S6 – 6 1m Shoulder probe
\+ T19–T21 – Nuclear moisture–density tests on Natural Subgrade
\+ T62–T65 – Nuclear moisture–density tests on Embankment
\+ T96–T98 – Nuclear moisture–density tests on Cl 2AB
□ B11 – Bulk sample of Embankment Material
o C54–C61 – Cores of PCC surface

Sampling and test plan for test section 060202, SPS–2 California



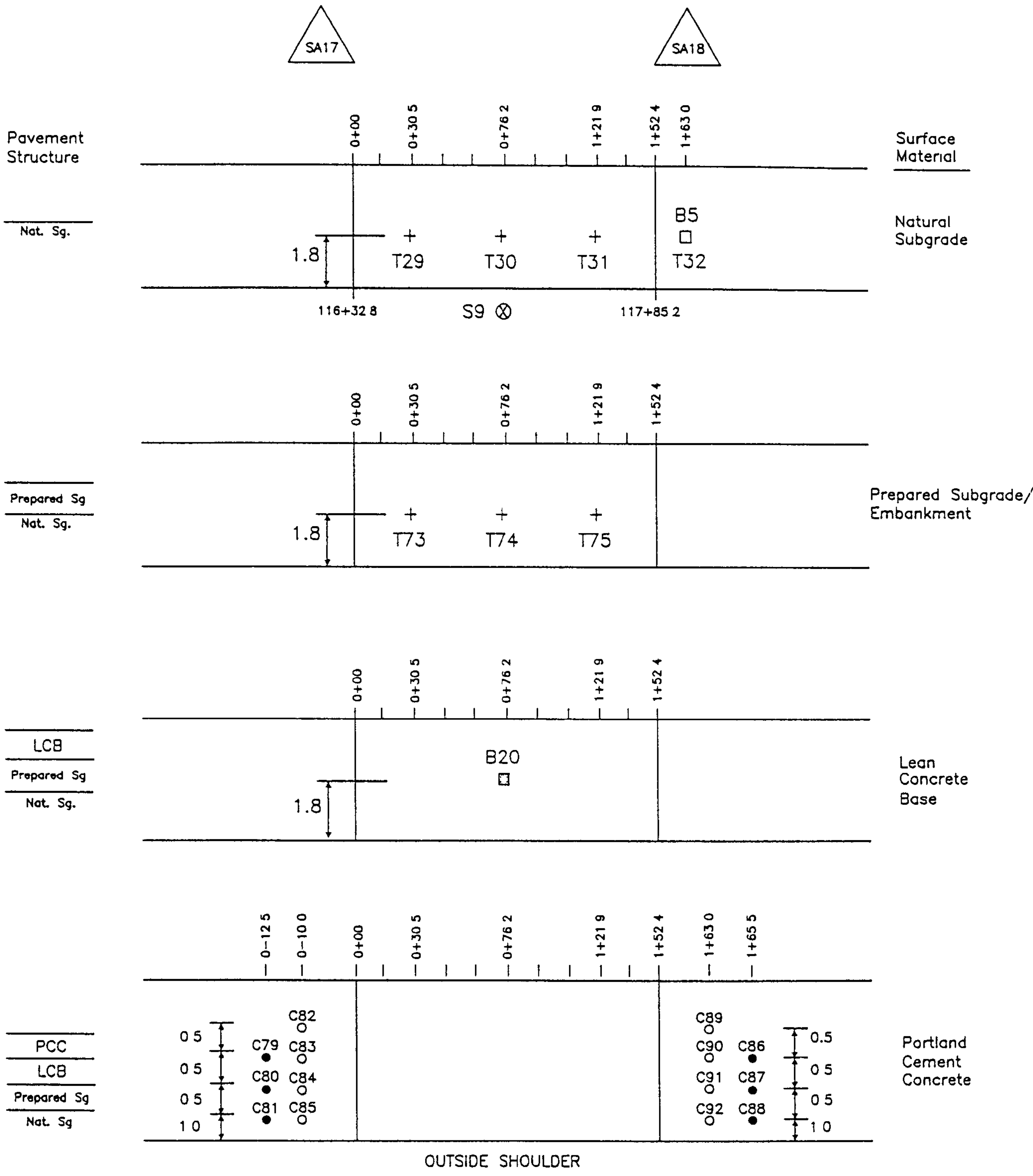
⊗ S7 – 6.1m Shoulder probe
\+ T22–T25 – Nuclear moisture-density tests on Natural Subgrade
○ A7–A9 – Thin wall sampling of Natural Subgrade
□ B4 – Bulk sample of Natural Subgrade
\+ T66–T69 – Nuclear moisture-density tests on Embankment
□ B12 – Bulk sample of Embankment
\+ T99–T101 – Nuclear moisture-density tests on Cl 2AB
∘ C62–C69 – Cores of PCC surface

Sampling and test plan for test section 060204, SPS-2 California



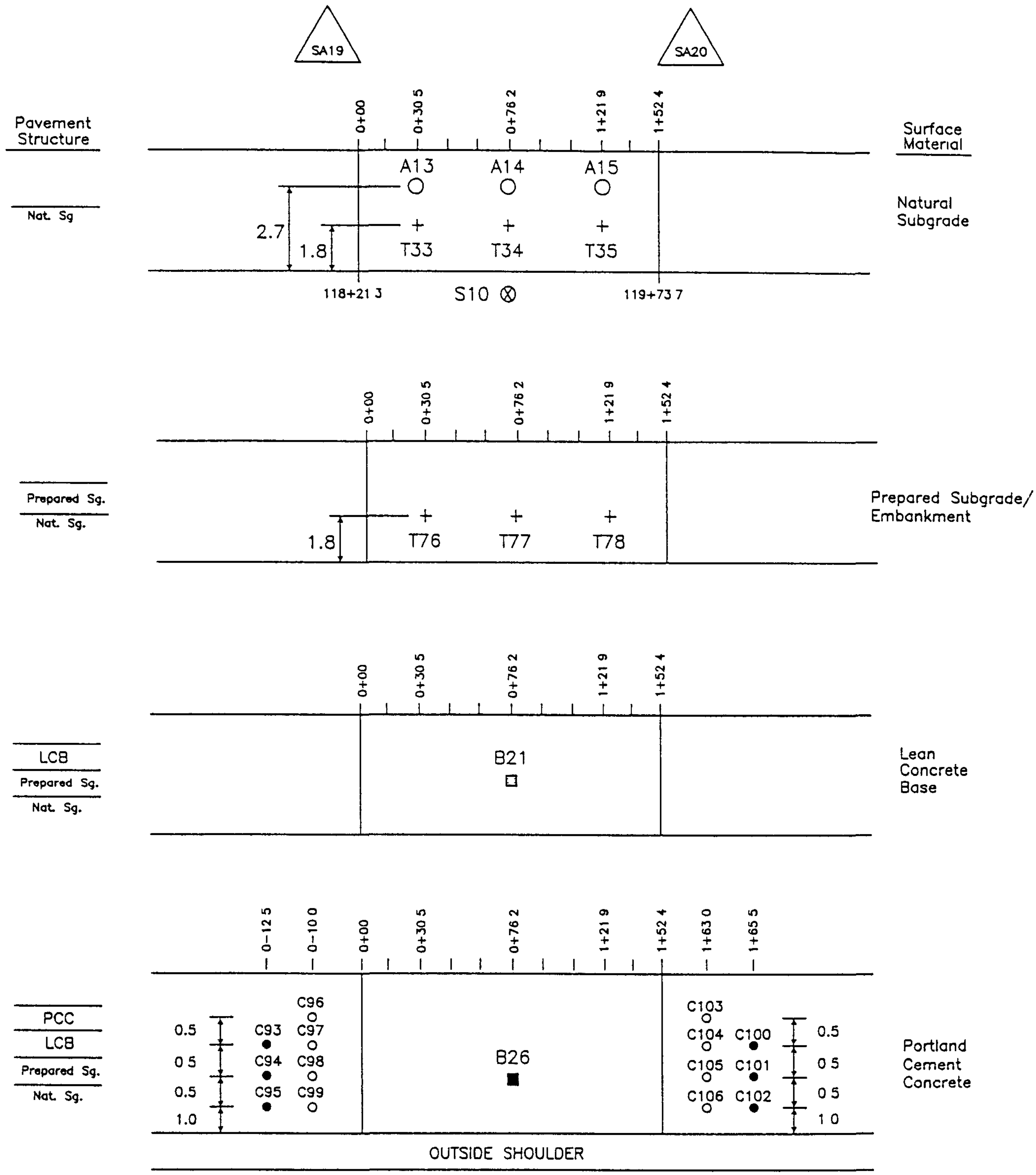
⊗ S8 – 6.1m Shoulder probe
○ A10–A12 – Thin wall sampling of Natural Subgrade
\+ T26–T28 – Nuclear moisture–density tests on Natural Subgrade
\+ T70–T72 – Nuclear moisture–density tests on Embankment
□ B15 – Bulk sample of Cl 2AB
\+ T102–T105 – Nuclear moisture–density tests on Cl 2AB
■ B25 – Bulk sample of PCC
° C70–C78 Cores of PCC surface

Sampling and test plan for test section 060212, SPS–2 California



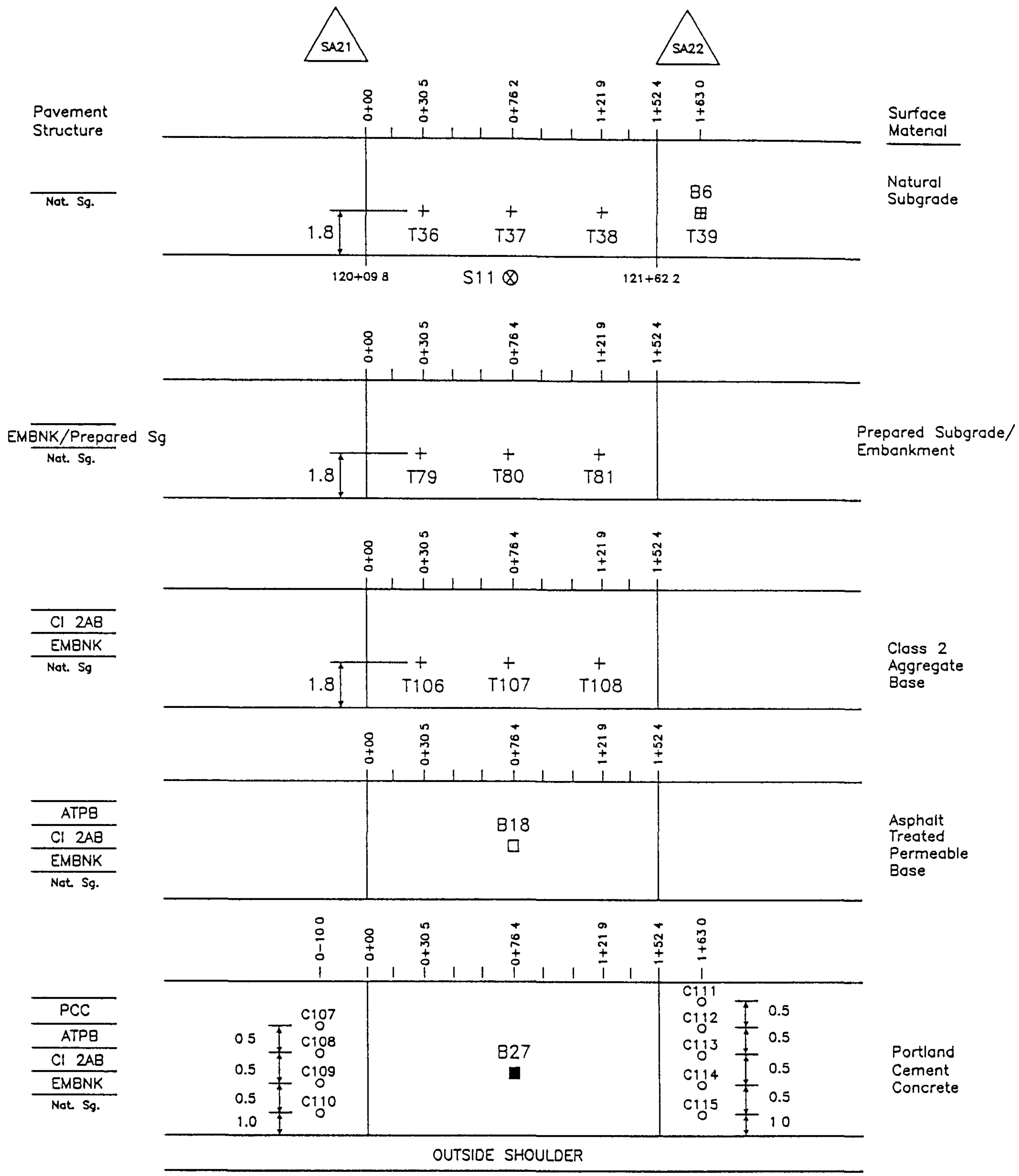
⊗ S9 – 6.1m Shoulder probe
\+ T29–T32 – Nuclear moisture-density tests on Natural Subgrade
□ B5 – Bulk sample of Natural Subgrade
\+ T73–T75 – Nuclear moisture-density tests on Prepared Subgrade
□ B20 – Bulk sample of LCB
● C79–C81, C86–C88 – Cores of LCB
○ C82–C85, C89–C92 – Cores of PCC surface

Sampling and test plan for test section 060208, SPS–2 California



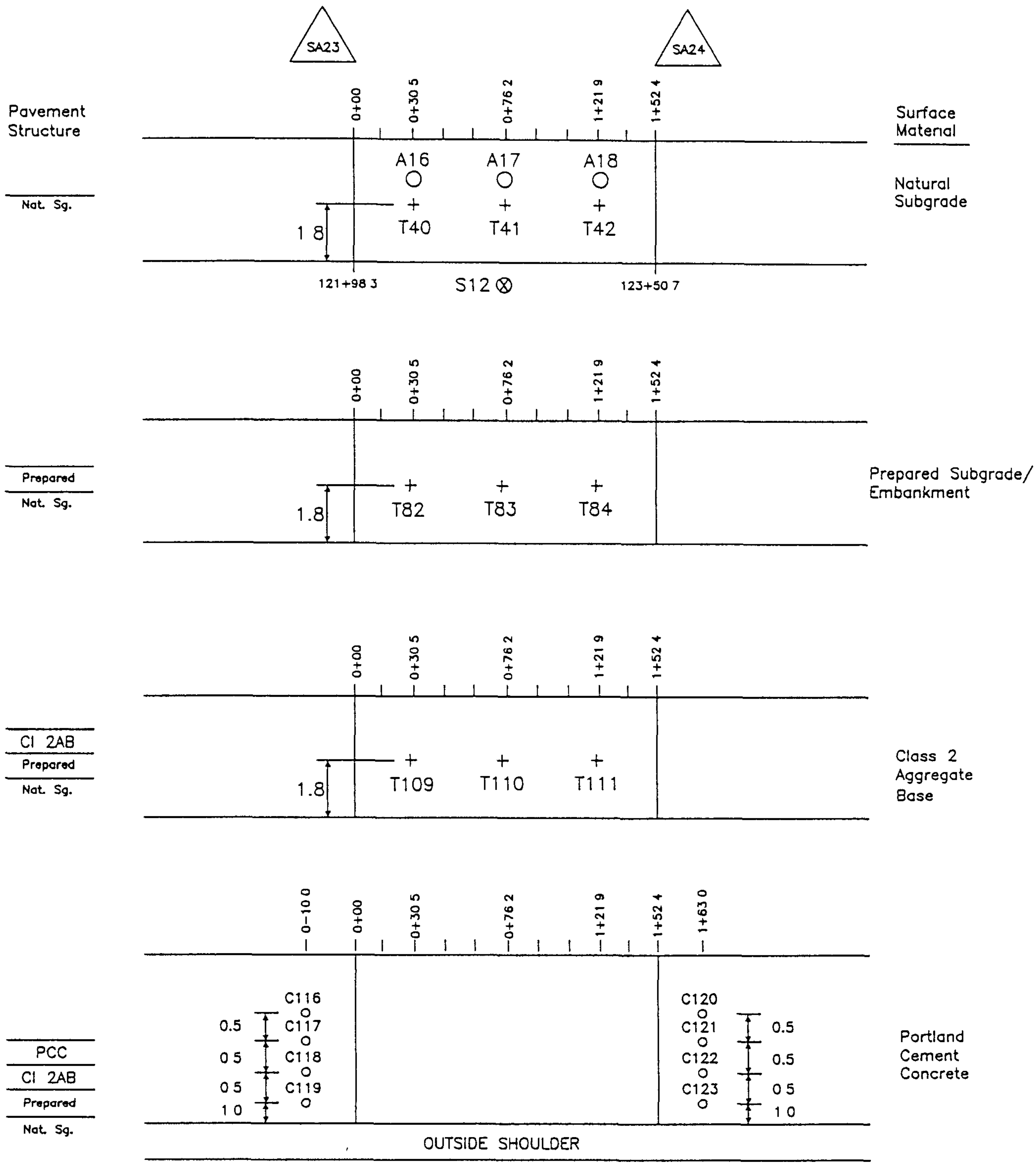
⊗ S10 – 6.1m Shoulder probe
\+ T33–T35 – Nuclear moisture–density tests on Natural Subgrade
○ A13–A15 Thin wall sampling of Natural Subgrade
\+ T76–T78 Nuclear moisture–density tests on Prepared Subgrade
□ B21 – Bulk sample of LCB
■ B26 – Bulk sample of PCC
● C93–C95, C100–C102 – Cores of LCB
○ C96–C99, C103–C106 – Cores of PCC surface

Sampling and test plan for test section 060205, SPS–2 California



⊗ S11 – 6.1m Shoulder probe
\+ T36–T39 – Nuclear moisture-density tests on Natural Subgrade
□ B6 – Bulk sample of Natural Subgrade
\+ T79–T81 – Nuclear moisture-density tests on Embankment/Prepared Subgrade
\+ T106–T108 – Nuclear moisture-density tests on Cl 2AB
□ B18 – Bulk sample of ATPB
■ B27 – Bulk sample of PCC
o C107–C115 – Cores of PCC surface

Sampling and test plan for test section 060209, SPS-2 California



⊗ S12 – 6.1m Shoulder probe
○ A16–A18 Thin Wall Sampling of Natural Subgrade
\+ T40–T42 – Nuclear moisture-density tests on Natural Subgrade
\+ T82–T84 – Nuclear moisture-density tests on Prepared Subgrade
\+ T109–T111 – Nuclear moisture-density tests on Class 2 Aggregate Base
o C116–C123 – Cores of PCC surface

Sampling and test plan for test section 060201, SPS-2 California

Field and laboratory test plan for **Natural Subgrade** materials, SPS-2 California.

Test Name	LTPP Test Designation	LTPP Protocol	No. of Tests	Material Source/ Test Location
Sieve Analysis	SS01	Ship to FHWA Lab	6	B1-B6
Hydrometer to 0.01mm	SS02	Ship to FHWA Lab	6	B1-B6
Atterberg Limits	SS03	Ship to FHWA Lab	6	B1-B6
Subgrade Classification & Type	SS04	Ship to FHWA Lab	12	B1-B6 and A2,A5 A8,A11,A14,A17
Subgrade Classification & Type	SS04	P52	12	A1,A3,A4,A6,A7,A9 A10,A12,A13,A15. A16,A18[1]
Moisture-Density Relations	SS05	Ship to FHWA Lab	6	B1-B6
Resilient Modulus	SS07	Ship to FHWA Lab	5 or 6	A2,A5,A8,A11,A14 A17 or B1-B6
Unit Weight	SS08	P56	6	A1,A4,A7,A10,A13 A16
Natural Moisture Content	SS09	Ship to FHWA Lab	6	B1-B6
Unconfined Compressive Strength	SS10	P54	6	A1,A4,A7,A10,A13 A16
Hydraulic Conductivity	SS11 or UG09	P57 or P48	3	A6,A12,A18 or B1 B3,B5
In-Place Density		LTPP Method	42	T1-T42
Depth to Rigid Layer		LTPP Method	12	S1 - S12

[1]Visual-Manual Classification Method Only.

Field and laboratory test plan for **Embankment** materials, SPS-2 California.

Test Name	LTPP Test Designation	LTPP Protocol	No. of Tests	Material Source/ Test Location
Sieve Analysis	SS01	Ship to FHWA Lab	6	B7 - B12
Hydrometer to 0.01mm	SS02	Ship to FHWA Lab	6	B7 - B12
Atterberg Limits	SS03	Ship to FHWA Lab	6	B7 - B12
Subgrade Classification & Type	SS04	Ship to FHWA Lab	6	B7 - B12
Moisture-Density Relations	SS05	Ship to FHWA Lab	6	B7 - B12
Resilient Modulus	SS07	Ship to FHWA Lab	6	B7 - B12
Natural Moisture Content	SS09	Ship to FHWA Lab	6	B7 - B12
Hydraulic Conductivity	UG09	P48	3	B7, B9, B12
In-Place Density		LTPP Method	42	T43 - T84

Note 1 - Visual-manual classification method only

Field and laboratory test plan for **Class 2 Aggregate Base** materials, SPS-2 California.

Test Name	LTPP Test Designation	LTPP Protocol	No. of Tests	Material Source/ Test Location
Particle Size Analysis	UG01	Ship to FHWA Lab	3	B13 - B15
Sieve Analysis (washed)	UG02	Ship to FHWA Lab	3	B13 - B15
Atterberg Limits	UG04	Ship to FHWA Lab	3	B13 - B15
Moisture-Density Relations	UG05	Ship to FHWA Lab	3	B13 - B15
Resilient Modulus	UG07	Ship to FHWA Lab	3	B13 - B15
Classification	UG08	Ship to FHWA Lab	3	B13 - B15
Permeability	UG09	P48	3	B13 - B15
Natural Moisture Content	UG10	Ship to FHWA Lab	3	B13 - B15
In-Place Density		LTPP Method	27	T85 - T111

Field and laboratory test plan for as-delivered **Lean Concrete Base** material, SPS-2 California.

Test Name	**LTPP Test Designation**	**LTPP Protocol**	**No. of Tests**	**Material Source/ Test Location**
Lean Concrete Base - As Delivered				
Compressive Strength	PC01	P61		
7 Day			6	B19 - B21 (Note 1)
28 Day			6	
1 Year			6	
Air Content	ASTM C231	LTPP Method	3	B19 - B21
Slump	ASTM C143	LTPP Method	3	B19 - B21
Temperature	AASTM C1064	LTPP Method	3	B19 - B21

Note 1. A total of 6 cylinder specimens are molded from each bulk sample, two specimens for each cure age.

Field and laboratory test plan for as-delivered **PCC** material, SPS-2 California.

Test Name	LTPP Test Designation	LTPP Protocol	# of Tests	Material Source /Test Location	
Compressive Strength	PC01	P61		3 8 MPa PCC mix	6.3 MPa PCC mix
14 Day			6	B25-B27[Note 1]	B22-B24[Note 1]
28 Day			6		
1 Year			6		
Splitting Tensile Strength	PC02	P62		3 8 MPa PCC mix	6 2 Mpa PCC mix
14 Day			6	B25-B27	B22-B24
28 Day			6		
1 Year			6		
Flexural Strength	PC09	P69		3 8 MPa PCC Mix	6 2 MPa PCC mix
14 Day			6	B25-B27	B22-B24
28 Day			6		
1 Year			6		
Air Content	ASTM C231	LTPP Method	6	B22-B27	
Slump	ASTM C143	LTPP Method	6	B22-B27	
Temperature	ASTM C1064	LTPP Method	6	B22-B27	

Note 1. A total of 6 cylinder specimens and 3 beam specimens are molded from each PCC bulk sample.

Bulk samples and molded specimens from PCC mix, SPS-2 California.

Material Source/Test Location	Sample No.	Test Age After Placement	Specimen No.			Test Section
			152mm x 305mm Cylinder Compression	152mm x 305mm Cylinder Indirect Tensile	152mm x 508mm Beam Flexural Strength	
B22	BP01	14 days	GX01	GX02	FX01	060211
		28 days	GY01	GY02	FY01	
		1 year	GZ01	GZ02	FZ01	
B23	BP02	14 days	GX03	GX04	FX02	060207
		28 days	GY03	GY04	FY02	
		1 year	GZ03	GZ04	FZ02	
B24	BP03	14 days	GX05	GX06	FX03	060210
		28 days	GY05	GY06	FY03	
		1 year	GZ05	GZ06	FZ03	
B25	BP04	14 days	GX07	GX08	FX04	060212
		28 days	GY07	GY08	FY04	
		1 year	GZ07	GZ08	FZ04	
B26	BP05	14 days	GX09	GX10	FX05	060205
		28 days	GY09	GY10	FY05	
		1 year	GZ09	GZ10	FZ05	
B27	BP06	14 days	GX11	GX12	FX06	060209
		28 days	GY11	GY12	FY06	
		1 year	GZ11	GZ12	FZ06	

Field and laboratory test plan for as-placed **PCC** material, SPS-2 California.

Test Name (Age)	LTPP Test Designation	LTPP Protocol	# of Tests	Material Source/ Test Location
Portland Cement Concrete - As Placed (Cores)				
Compressive Strength	PC01	P61		
14 Day			12	C1,C10,C21,C35,C46,C54,C62, C70,C82,C96,C107,C116
28 Day			12	C2,C11,C22,C36,C47,C55,C63, C71,C83,C97,C108,C117
1 Year			12	C3,C12,C23,C37,C48,C56,C64, C72,C84,C98,C109,C118
Splitting Tensile Strength	PC02	P62		
14 Day			12	C5,C14,C28,C42,C50,C58,C66, C74,C89,C103,C111,C120
28 Day			12	C6,C15,C29,C43,C51,C59,C67, C75,C90,C104,C112,C121
1 Year			12	C7,C16,C30,C44,C52,C60,C68, C76,C91,C105,C113,C122
PCC Unit Weight	PC05	P65	12	C4,C13,C24,C38,C49,C57,C65, C73,C85,C99,C110,C119
Static Modulus of Elasticity	PC04	P64		
28 Day			12	C4,C13,C24,C38,C49,C57,C65, C73,C85,C99,C110,C119
1 Year			12	C8,C17,C31,C45,C53,C61,C69, C77,C92,C106,C114,C123
Core Examination and Thickness	PC06	P66	98	C1-C17,C21-C24,C28-C31,C35-C38,C42-C78,C82-C85,C89-C92,C96-C99,C103-C123
Air Content @ 28 Days	PC08	P68	2	C2,C55
PCC Thermal Coefficient		Ship to FHWA	2	C9,C78

APPENDIX C

AUGER PROBE RESULTS

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING — SHEET NUMBER 1 OF 1

SHOULDER PROBE LOG

SAMPLING DATA SHEET 9

RP REGION: Western — STATE: California — STATE CODE: 06

S EXPERIMENT NO: 2 — SPS PROJECT CODE: 02

ROUTE/HIGHWAY: SR 99 — Lane: LT — Direction: [illegible] — TEST SECTION NO.: 07

PLE/TEST LOCATION: ☒ Before Section ☐ After Section ☐ Within Section — FIELD SET NO.: 1

OPERATOR: Roger [illegible] — EQUIPMENT USED: [illegible] — AUGERING DATE: 5-30-00

GER PROBE NUMBER: 33 — LOCATION STATION: 0+00 — OFFSET: [illegible] feet from o/s

P OF ROCK BASED ON: [illegible] -24 [illegible]

Scale (feet)	Depth from Surface (Feet)	Material Description	Material Code
1–6	6.0	Damp silty sand brown in color	214
7–12	12.0	Damp silty sand light brown in color	214
13–18	18.0	Damp silty sand light brown in color	214
19–20	20.0	Same as above	214

ENT'D MAY 30 2001

REFUSAL WITHIN 20 FEET (Y/N): N — DEPTH TO REFUSAL: ______ (FEET)

GENERAL REMARKS: Auger Hole located in the median [illegible]

FIED: [signature] — VERIFIED AND APPROVED: SRIKANTH [illegible] — DATE: 05-30-19[illegible] (Month- Day- Year)

Crew Chief — SHRP Representative

Affiliation: CIT — Affiliation: NCE, WRCOC

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING

SHOULDER PROBE LOG

SAMPLING DATA SHEET 9

SHEET NUMBER ____ OF 1

RP REGION Western STATE California

STATE CODE 06

S EXPERIMENT NO 02

SPS PROJECT CODE 02

ROUTE/HIGHWAY SR 99 Lane RT Direction NB

TEST SECTION NO. 06

MPLE/TEST LOCATION: ☒ Before Section ☐ After Section ☐ Within Section

FIELD SET NO. 1

OPERATOR Roger Cruz? EQUIPMENT USED ____ AUGERING DATE 5-30-00

IGER PROBE NUMBER S11 LOCATION STATION. ~~[illegible]~~ 0-55 OFFSET. 5.50 feet from ~~O/S~~ [illegible]

OP OF ROCK BASED ON: ____

Scale (feet)	Depth from Surface (Feet)	Material Description	Material Code
1–5	5.0	Dark brown, Damp silty Sand	214
6–20	↓	Light brown Damp silty Sand.	214

ENT'D MAY 30 2001

REFUSAL WITHIN 20 FEET (Y/N): N DEPTH TO REFUSAL: ____ (FEET)

GENERAL REMARKS: Auger hole located in the median due to field conditions

CERTIFIED [signature]

Field Crew Chief

Affiliation. [illegible]

VERIFIED AND APPROVED Srikanth Holikatti

SHRP Representative

Affiliation: NCE WRIOC

DATE ____-____-19____

Month- Day- Year

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING

SHOULDER PROBE LOG

SAMPLING DATA SHEET 9

SHEET NUMBER ____ OF 1

LTPP REGION WESTERN STATE CALIFORNIA

SPS EXPERIMENT NO 2

ROUTE/HIGHWAY SR 99 Lane RT Direction NB

S[redacted]PLE/TEST LOCATION. ☒ Before Section ☐ After Section ☐ Within Section

STATE CODE 06

SPS PROJECT CODE 02

TEST SECTION NO. 10

FIELD SET NO. 1

OPERATOR [illegible] EQUIPMENT USED CS2000 AUGERING DATE 5-30-00

AUGER PROBE NUMBER S5 LOCATION STATION ~~10+37+x~~ 0-48 OFFSET. ~~57 ft~~ -23.35 feet from O/S

TOP OF ROCK BASED ON:

Scale (feet)	Depth from Surface (Feet)	Material Description	Material Code
1			
2			
3	5.0	Damp Dark brown silty sand	214
4			
5			
6			
7	8.0	Damp Dark brown silty sand	214
8			
9	10.0	Damp Dark brown silty sand with small amounts of clay	214
10			
11			
12	12.0	Damp Brown Sandy silty clay	113
13	14.0	Light brown silty sand	214
14			
15	16.0	Damp Gray fine silty sand.	214
16			
17			
18			
19		Damp brownish gray fine silty sand	214
20	20.0		

ENT'D MAY 30 2001

REFUSAL WITHIN 20 FEET (Y/N): N DEPTH TO REFUSAL: ________ (FEET)

GENERAL REMARKS:

CERTIFIED [signature]

Field Crew Chief

Affiliation C/T

VERIFIED AND APPROVED S Hellikawi

SHRP Representative

Affiliation NCE

DATE ____-____-19___

Month- Day- Year

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING

SHOULDER PROBE LOG

SAMPLING DATA SHEET 9

SHEET NUMBER ____ OF 1

REGION Western STATE California STATE CODE 06

SPS EXPERIMENT NO 2 SPS PROJECT CODE 02

ROUTE/HIGHWAY I-280 Lane LT Direction NB TEST SECTION NO. 02

MPLE/TEST LOCATION: ☒ Before Section ☐ After Section ☐ Within Section FIELD SET NO. 1

OPERATOR Roger Bri... EQUIPMENT USED CME 75.000 AUGERING DATE 5-30-00

AUGER PROBE NUMBER S6 LOCATION STATION: 110+52.2 OFFSET. 15.0 feet from O/S 4

TOP OF ROCK BASED ON: 0-3 ~~B6~~-23-32

Scale (feet)	Depth from Surface (Feet)	Material Description	Material Code
1–5	5.0	Brown damp silty clay	131
5–7	7.0	Light brown damp sandy clay	113
7–10	10.0	Brown/Gray damp silty clay with gravel	104
10–15	15.0	Damp light brown silty sand (uniform)	214
15–20	20.0	Damp Brown/Grayish fine sand	201

ENT'D MAY 30 2001

REFUSAL WITHIN 20 FEET (Y/N): N DEPTH TO REFUSAL: ________ (FEET)

GENERAL REMARKS: Auger hole located in the median due to field conditions

CERTIFIED Roger M. Bri... VERIFIED AND APPROVED Sri... DATE 05-30-19 2000

Field Crew Chief SHRP Representative Month- Day- Year

Affiliation CIT Affiliation NCE Linkow

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING

SHOULDER PROBE LOG

SAMPLING DATA SHEET 9

SHEET NUMBER 1 OF 1

LTPP REGION WESTERN STATE CALIFORNIA STATE CODE 6
SPS EXPERIMENT NO 2 SPS PROJECT CODE 02
ROUTE/HIGHWAY SR 99 Lane RT Direction NB TEST SECTION NO. 12
SAMPLE/TEST LOCATION. ☑ Before Section ☐ After Section ☐ Within Section FIELD SET NO. 1
OPERATOR Roger [illegible] EQUIPMENT USED CS 2000 AUGERING DATE 5-2-2000
SHOULDER PROBE NUMBER 3 LOCATION STATION. 0-20 OFFSET: ~~24~~ feet from O/S ℄
TYPE OF ROCK BASED ON:

Scale (feet)	Depth from Surface (Feet)	Material Description	Material Code
1–5	5.0	Dark brown damp silty sand	214
5–10	10.0	Damp medium brown silty sand	214
10–15	15.0	Damp light brown fine sand with silt	214
15–20	20.0	Wet grayish brown fine sand	201

ENT'D MAY 30 2001

REFUSAL WITHIN 20 FEET (Y/N): N DEPTH TO REFUSAL: ______ (FEET)

GENERAL REMARKS: Borehole is located [illegible] from the edge of shoulder between [illegible]

CERTIFIED [signature]
Field Crew Chief
Affiliation C, T, I

VERIFIED AND APPROVED SRIKANTH [illegible]
SHRP Representative
Affiliation: NCE [illegible]

DATE 5-2-~~19~~2000
Month- Day- Year

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING

SHEET NUMBER ____ OF ____

SHOULDER PROBE LOG

SAMPLING DATA SHEET 9

[redacted]RP REGION Western STATE CA STATE CODE 06
PS EXPERIMENT NO 2 SPS PROJECT CODE 02
ROUTE/HIGHWAY ____ Lane RT Direction NB TEST SECTION NO. ____
MPLE/TEST LOCATION. ☒ Before Section ☐ After Section FIELD SET NO. 1
☐ Within Section
ERATOR ____ EQUIPMENT USED ____ AUGERING DATE 5-__-2000
GER PROBE NUMBER ____ LOCATION STATION. ____ OFFSET. ____ feet from o/s LE
P OF ROCK BASED ON. ____ 0-31 -24

Scale (feet)	Depth from Surface (Feet)	Material Description	Material Code
1–5	5.0	Light brown damp fine Sand with Silt	214
6–10	10.0	Light brown damp fine Sand with Silt	214
11–15	15.0	Light brown damp fine Sand with Silt	214
16–17	17	Wet gray sand	201
18–20	20	Wet gray sand (WT ?)	201

ENT'D MAY 30 2001

REFUSAL WITHIN 20 FEET (Y/N): N DEPTH TO REFUSAL: ____ (FEET)

GENERAL REMARKS: Hole located ____ shoulder edge (20') ____

CERTIFIED

Field Crew Chief

Affiliation CIT

VERIFIED AND APPROVED

SHRP Representative

Affiliation: ____

DATE 05-__-2000

Month- Day- Year

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING

SHOULDER PROBE LOG

SAMPLING DATA SHEET 9

SHEET NUMBER 1 OF 1

RP REGION WESTERN STATE CALIFORNIA STATE CODE 0 6
SPS EXPERIMENT NO 2 SPS PROJECT CODE 2 2
ROUTE/HIGHWAY [illegible] Lane R- Direction NB TEST SECTION NO. 0 5
SAMPLE/TEST LOCATION. ☒ Before Section ☐ After Section ☐ Within Section FIELD SET NO. 1
OPERATOR [illegible] EQUIPMENT USED CS 2000 AUGERING DATE 5-31-2000
ER PROBE NUMBER S1C LOCATION STATION. ~~[illegible]~~ 0-40 OFFSET: ~~[illegible]~~ -24 [illegible] feet from o/s LE
OF ROCK BASED ON:

Scale (feet)	Depth from Surface (Feet)	Material Description	Material Code
1–4	4 0	Damp brown sand with Silt	214
4–5	5 0	Damp dark gray clayey sand	216
5–9	9 0	Damp dark brown fine sand with Silt	214
9–15	15 0	Damp brown fine Sand with silt	214
15–18	18 0	Damp to wet fine Sand with silt	214
18–20	20	Wet clayey fine Sand (WT) Reddish brown in Colour	216

ENT'D MAY 30 2001

REFUSAL WITHIN 20 FEET (Y/N): N DEPTH TO REFUSAL: ______ (FEET)

GENERAL REMARKS: Bore hole [illegible] located [illegible] 100' South of [illegible]

CERTIFIED [signature]
Field Crew Chief
Affiliation CTL

VERIFIED AND APPROVED SRIKANTH HOLIKATTI
SHRP Representative
Affiliation: [illegible]

DATE 5-31-2000
Month- Day- Year

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING — SHEET NUMBER 1 OF 1

SHOULDER PROBE LOG

SAMPLING DATA SHEET 9

P REGION WESTERN — STATE CALIFORNIA — *STATE CODE* 0 6

PS EXPERIMENT NO 2 — *SPS PROJECT CODE* 0 2

ROUTE/HIGHWAY SR 99 — Lane 2 — Direction N — *TEST SECTION NO.* 0 9

[redacted]MPLE/TEST LOCATION: ☒ Before Section ☐ After Section ☐ Within Section — *FIELD SET NO.* 1

OPERATOR [illegible] — EQUIPMENT USED CS 2000 — *AUGERING DATE* _-_-2000

GER PROBE NUMBER S1 — *LOCATION STATION.* 119+12.4 — *OFFSET:* -24 *feet from* °/s

OF ROCK BASED ON: 0-41

Scale (feet)	*Depth from Surface (Feet)*	*Material Description*	*Material Code*
1–5	5.0	Damp brown fine [illegible] Silt	214
5–8.5	8.5	Damp dark brown fine Sand with Silt	214
8.5–10	10.0	Damp dark brown fine clayey Sand	216
10–12	12.0	Damp dark grayish brown Sandy clay	113
12–15	15.0	Damp dark brown Sand	201
15–17	17.0	Damp dark brown Clayey Sand	216
17–20	20.0	Wet dark brown Clayey Sand	216

ENT'D MAY 30 2001

REFUSAL WITHIN 20 FEET (Y/N): N — *DEPTH TO REFUSAL:* ______ *(FEET)*

GENERAL REMARKS:

CERTIFIED [signature] — Field Crew Chief — Affiliation C[illegible]

VERIFIED AND APPROVED Srikanth [illegible] — SHRP Representative — Affiliation: NCE, WRCOC

DATE 05-31-2000 — Month- Day- Year

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING

SHEET NUMBER ____ OF ____

SHOULDER PROBE LOG

SAMPLING DATA SHEET 9

.P REGION WESTERN STATE CALIFORNIA STATE CODE 0 6

PS EXPERIMENT NO 2 SPS PROJECT CODE

UTE/HIGHWAY Lane Direction TEST SECTION NO.

4PLE/TEST LOCATION. ☒ Before Section ☐ After Section ☐ Within Section FIELD SET NO.

ERATOR EQUIPMENT USED AUGERING DATE

GER PROBE NUMBER LOCATION STATION. 0-115 OFFSET. -24 feet from °/s

? OF ROCK BASED ON.

Scale (feet)	Depth from Surface (Feet)	Material Description	Material Code
1–3	.	Dark ... fine sand with silt	214
3–5	5.0	Brown damp fine sand with silt	214
5–7	7.0	Gray damp fine sand with silt	214
7–9	9.0	Light gray damp fine sand with silt	214
9–12	12.0	Brown damp clayey sand	216
12–13.5	13.5	Gray damp sandy clay	113
13.5–15	15.0	Light gray damp clayey sand	216
15–20	20.0	Dark brown to grayish brown damp sandy clay	113

ENT'D MAY 30 2001

REFUSAL WITHIN 20 FEET (Y/N): N DEPTH TO REFUSAL: ____ (FEET)

GENERAL REMARKS:

CERTIFIED VERIFIED AND APPROVED DATE

Field Crew Chief SHRP Representative Month- Day- Year

Affiliation Affiliation

LTPP-SPS MATERIAL SAMPLING AND FIELD TESTING

SHEET NUMBER ____ OF 1

SHOULDER PROBE LOG

SAMPLING DATA SHEET 9

RP REGION Western STATE CA STATE CODE 0 6

PS EXPERIMENT NO 02 SPS PROJECT CODE 2 2

ROUTE/HIGHWAY SR Lane LT Direction NB TEST SECTION NO. 0 4

MPLE/TEST LOCATION. ☒ Before Section ☐ After Section ☐ Within Section FIELD SET NO. 1

OPERATOR [illegible] EQUIPMENT USED [illegible] AUGERING DATE [illegible]

GER PROBE NUMBER [illegible] LOCATION STATION. 0+25 OFFSET. -23 feet from O/S

P OF ROCK BASED ON:

Scale (feet)	Depth from Surface (Feet)	Material Description	Material Code
1–5	[illegible]	Damp [illegible] silty sand	214
5–10	10.0	Damp light brown silty Sand	214
10–12	12.5	Damp light brown silty Sand	214
12–15	15.0	Damp grayish brown silty Sand	214
15–17	17.0	Wet dark brown Sand	201
17–20	20	Wet dark brown/gray ~~Sand~~ Clayey Sand (water table)	216

ENT'D MAY 30 2001

REFUSAL WITHIN 20 FEET (Y/N): N DEPTH TO REFUSAL: ______ (FEET)

GENERAL REMARKS: The borehole is located 6.0 m south of Transition [illegible]

CERTIFIED [signature]
Field Crew Chief
Affiliation C.T.

VERIFIED AND APPROVED
SRIKANTH HOLIKATTI
SHRP Representative
Affiliation. NCE [illegible]

DATE
05 - 31 - 2000
Month- Day- Year

APPENDIX D

PCC MIX DESIGN

AMERICAN TRANSIT-MIX CO., INC.

Main Office. 318 Beard Avenue, Modesto, CA 95354 Office: (209) 529-4115 FAX: (209) 521-8546
Dispatch: Central Valley (209) 524-6322 - Fresno (559) 434-2200 - Bakersfield (661) 325-8614
Plants: Stockton - Tracy - Modesto - Newman - Turlock - Madera - Fresno - Bakersfield

Group 268	Mix Number 29733

Report No. 56921
04/06/2000
05050004

MET 1.5 5.0 C+F (25%)

FCI
ATTN: GREG

#10-0437U4 DELHI PROJECT
DELHI, CA

MATERIALS DESCRIPTION

CEMENT TYPE II MODIFIED ASTM C-150
BORAL FLY ASH ASTM C-618 CLASS F
WATERFORD 1 1/2" X 3/4" ASTM C-33 SIZE 4
WATERFORD 1" X #4 ASTM C-33 SIZE 57
WATERFORD CONCRETE SAND ASTM C-33

This mix will produce concrete meeting the design criteria when produced, sampled and tested in accordance with ASTM C-94 and UBC.
Mix will be adjusted as required by UBC Section 905 to maintain the noted strength level.

Cementitious Material 5.00 sk.
Maximum Size Aggregate 1.5 in.
Slump See Note. in.
W/C+F ratio 0.51
Entrained Air n/a %

Code	Material	Solid Volume	SSD Quantity
1011	CEMENT TYPE II MODIFIED	1.79 cf	352 lbs
9100	BORAL FLY ASH	0.89 cf	118 lbs
1135	WATERFORD 1 1/2" X 3/4"	7.26 cf	1246 lbs
1136	WATERFORD 1" X #4	5.24 cf	900 lbs
2118	WATERFORD CONCRETE SAND	7.70 cf	1253 lbs
	Air (1.00 %)	0.27 cf	
	Water (28.8 gal.)	3.85 cf	240 lb
	Totals.	27.00 cf	. . .4109 lbs

Uses: CONCRETE PAVING.
Note: NOMINAL PENETRATION 0-1 INCH.
REPLACES REPORT 55878 MIX 29246.
Note : METRIC MIX BATCHED AND ORDERED IN POUNDS/CUBIC YARDS. ONE CUBIC YARD APPROXIMATELY 0.75 CUBIC METERS.
Note : PLEASE FORWARD STRENGTH DATA TO AMERICAN TRANSIT MIX FOR STATISTICAL ANALYSIS PER ASTM C-94 SECTION 14.4

Additions

METRIC CONVERSIONS FOR CONCRETES, MORTARS AND GROUTS

4/6/2000

FCI

Report #	56921	56922
Mix #	29733	29733

#10-0437U4 DELHI PROJECT

						Adjusted Metric Volume	Adjusted Metric Weight
Cementitious Sacks		5 00					
Material	%	Wt	Sp Gr	Volume	Volume	Volume	Weight
		lb		cf	cy	m3	kg/m3
Cement		352	3.15	1.79	0 07	0 00	0 00
Flyash		118	2 15	0 88	0.03	0 00	0 00
Waterford 1 1/2"		1246	2.75	7.26	0.27	0.27	739.22
Waterford 1"		900	2 75	5.24	0.19	0 19	533.95
Waterford Conc Sand Floats		1256	2 61	7 71	0.29	0 29	744 89
Air	1 0%			0 27	0 01	0 01	
Water	28 80	240	1 00	3.84	0.14	0 14	142.33
TOTAL		4111		27 00	1 00	0 90	2160.39
Admixture:					oz/cy	ml/m3	ml/ckg
			0 00		0	0	0.00
						0	0 00

			kg
Cement per Caltrans Class or Spec			
Cement Reduction Water Reducer			0%
Adjusted Cement Required kg			0
Cement Used			278 847
	%	kg/m3	lb/cy
Portland Cement	75%	0	352.00
Fly ash	25%	0	118.00
Total Cementitious		0 00	470

4/0 lb/cy

Order concrete by cubic yard

Abbreviations:			ConversionFactor English to Metric
cf = cubic feet			
cy = cubic yards	m3 = cubic meters		0.764555
gal = gallons	l = liters		3 785412
lb = pounds	kg = kilograms		0 453592
oz = fluid ounces	ml = milliliters		29 57353
	kg/m3		0 593276

AMERICAN TRANSIT-MIX CO., INC.

Main Office: 318 Beard Avenue, Modesto, CA 95354 Office: (209) 529-4115 FAX (209) 521-8546
Dispatch: Central Valley (209) 524-6322 - Fresno (559) 434-2200 - Bakersfield (661) 325-8814
Plants: Stockton - Tracy - Modesto - Newman - Turlock - Madera - Fresno - Bakersfield

Group 268	Mix Number 29730

1.5 2.87 SKS AIR

Report No. 56906
04/05/2000
05028702

FCI
ATTN: GREG

#10-0437U4 HIGHWAY 99
DELHI, CA

MATERIALS DESCRIPTION

CEMENT TYPE II MODIFIED ASTM C-150
WATERFORD 1 1/2" X 3/4" ASTM C-33 SIZE 4
WATERFORD 1" X #4 ASTM C-33 SIZE 57
WATERFORD CONCRETE SAND ASTM C-33
DAREX II ASTM C-260

This mix will produce concrete meeting the design criteria when produced, sampled and tested in accordance with ASTM C-94 and UBC.
Mix will be adjusted as required by UBC Section 1905 to maintain the noted strength level.

Cementitious Material 2.87 sk.
Maximum Size Aggregate 1.5 in.
Slump See Note. in.
W/C+F ratio 1.01
Entrained Air 3.00 %

Code	Material	Solid Volume	SSD Quantity
1011	CEMENT TYPE II MODIFIED	1.37 cf	270 lbs
1135	WATERFORD 1 1/2" X 3/4"	4.00 cf	687 lbs
1136	WATERFORD 1" X #4	8.01 cf	1375 lbs
2118	WATERFORD CONCRETE SAND	8.44 cf	1375 lbs
9833	DAREX II	0.00 cf	1 oz
	Air (3.00 %)	0.81 cf	
	Water (32.7 gal.)	4.37 cf	272 lb
	Totals.	27.00 cf	. . .3979 lbs

Uses: LEAN PAVING.
Note: SLUMP 25-75MM.
CORRECTED REPORT.
Note : METRIC MIX BATCHED AND ORDERED IN POUNDS/CUBIC YARDS. ONE CUBIC YARD APPROXIMATELY 0.75 CUBIC METERS.
Note : PLEASE FORWARD STRENGTH DATA TO AMERICAN TRANSIT MIX FOR STATISTICAL ANALYSIS PER ASTM C-94 SECTION 14.4
Note : ADJUST AIR ENTRAINMENT FOR WEATHER AND JOB CONDITIONS BY IMMEDIATELY REPORTING FIELD TESTING RESULTS TO THE PLANT.

[signature]	Additions

6/6

CALTRANS DISTRICT - 10 MATERIALS ENGINEERING BRANCH

1 1/2" MAX. PORTLAND CEMENT CONCRETE MIX DESIGN

new 7/93

Mix I.D. / No.: 0437U4
Use: Pavement
Designed By: G. Crowley
Checked By:

8.5 Sack Mix

Water-Cement Ratio: 0.43665

Date: 4/12/00
Resident Engineer: Pam Marquez
Contract No.: 10-0437U4
Dist. - Co. - Rte. - P.M.: 10-MER-R49.6/R58.6
Concrete Plant: Jobsite-Portable

Nominal Size	Percent Used	Specific Gravity	Aggregate Sieve Analysis - Percent Passing											
			#200	#100	#50	#30	#16	#8	#4	3/8"	3/4"	1"	1 1/2"	2"
FA #1	38%	2.61	3	7	20	41	65	80	97	100	100	100	100	100
FA #2														
CA #1	26%	2.75						1	5	22	78	95	100	100
CA #2	36%	2.75								1	5	25	92	100
CA #3														
Total	100%													
Combined Grading -->			1	3	8	16	25	31	38	44	60	72	97	100
Grading Limits 1 1/2" Max. -->			0 - 3	1 - 6	4 - 10	10 - 22	17 - 33	23 - 38	30 - 45	38 - 55	45 - 75	50 - 86	90 - 100	100
Grading Limits Check -->			O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
"X" Values -->					20	41	65			22	78	28		
"X" value Ranges -->					14-26	32-50	55-75			7-37	63-93	10-46		
"X" Value Range Check -->					O.K.	O.K.	O.K.			O.K.	O.K.	O.K.		

Aggregate Sieve Analysis and "X" Values from letter submitted by --> William C. Brown, SFA   Dated --> 2/26/99

Cement		Flyash		Water		Entrapped Air		Entrained Air				Aggregate Volume	
Lbs/CY	799	Lbs/CY	0	Lbs/CY	360	Percent	1.5%	Ounces	?	Percent	2.0%	"K" = CF	16.76

Batch Information For One Cubic Yard			
Component	Lbs *	CF	Gals.
Cement	799	4.06	
Flyash	0	0.00	
FA #1	978	6.01	
FA #2	0	0.00	
CA #1	748	4.36	
CA #2	1035	6.03	
CA #3	0	0.00	
Water	349	5.59	41.8
Entrapped Air		0.41	
Entrained Air		0.54	
Total	3909	27.00	
		O.K.	

Material Source Information			
Component	Type	Size	Source
Cement	II		California Portland Cement Company
Flyash			Boral Products
FA #1		Sand	Santa Fe Aggregates - Waterford
FA #2			
CA #1		1" X #4	Santa Fe Aggregates - Waterford
CA #2		1 1/2" X 3/4"	Santa Fe Aggregates - Waterford
CA #3			
Water			?
Air			
Admix #1			
Admix #2			

* all aggregate batch weights are S.S.D..