MI SPS-2

soil and materials
engineers, inc.

March 15, 1996

Mr. Ben Worel, P.E.
Braun Intertec, Inc.
6875 Washington Avenue South
P.O. Box 39108
Minneapolis, MN 55439

Re: Michigan SPS-2 Construction Report
FHWA-LTPP
SME Project No. PP18400

Dear Ben:

Enclosed please find three copies of the construction report for the Michigan SPS-2 project.

Should you have any questions concerning this report, please contact our office.

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC.

Cary T. Keller, P.E.
Senior Engineer

Chuck A. Gemayel, P.E.
Senior Associate

Enclosure: Construction Report: Michigan SPS-2 (3 copies)

pc: Erland Lukanen, Braun Intertec
Richard Ingberg, FHWA-LTPP
Monte Symons, FHWA-LTPP

FEDERAL HIGHWAY ADMINISTRATION
Long Term Pavement Performance
Specific Pavement Studies

DRAFT

CONSTRUCTION REPORT ON SPS-2
Michigan Department of Transportation
Federal Project No: NH 23-1(325)
Fed. Item No: HN 0043
Project No. NH 58034
Job No. 32750A

US 23 Northbound, Monroe County
Michigan

Report Prepared by:
Soil and Materials Engineers, Inc.
FHWA-LTPP North Central Region
December, 1995

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1.0 INTRODUCTION

The SHRP experimental project SPS-2, "Strategic Study of Structural Factors for Rigid Pavements" investigates the effect of selected structural factors on the long term performance of rigid pavements. In this experiment, twelve test sections with varying layer thickness, portland cement concrete (PCC) strength, base type and lane width are constructed. The SPS-2 project was constructed using the construction guidelines contained in the document "Specific Pavement Studies: Construction Guidelines for Experiment SPS-2, Strategic Study of Structural Factors for Rigid Pavements", Operational Memorandum SHRP-LTPP-OM-018 (December, 1990).

The Michigan SPS-2 project was constructed as part of the reconstruction of the northbound lanes of US-23, a four-lane divided highway, in 1993. The project is located in Monroe County, Michigan which is situated in the southeast corner of the lower peninsula of Michigan north of the border with Ohio. The location of the project in the state is shown in Fig. 1. The project was opened to traffic in November, 1993.

1.1 Project Background

Prior to reconstruction, the US-23 pavement consisted of 6 inches of asphalt concrete overlay over 9 inches of jointed reinforced concrete pavement. The concrete was placed on 4 inches of dense graded aggregate base and 12 to 18 inches of sand subbase. The pavement was experiencing severe distress in the form of joint reflection cracking and rutting.

The project involved reconstruction of 6.021 miles of pavement in both the north and southbound lanes of this divided highway. The proposal for the work included removing the existing pavement, grading, concrete pavement and shoulders, and constructing MDOT and SHRP test sections.

The project was advertised for bids in the early spring of 1992 and the construction contract was awarded soon after to Interstate Highway Construction (IHC). Construction of the southbound lanes was completed in 1992. The northbound lanes were reconstructed in 1993. The northbound traffic was rerouted to the southbound lanes.

1.2 Construction

The pavement reconstruction consisted of removal of the asphalt concrete and portland cement concrete layers and regrading and compacting the existing aggregate base. Due to disturbance of the relatively thin base layer during pavement removal and its in-place condition,

MICHIGAN

SPS-2

STRATEGIC STUDY OF STRUCTURAL FACTORS FOR RIGID PAVEMENTS

US-23 NORTHBOUND MONROE COUNTY

STRATEGIC HIGHWAY RESEARCH PROGRAM

Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	**PROJECT LOCATION DIAGRAM** **MICHIGAN SPS-2** **OTTAWA LAKE, MICHIGAN**

Figure No. 1

the scope of work was changed to include removal and replacement of the aggregate base. A new dense graded aggregate base layer was placed after compacting the existing sand subbase. A permeable base layer consisting of 4 inches of open-graded asphalt stabilized material was then placed. The permeable base used crushed recycled concrete for the aggregate and was stabilized with an asphalt emulsion. Finally, a 10.5 inch jointed reinforced concrete pavement was constructed. The project was built according to MDOT's Standard Specifications for Construction (1990) and Special Provisions in effect at that time or required by the SPS-2 construction guidelines.

The construction of the SHRP sections required the removal of the 15-/2 to 18-1/2 inches of subbase. The embankment was then constructed using fine-grained soil that was similar to the existing subgrade. The embankment clay was required to have a minimum of 60% of the material passing the No. 200 sieve and a Plasticity Index (PI) of 10 or greater. The test sections were constructed as an inlay, therefore the SHRP pavement layers were constructed only to a width of 3 feet outside the mainline pavement and not the full width of the shoulder. The existing sand subbase wedge along the outside shoulder of the undrained test sections was removed and replaced with fine-grained soil. However, the existing sand subbase wedge along the inside shoulder of all (drained and undrained) test sections was left in place.

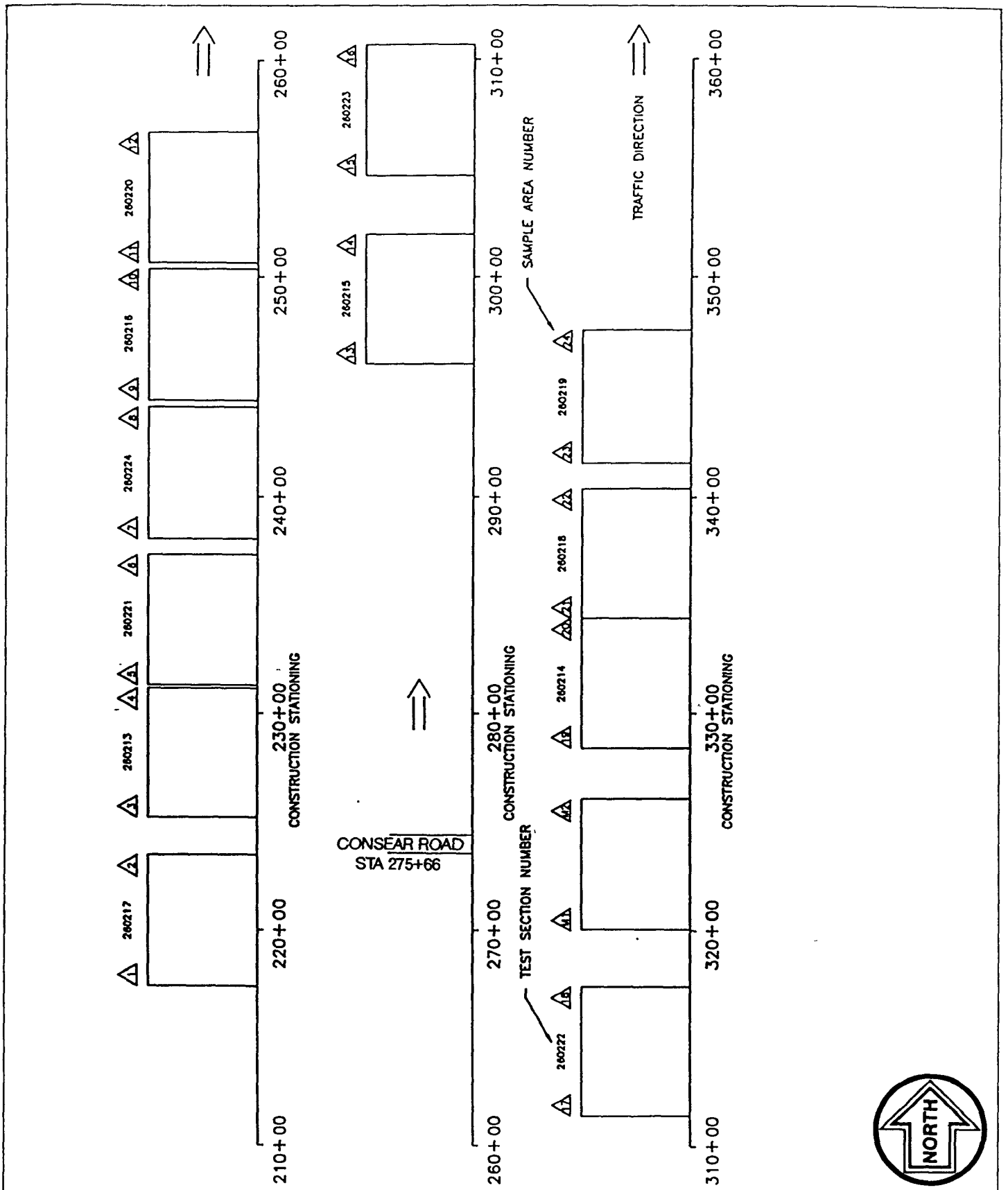
The remaining pavement layers were constructed according to the SPS-2 material and layer thickness requirements.

All test sections were constructed with asphalt concrete shoulders with the exception of the control section 260259, which had tied concrete shoulders. All test sections were sealed with low modulus silicone joint sealant (including the shoulder joint) with the exception of 260259 which had neoprene insert joint seals for the transverse joints and hot-poured rubberized asphalt sealant for the longitudinal joints.

1.3 Experimental Cell

The SPS-2 project included the primary experiment only, which is the doweled jointed plain concrete pavements experiment. This project falls into the experimental cell for pavements on fine-grained soils in the "wet-freeze" environmental zone and the test sections correspond to the K series (K1 through K12) in the experimental plan. To fulfill the requirement for a fine-grained subgrade, the existing sand subbase was removed and replaced with clay embankment similar to the existing subgrade.

The Michigan SPS-2 project incorporated the twelve SHRP test sections and a control section typical of the project reconstruction. No supplemental test sections were constructed. The layout of the test sections is provided in Figure 2.



Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	LAYOUT OF TEST SECTIONS DIAGRAM MICHIGAN SPS-2 OTTAWA LAKE, MICHIGAN

Figure No. 2

1.4 Traffic Characteristics

The SPS-2 project is located along northbound US-23, which is a divided highway, with two lanes in the northbound and southbound directions. Figure 3 displays the project location and the site topography.

The functional class of the highway is a rural principal arterial. The SPS-2 project begins north of Sterns Road (Exit 1) and is interrupted by Consear Road (Exit 3), a low-volume county road. There are six test sections located south of Consear Road and seven test sections located north of the Consear Road interchange. Design traffic data obtained from the nomination forms is as follows:

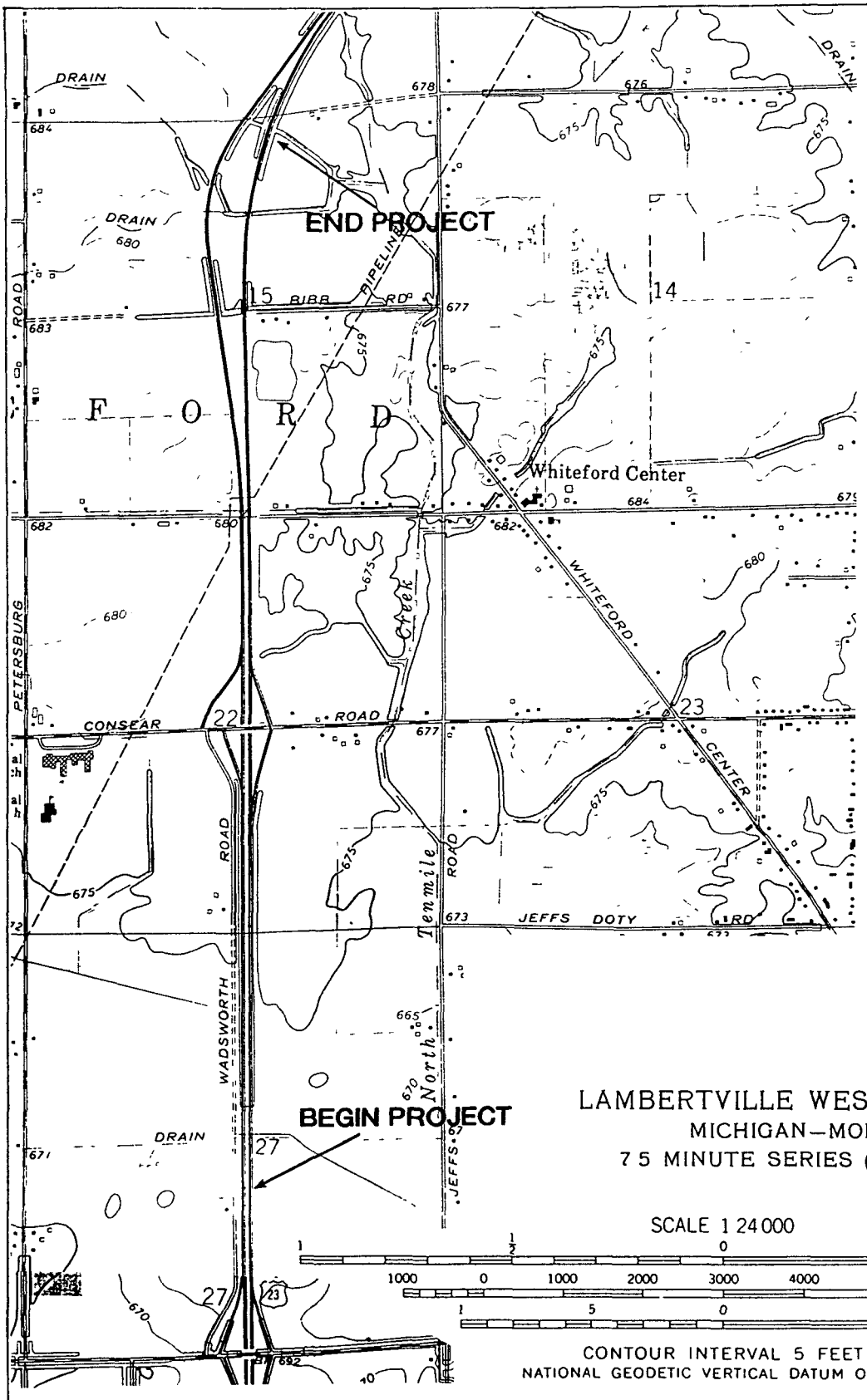
Annual Average Daily Traffic (Two Directions)	35,000 (1989)
% Heavy Trucks and Combinations (Of AADT)	22%
Estimated 18K ESAL Rate in Study Lane (1,000 ESAL/Yr)	890
Total Design 18K ESAL Applications in Design Lane *	26.6 Million
Design Period (Years)	20

* A growth rate of 4% per year was used.

Due to the presence of an interchange within the SPS-2 project, it was necessary to collect traffic data to determine the impact that the interchange would have on the flow of traffic between the two sets of test sections. Figure 4 presents the layout of the traffic counters at Consear Road while Table 1 provides the results of the traffic counts which were taken March 4 - 5, 1991. Counters were also installed along the north and southbound mainline pavement.

The ramp and mainline counts confirmed the assumption of a low traffic volume exiting or entering the highway at Consear Road. The ramp count for the northbound off-ramp averaged 157 vehicles per day (VPD) compared to the ramp count for the on-ramp which averaged 543 VPD. The mainline northbound pavement south of the interchange had a 5-day count of 14,859 VPD and had a 5-day count of 13,625 north of the interchange. The ramp volume represents about 2% - 4% of the mainline traffic. Based on these traffic counts, the test sections located south of the interchange carry a slightly higher volume of traffic than the sections north of the interchange.

Based on the traffic counts, the layout of the test sections was approved by SHRP provided there would be traffic monitoring equipment located on the north and south sides of the interchange. As a part of the reconstruction project, a weigh-in-motion (WIM) and automatic vehicle classifier (AVC) were placed south of the interchange while an AVC only was placed north of the interchange.



QUADRANGLE LOCATION

LAMBERTVILLE WEST QUADRANGLE
MICHIGAN—MONROE CO.
7 5 MINUTE SERIES (TOPOGRAPHIC)

SCALE 1 24 000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

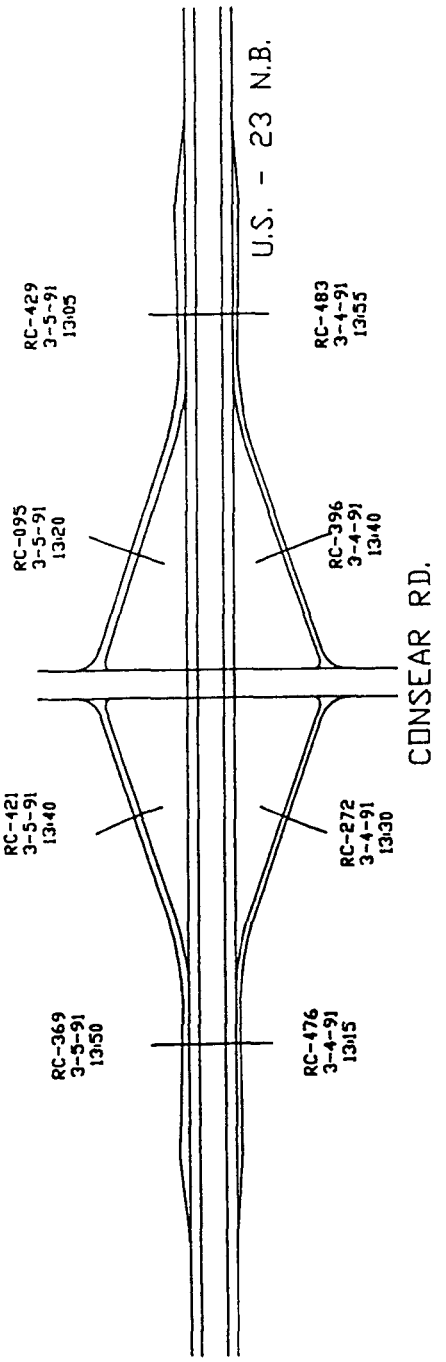
1 5 0 1 KILOMETER

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

NORTH

Date 2-29-96 Drawn By ARR Scale AS SHOWN Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	**PROJECT LIMITS AND SITE TOPOGRAPHY DIAGRAM** **MICHIGAN SPS-2** **OTTAWA LAKE, MICHIGAN**

Figure No. 3



Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	**TRAFFIC COUNTS AT CONSEAR ROAD** **MICHIGAN SPS-2** **OTTAWA LAKE, MICHIGAN**

Figure No. 4

TABLE 1

TRAFFIC COUNTS OBTAINED AT CONSEAR ROAD

LOCATION OF COUNTER	COUNTER NUMBER	DATE	TIME COUNT STARTED	TOTAL NNUMBER OF VEHICLES							5-DAY AVG	COMMENTS
				MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY		
MAINLINE N B.	RC-476	3-4-91	13:15	7129	15248	15232	15401	17893	12548	13220	14859	
OFF-RAMP N B.	RC-272	3-4-91	13 30	389	564	547	556	599	565	449	543	
ON-RAMP N B.	RC-398	3-4-91	13 40	72	164	182	175	164	162	102	157	
MAINLINE N B.	RC-483	3-4-91	13 55	6897	15098	15053	15122	17799	6526	---	13625	COUNT STOPPED AT NOON ON SATURDAY 5-DAY AVG DOES NOT INCLUDE SAT & SUN
MAINLINE S B.	RC-429	3-5-91	13 05	---	7096	14909	15341	16902	10956	11271	13876	
OFF-RAMP S B.	RC-095	3-5-91	13:20	---	94	200	202	201	194	116	183	
ON-RAMP S B.	RC-421	3-5-91	13:40	---	205	538	560	570	552	422	528	
MAINLINE S B.	RC-369	3-5-91	13 50	---	7577	17177	18656	18678	12181	12582	15855	

1.5 Test Section Geometry

Appendix A contains the plan and profile sheets within the limits of the SPS-2 project and also contains typical sections and plan notes. The terrain in which the project is situated is relatively flat and most of the test sections are located on shallow fills with the exception of the test sections at the north end of the project (260214, 260218, 260219) which are located on deeper fills. A summary of the test section layout and geometry of the highway in the areas of the test sections is provided in Table 2. Most of the test sections are located on tangents, however test section 260214 is located on the transition to a horizontal superelevation of 0.037'/ft. Test sections 260218 and 260219 which are located after 260214 are in the full superelevated section. The vertical alignment of the test sections ranges from a grade of 0.00% to +0.55%.

1.6 Summary of Known Deviations from Guidelines

The following is a bullet list of known deviations from the site location, construction, and data collection and materials sampling and testing guidelines. The SPS Project Deviation Report for the project can be found in Appendix B. The project was designed under the SPS-2 Construction Guidelines dated December, 1990. There have been numerous revisions to the construction guidelines since the latest version was published in 1993 and are the source of some of the deviations discussed. Any deviations which may impact the performance of the test sections and are not covered by SHRP documents are discussed in Section 2.2 Construction Schedule. The guidelines regarding construction practices (e. g. placement methods, compaction requirements, etc.) and materials (e. g. design strengths, gradations) were generally followed and will not be discussed unless there was some deviation from the guidelines.

Site Location Deviations:

Traffic flow over all of the test sections on the project is not uniform.

A 30" concrete culvert was located about 10-1/2 ft. below the top of pavement under test section 260224.

Construction Deviations:

Subgrade or Embankment

Moisture content of the compacted subgrade (embankment) was not maintained in the range of 85% to 120% of the optimum moisture content on test sections 260213, 260214, 260215, 260216, 260217, 260218, 260219, and 260220.

DGAB

The DGAB layer on test section 260221 segregated.

TABLE 2
MICHIGAN SPS–2 GEOMETRY

TEST SECTION	BEGIN	END	HORIZONTAL ALIGNMENT	VERTICAL ALIGNMENT
260217	217+40	223+40	TANGENT	+0 28%/0 0% P I = 219+85 72 LENGTH = 400 FT
260213	225+15	231+15	TANGENT	0 0%/0 12%/0 0% P I. = 226+80 LENGTH = 400 FT P I = 230+90 LENGTH = 400 FT
260221	231+30	237+30	TANGENT	0 0%
WIM, AVC	237+45	238+05		
260224	238+05	244+05	TANGENT	0 0%
260216	244+35	250+35	P C = 248+06 51 P I = 250+58 74 P T = 252+55 97 DELTA = 00°39'30 00" RT D = 00°10'00 82" R = 34330 48 NO SUPERELEVATION	0 0%
260220	250+65	256+65	P C = 248+06 51 P I = 250+58 74 P T = 252+55 97 DELTA = 00°39'30 00" RT D = 00°10'00 82" R = 34330 48 NO SUPERELEVATION	0 0%
CONSEAR RD (275+66 04)	257+40	294+74 04		
260215	296+00	302+00	TANGENT	0 0%
AVC	302+75	304+00		
260223	304+70	310+70	TANGENT	0 0%/+0 55% P.I. = 312+42.26 LENGTH = 800 FT.
260222	311+40	317+40	TANGENT	0 0%/+0.55% P.I. = 312+42.26 LENGTH = 800 FT.
260259	320+03	326+03	TANGENT	+0 55%
260214	328+40	334+40	P.C. = 331+64 30 P.I. = 350+88 58 P.T. = 368+77 22 DELTA = 37°07'45 00" RT D = 01°00'00 00" R = 5729.58 SUPER = 0 037'/FT. TRANS LENGTH = 270' FULL SUPER FROM 332+35 82 TO 368+05 71	+0 55%
260218	334+40	340+40	SEE CURVE DATA ABOVE	+0 55%/–0 81% P.I. = 336+76 99 LENGTH = 800 FT
260219	341+15	347+15	SEE CURVE DATA ABOVE	–0 81%/+0 08% P.I. = 350+11 LENGTH = 800 FT.

NOTES: *BEGINNING AND ENDING STATIONS ARE THE 600 FT. CONSTRUCTION LIMITS*
BEGINNING AND END STATIONS FOR CONSEAR RD. INTERCHANGE ARE FROM BEGINNING OF ON–RAMP TO END OF OFF–RAMP. THE CENTERLINE INTERSECTIONS OF THE ROADS ARE ALSO PROVIDED

Prior to paving, the surface of the DGAB was not kept uniformly moist in test sections 260213, 260214, 260215, and 260216.

PATB

Geotextile filter fabric for underdrains did not extend a minimum of 1 ft. under pavement.

Traffic was allowed to operate on the outside shoulder area of the PATB. Rutting of the PATB (1/2" to 1-3/4") occurred in all of the test sections constructed with a PATB base.

LCB

A transverse construction joint in the LCB was located within test section 260218.

The paving equipment was allowed to operate on the outside shoulder area of the LCB. Longitudinal cracking of the LCB layer was observed in test sections 260217 and 260220.

Based on the results of testing performed on samples of fresh LCB taken during field MST, the LCB sampled from test sections 260218, 260219, and 260220 had a slump lower than the SHRP lower limit of 1".

Based on the results of cores taken from before the test section, the LCB placed in section 260218 did not satisfy the thickness tolerance of +/- 1/2".

PCC

Based on the results of testing performed on samples of fresh concrete taken during field MST, the concrete sampled from test sections 260214, 260219, and 260220 had an air content lower than the lower SHRP limit of 5.0%. The concrete sampled for MST from sections 260215 and 260219 had a slump lower than the lower SHRP limit of 1".

Based on the results of laboratory testing of field made flexural beam specimens, the SHRP requirements for 550 psi and 900 psi 14 day flexural strength concrete were not satisfied.

Based on the results of cores, the PCC placed in the following test sections did not satisfy the thickness tolerance of +/- 1/4": 260213, 260214, 260217, 260218, and 260222. Test section 260259 (control) was constructed thicker than specified, however it was not required to meet the SHRP thickness tolerance.

Data Collection and Materials Sampling and Testing Guidelines Deviations:

Elevations

Elevation measurements were not taken at the required locations on the embankment layers placed early in the project.

Elevation measurements have only a fair to poor correlation with measured pavement thicknesses.

PCC

Samples of PCC representative of the mix used for test section 260259 were not taken at the test section location.

Site Location Deviations

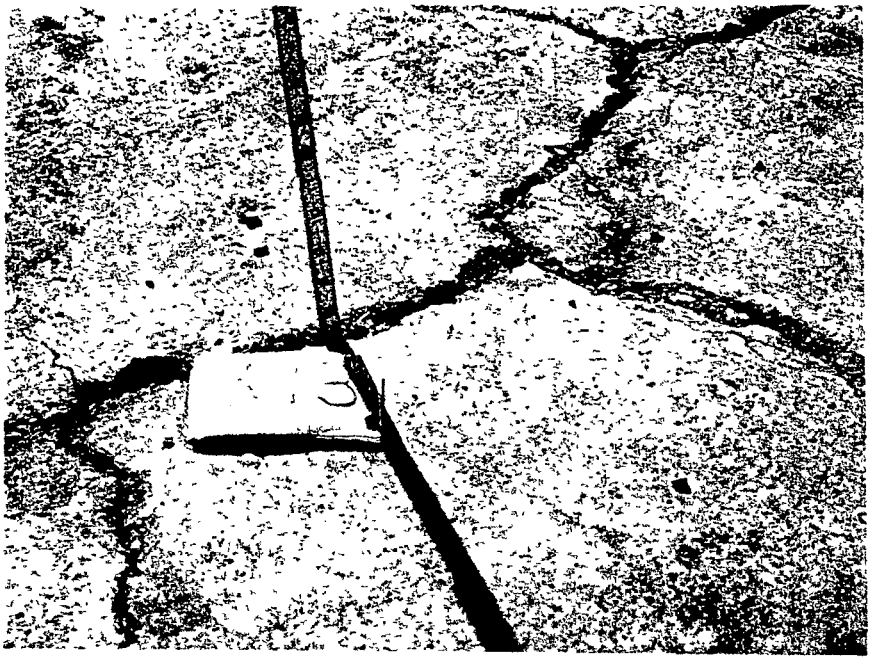
The deviation for the traffic flow was discussed previously under the traffic characteristics. The deviation was approved by SHRP during the nomination process and the guidelines were later revised to allow for differences in the traffic flow of not more than 10% between the lowest and highest trafficked test sections.

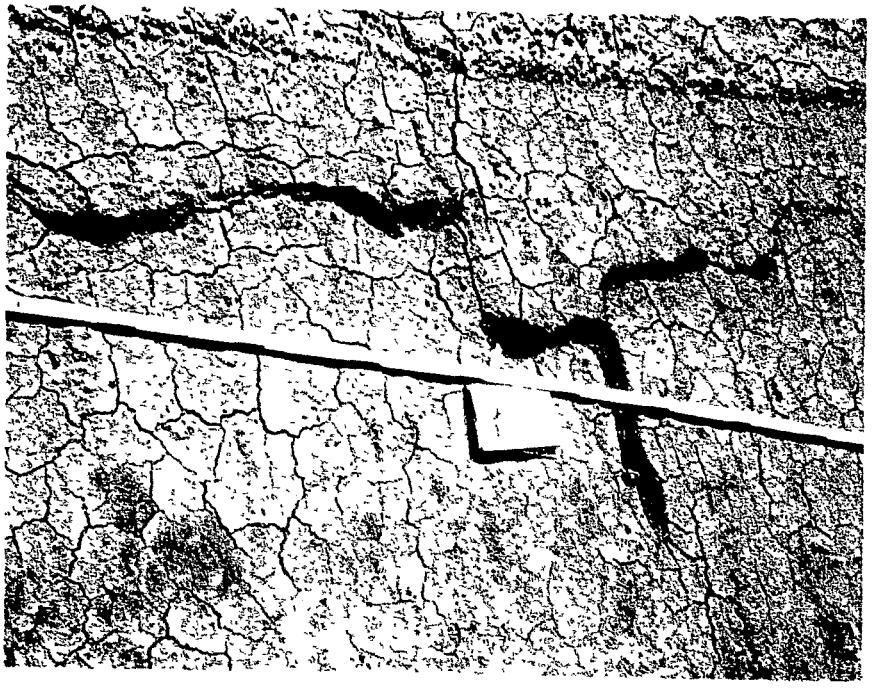
The location of a 30" concrete culvert beneath test section 260224 at Sta 2+20 was unavoidable given the site constraints. A visit to the site verified that any pavement distress in the existing pavement did not appear to be related to the presence of a culvert. Since the project involved the reconstruction of an existing roadway it was believed that all settlement associated with the drainage structure had occurred during the life of the pavement. Proofroll of the prepared embankment surface did not reveal any instability related to the culvert.

Construction Deviations

Subgrade or Embankment

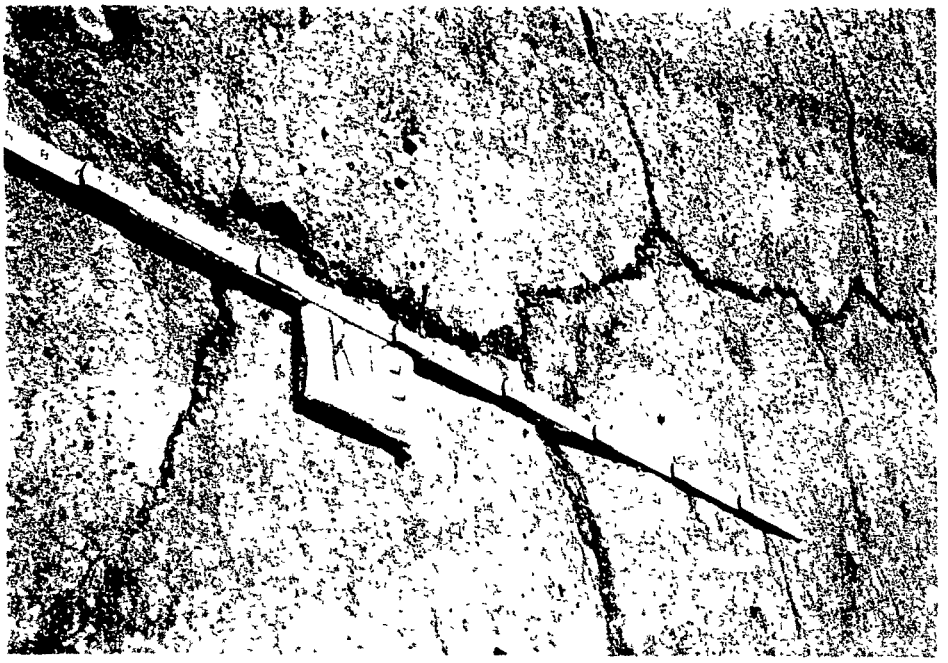
The moisture content of the compacted subgrade and embankment clay layers was within the specified 85% - 120% of optimum moisture content at the time of compaction and was generally placed at a moisture content below optimum. As a result of delays between the completion of the embankment layer and the placement of the following layer and a hot, dry summer, severe desiccation cracking of the clay occurred as the photos taken in sections 260213 and 260217 show in Figures 5A and B. The cracks ranged from 1/4 inch to 2 inches wide and from 4" to 10" deep and were less severe in test sections 260214, 260215, 260218, and 260219. This cracking may have also been related to the compaction of the clay at below optimum moisture content. Although this method produces a more stable construction platform, the material is more prone to shrinkage. All of the test sections constructed with a DGAB layer or an LCB layer were affected. The sections with a DGAB filter layer below the PATB were not affected since the DGAB was placed soon after completing the embankment layer.

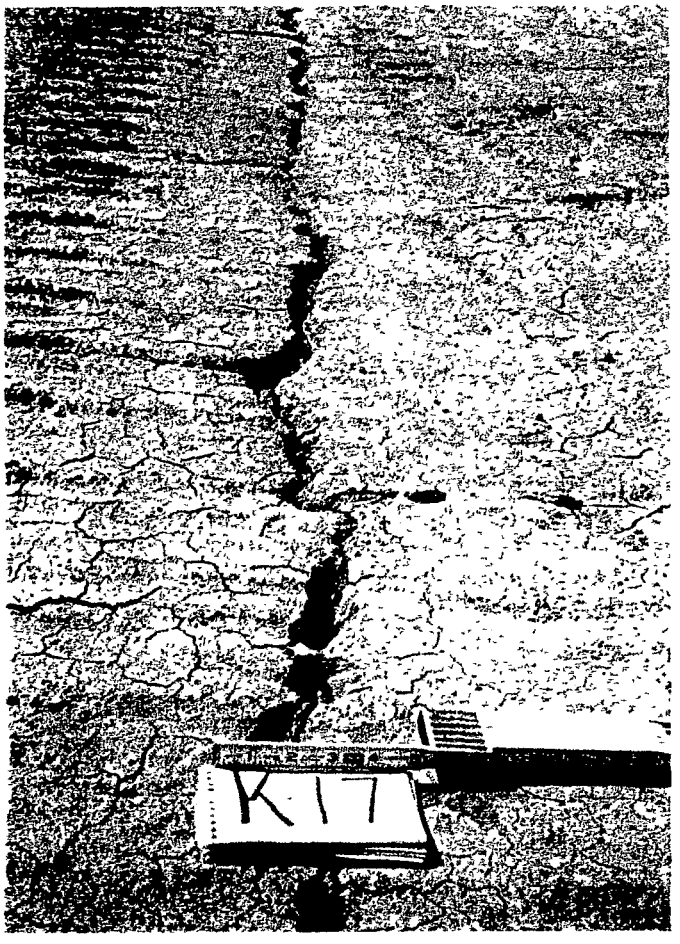




Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	**SEVERE DESSICATION CRACKING OF EMBANKMENT REQUIRING REWORKING** **MICHIGAN SPS-2** **OTTAWA LAKE, MICHIGAN**

Figure No. 5A





Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	**SEVERE DESSICATION CRACKING OF EMBANKMENT REQUIRING REWORKING** **MICHIGAN SPS-2** **OTTAWA LAKE, MICHIGAN**

Figure No. 5B

A work order was issued by MDOT which required scarifying and compacting the clay to eliminate the cracks and satisfy the compaction and moisture content requirements. Test section 260215, which had uncompacted DGAB placed on the embankment surface soon after completion of the layer, was not too badly desiccated and was not reworked. Test sections 260214, 260218, and 260219, located at the north end of the project, were not also not as severely cracked (Figures 6A and B) and the contractor was required to keep the grade moist by spraying water on the surface daily during conditions which would cause drying of the layer. Uncompacted DGAB had been placed on the first 200' of test section 260214 soon after it was completed and the remainder of the test section was not covered until August.

DGAB

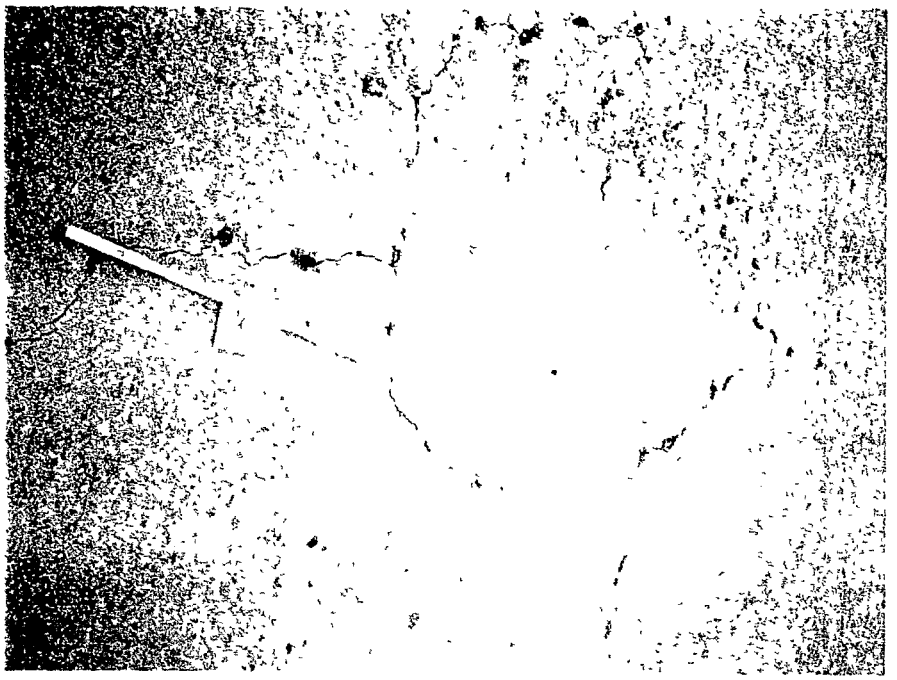
The segregation of the DGAB layer on test section 260221 was observed from Sta 0-50 to about 2+50 and was caused by finish grading of the layer following trimming by an autograder. An excess of coarse aggregate, and low moisture conditions were observed throughout this area. Density testing performed during MST at Sta 1+00 indicated the compaction criteria had not been met. MDOT was informed of these observations and directed the contractor to rework the worst affected area (Sta 0-50 to 1+00). The area was retested with satisfactory density test results although it was still somewhat segregated.

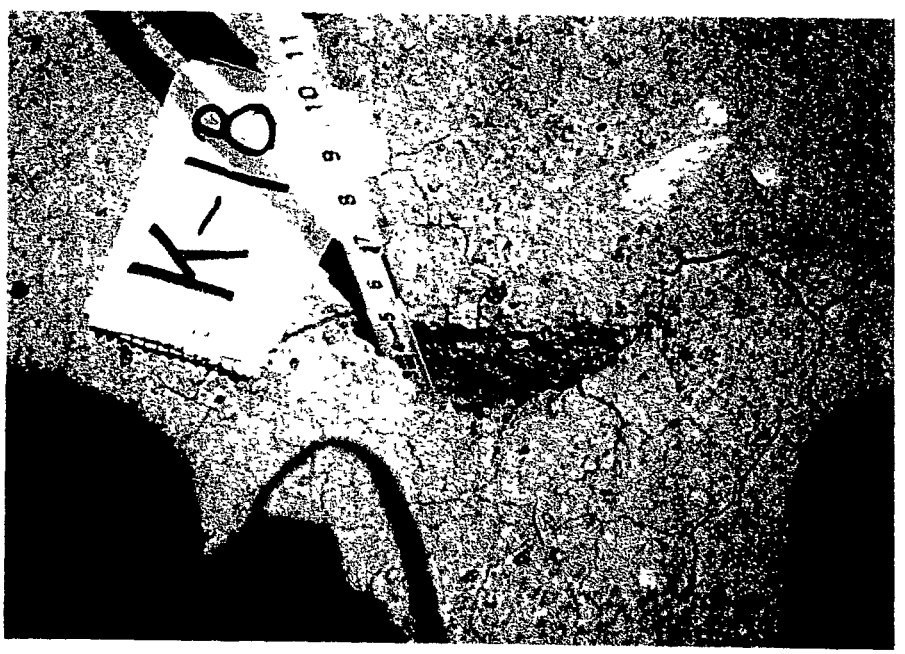
The moisture content of the DGAB layer in test sections 260214, 260215, 260216, and 260217 averaged only about 2.5% prior to placement of the PCC layer. The grade was not kept moist, nor was it moistened prior to placement of the PCC.

PATB

The December, 1993, construction guidelines required extension of the geotextile filter fabric on top of the PATB to a minimum of 1 ft. under the edge of pavement. This requirement was changed from that specified under the 1990 construction guidelines which were in effect at the time the project was designed. The fabric was not extended since the contractor had already ordered fabric which was cut to meet the dimensions required in the plans. Also, MDOT believed that there was a potential for damage of the fabric during the paving operations. Figure 7 shows the construction detail used (1990 guidelines) and the latest detail (1993 guidelines).

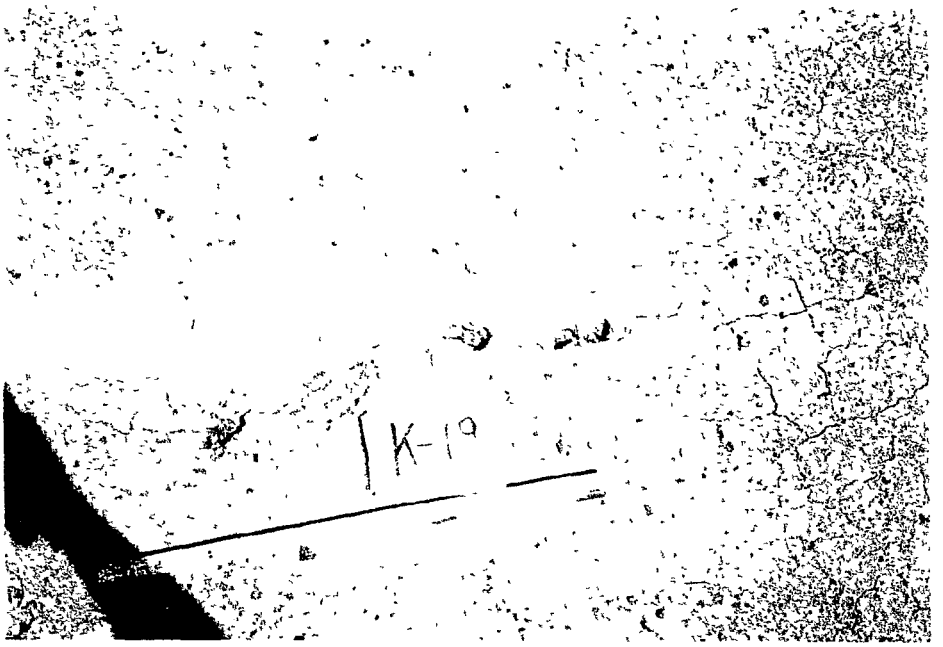
Trafficking of the outside shoulders of the PATB (the layers were placed to a distance of 3 ft. from the edge of pavement) was necessary during slipform paving operations due to site constraints imposed by the inlay reconstruction. As a result, rutting of the PATB layer occurred in the outside shoulder (1/2" to 1-3/4") throughout all of the test sections constructed with this layer. The rutting was also accompanied by some lateral displacement caused by movement of the underlying unstabilized edge drain backfill. The rutting was caused by the tracks of the slipform paving equipment and the tires of the finishing equipment. The contractor was requested to use plywood sheets under the tracks or wheels to distribute the loads. Although this was done, it did

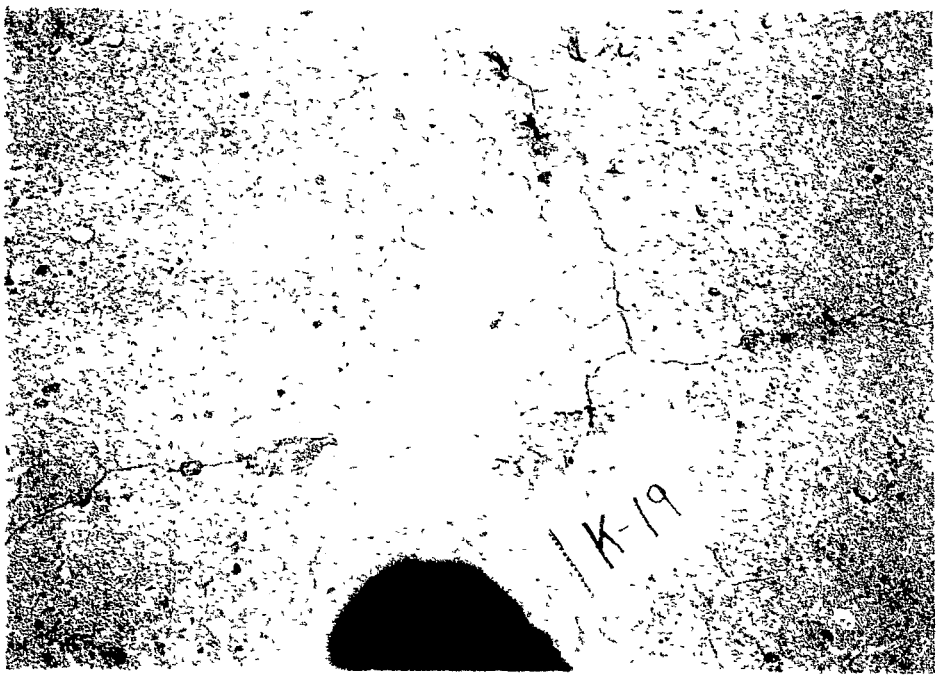




Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH– TOLEDO	soil and materials ·engineers, inc.	**MODERATE DESSICATION CRACKING OF EMBANKMENT REQUIRING RESTORATION AND MAINTENANCE OF MOISTURE** **MICHIGAN SPS-2** **OTTAWA LAKE, MICHIGAN**

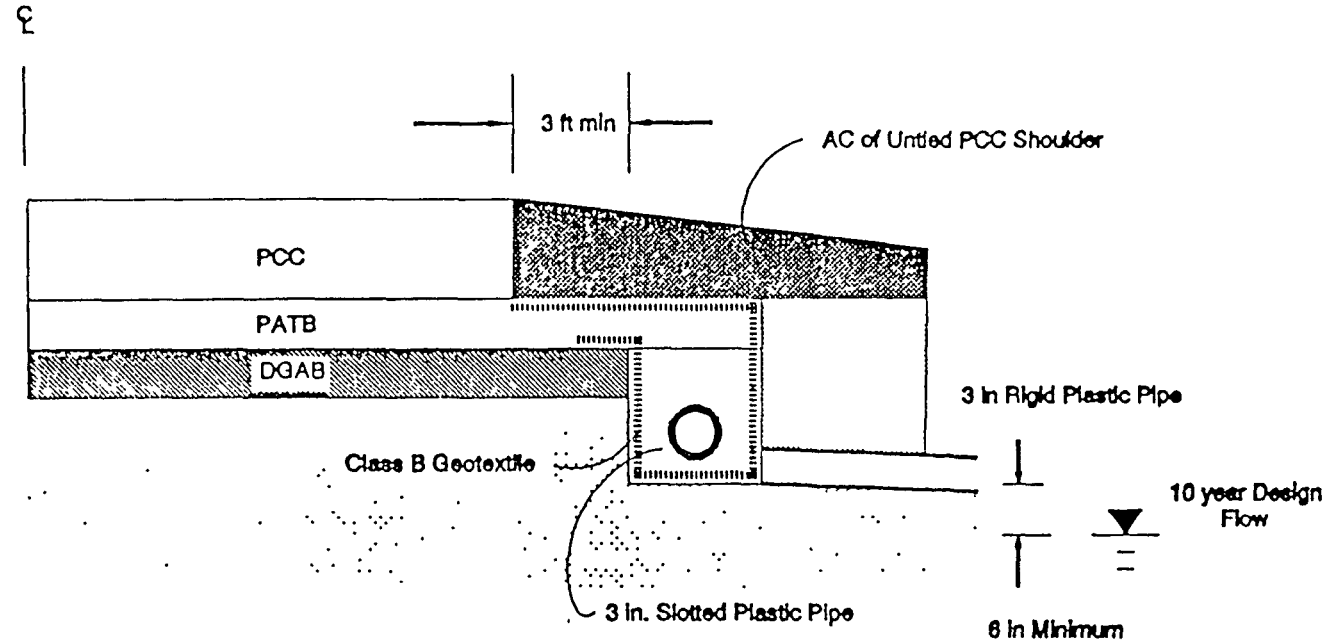
Figure No. 6A



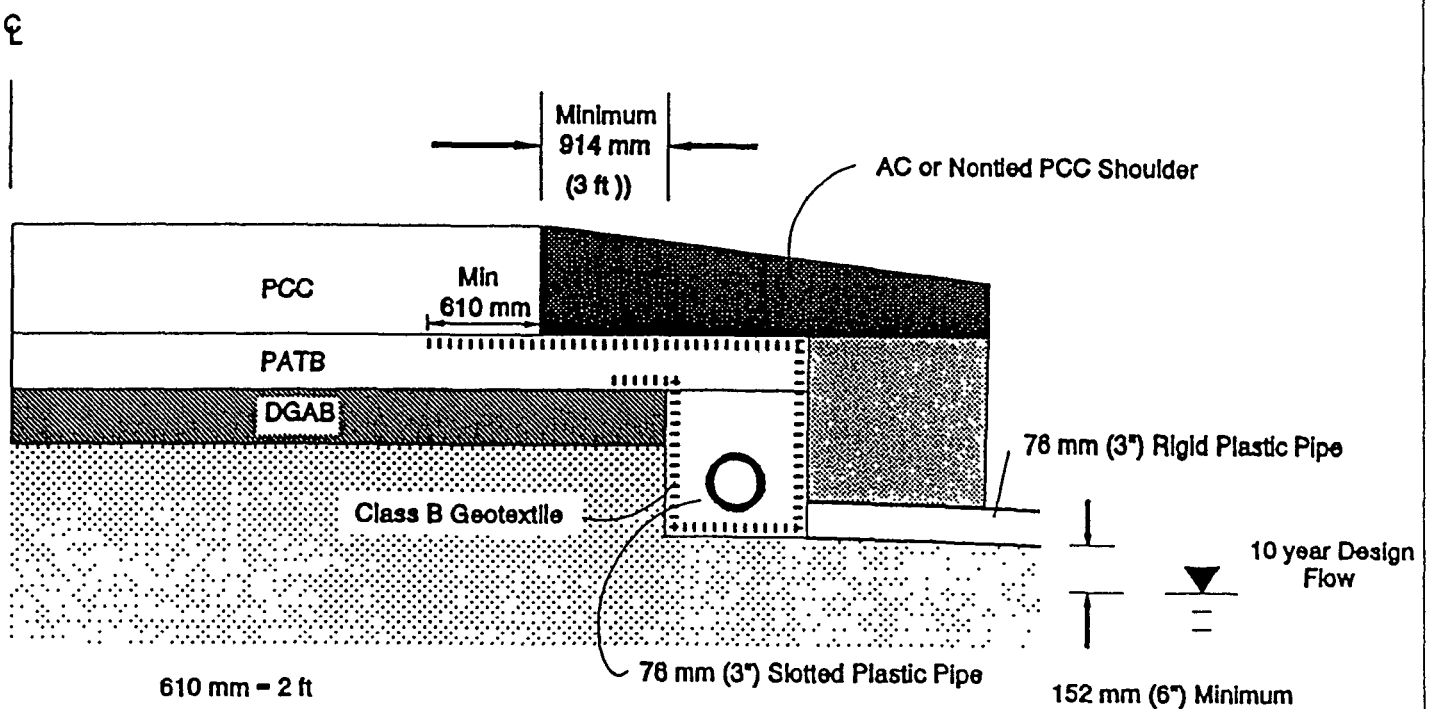


Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	**MODERATE DESSICATION CRACKING OF EMBANKMENT REQUIRING RESTORATION AND MAINTENANCE OF MOISTURE MICHIGAN SPS-2 OTTAWA LAKE, MICHIGAN**

Figure No. 6B



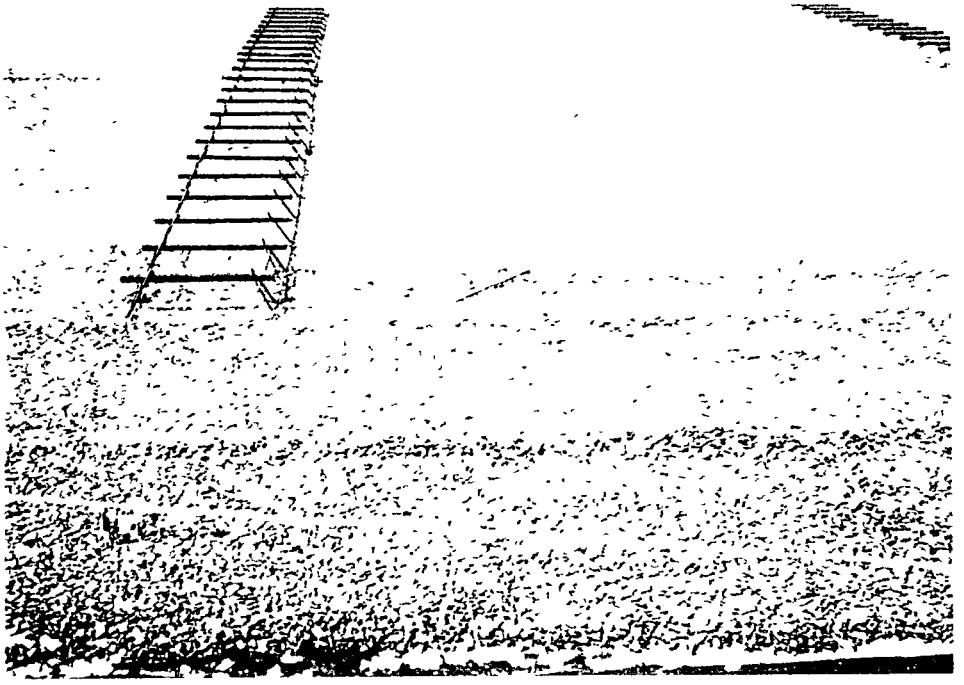
SPS-2 CONSTRUCTION GUIDELINES/DECEMBER 1990
AS-BUILT

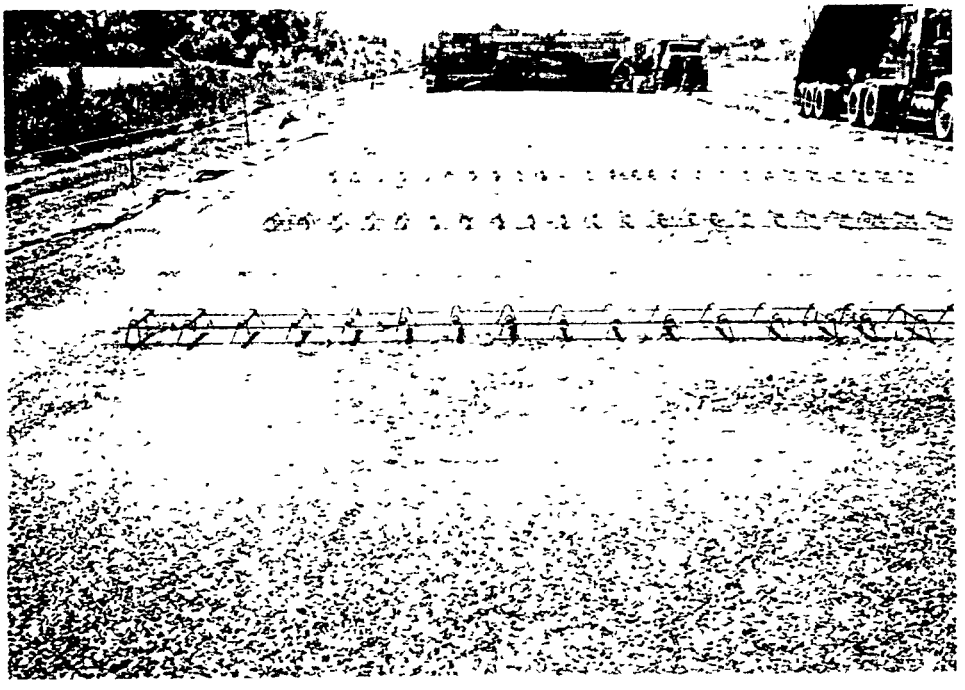


SPS-2 CONSTRUCTION GUIDELINES/REVISED DECEMBER 1993

Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	**UNDERDRAIN DETAILS AS-BUILT (ABOVE) AND REVISED MICHIGAN SPS-26 OTTAWA LAKE, MICHIGAN**

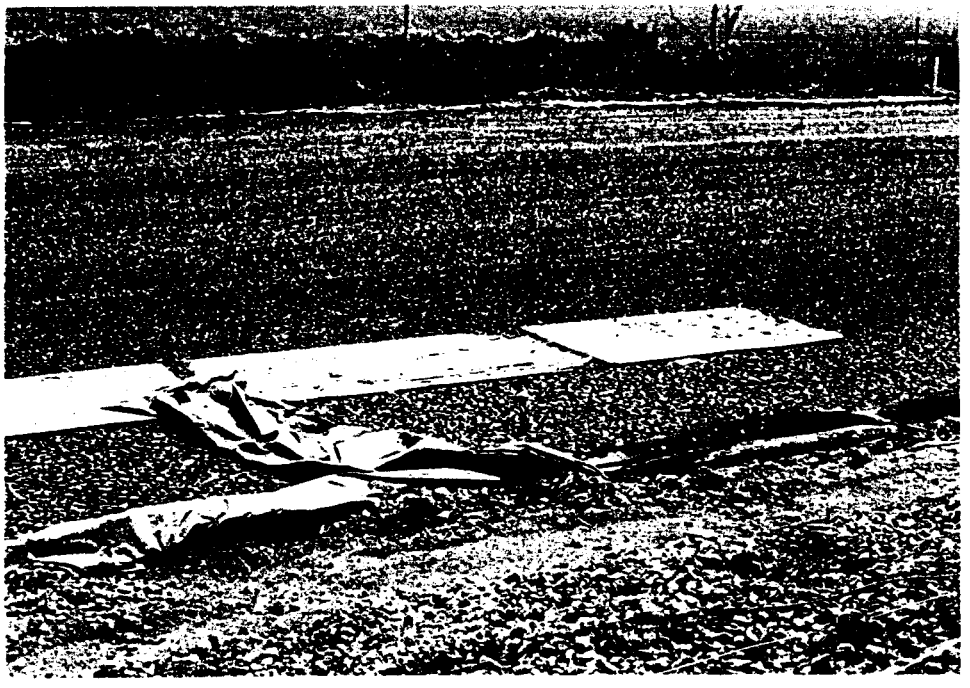
Figure No. 7





Date 2-29-96	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	**PATB RUTTING** **MICHIGAN SPS-26** **OTTAWA LAKE, MICHIGAN**
Drawn By ARR			
Scale			
Job PP 18400			

Figure No. 8A



Date 2-29-96 Drawn By Scale ARR Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials · engineers, inc.	**PATB RUTTING** **MICHIGAN SPS-26** **OTTAWA LAKE, MICHIGAN**

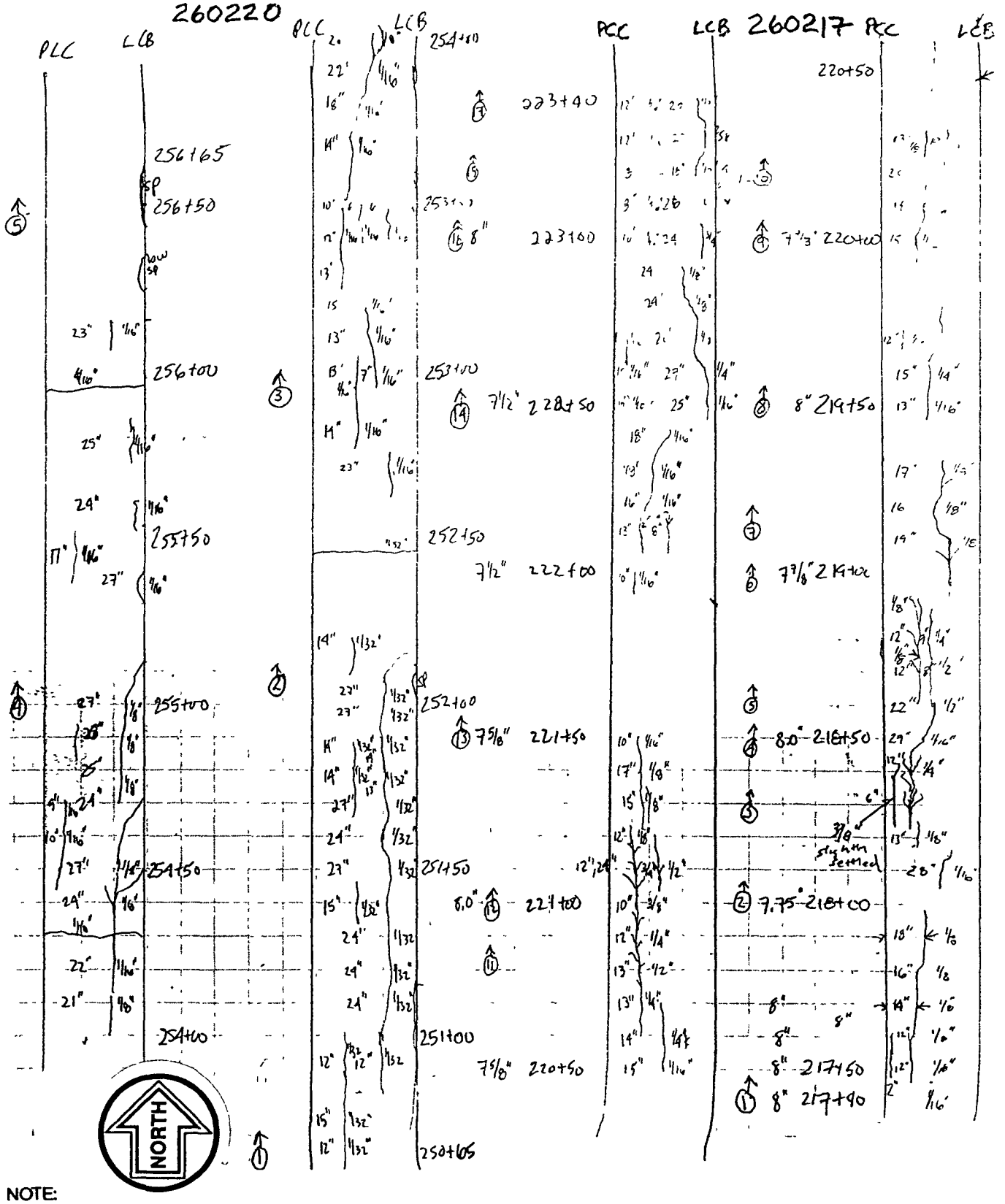
Figure No. 8B

Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	**LCB EDGE LONGITUDINAL CRACKING** **MICHIGAN SPS-26** **OTTAWA LAKE, MICHIGAN**

Figure No. 9

Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	LCB EDGE LONGITUDINAL CRACKING MICHIGAN SPS-26 OTTAWA LAKE, MICHIGAN

Figure No. 10



NOTE:
NUMBER SHOWN TO LEFT OF CRACK IS DISTANCE FROM EDGE OF PCC. NUMBER TO RIGHT IS WIDTH.
SP=SPALL PROJECT STATIONING SHOWN

Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	**SKETCHES OF LCB EDGE LONGITUDINAL CRACKING** **MICHIGAN SPS-26** **OTTAWA LAKE, MICHIGAN**

Figure No. 11

PCC

Based on the results of testing performed on samples of fresh concrete taken during field MST, test sections 260214, 260219, and 260220 had an air content lower than the lower SHRP limit of 5.0%. The air contents were 4.8%, 4.6%, and 4.5% respectively. Air content tests of hardened concrete performed on 28 day cores indicated an in-place air content of 4.7% for a core taken from test section 260221 and 3.9% for a core taken from test section 260216.

The concrete sampled for MST from sections 260215 and 260219 had a slump lower than the lower SHRP limit of 1" at 3/4" each.

Based on the results of laboratory testing of field made flexural beam specimens, the SHRP requirements for 550 psi and 900 psi 14 day flexural strength concrete were not satisfied. Presented below are the 14 day flexural strengths for concrete sampled for the MST.

Test Section	14 Day Flexural Strength (psi)	Design (psi) (1)
260213	645	525 - 575
260214	975	860 - 940
260215	585	525 - 575
260219	620	525 - 575
260220	970	860 - 940
260224	840	860 - 940

(1) Design limits of 525 - 575 were used for the specified 550 psi concrete and design limits of 860 - 940 psi were used for the specified 900 psi concrete.

The design strength limits were generally satisfied based on the laboratory mix designs. 365 day testing indicated that the flexural strengths of the "low" strength mix and the "high" strength mix were similar. The 550 psi mix had an average flexural strength of 890 psi while the 900 psi mix had an average flexural strength of 950 psi.

Presented below are the 365 day flexural strengths for concrete sampled for the MST.

Test Section	365 Day Flexural Strength (psi)	Design (psi) (1)
260213	915	525 - 575
260214	1000	860 - 940
260215	915	525 - 575
260219	835	525 - 575
260220	965	860 - 940
260224	875	860 - 940

For comparison purposes, split tensile strength (STS) testing and compressive strength testing were also conducted on field made cylinders and cores at 365 days. Presented below are the 365 day average STS and compressive strength tests results for cylinders and cores.

Design Strength (psi)	Cylinder STS (psi)	Core STS (psi)	Cylinder Comp. (psi)	Core Comp. (psi)
550	450	645	5270	6380
900	600	740	8900	8950

Presented below is a summary of the as-built thickness of concrete placed based on core measurements taken before and after each test section. The thicknesses are rounded to the nearest tenth of an inch. The deviation shown is either above or below the limits. For an 8" pavement these limits are 7-3/4" (rounded to 7.8") and 8-1/4" (rounded to 8.3"). For an 11" pavement these limits are 10-3/4" (rounded to 10.8") and 11-1/4" (rounded to 11.3"). The control section pavement was specified to be 10-1/2" thick, however the SHRP thickness tolerances were not required. Thickness measurements of the PCC at the pavement edge are provided in Appendix C.

Test Section	Average Thickness (in.)	Deviation (in.)
260213	8.4	+0.1
260214	8.9	+0.6
260217	8.5	+0.2
260218	7.1	-0.6
260222	8.5	+0.2
260259*	11.2	+0.7

It was necessary to rely upon the measured core thicknesses, since there was generally a poor correlation between the core thicknesses and the thickness obtained from the elevation measurements. In general, cores were taken from 25 ft. before and after each test section, with typical offsets from the edge of pavement of 3', 4.5', 6', 7.5', and 9'. This afforded the opportunity to determine the variation of the thickness in the transverse direction.

Table 3 presents the results of the post-construction coring program and summary statistics. Although the average thickness of the remaining sections satisfied the thickness tolerance, individual measurements may not have met the tolerance. In most cases there was a variation of the pavement thickness in a transverse direction. In some cases, the pavement nearer the centerline was thicker, in some it was thinner, and in some it was variable. There were very few instances where the thickness was uniform.

Based on the results of the thickness determinations made at the edge of the pavement within the test sections, the thickness tolerances appeared to be met. The above noted thickness difference between cores taken near the edge of pavement and those taken nearer the centerline could not be assessed.

TABLE 3. CORE THICKNESS RESULTS FOR PCC, LCB, AND PATB

Core Number	Sample Area	Core Location Begining of Monitoring Section	Test Section	Offset from Shoulder (ft)	PCC Thickness (in.)	Average Thickness Beginning/End (in.)	LCB Thickness (in.)	PATB Thickness (in.)
C1	1	0–25	260217	9.5	8.9		6.2	
C2	1	0–25	260217	8	8.7		–	
C3	1	0–25	260217	6.5	8.6		6.3	
C4	1	0–25	260217	5	8.4	8.7	–	
C5	2	5+25	260217	9.5	8.5		6.0	
C6	2	5+25	260217	8	8.4		6.0	
C7	2	5+25	260217	6.5	8.2		6.1	
C8	2	5+25	260217	5	8.1	8.3	6.3	
				AVG.	8.5		6.1	
				STD.DEV.	0.2		0.1	
C9	3	0–25	260213	9.5	8.4			
C10	3	0–25	260213	8	8.4			
C11	3	0–25	260213	6.5	8.4			
C12	3	0–25	260213	5	8.4	8.4		
C13	4	5+25	260213	11	8.5			
C14	4	5+25	260213	9.5	8.3			
C15	4	5+25	260213	8	8.5			
C16	4	5+25	260213	6.5	8.7			
C17	4	5+25	260213	5	8.6	8.5		
				AVG.	8.5			
				STD.DEV.	0.1			
C18	5	0–25	260221	9.5	8.3			
C19	5	0–25	260221	8	8.1			
C20	5	0–25	260221	6.5	8.5			
C21	5	0–25	260221	5	8.8	8.4		
C22	6	5+25	260221	9.5	7.7			
C23	6	5+25	260221	8	7.9			
C24	6	5+25	260221	6.5	7.8			
C25	6	5+25	260221	5	7.9	7.8		
				AVG.	8.1			
				STD.DEV.	0.4			

TABLE 3. CORE THICKNESS RESULTS FOR PCC, LCB, AND PATB
CONTINUED

Core Number	Sample Area	Core Location Begining of Monitoring Section	Test Section	Offset from Shoulder (ft)	PCC Thickness (in.)	Average Thickness Beginning/End (in.)	LCB Thickness (in.)	PATB Thickness (in.)
C26	7	0–25	260224	9.5	11.0			
C27	7	0–25	260224	8	11.0			
C28	7	0–25	260224	6.5	10.9			
C29	7	0–25	260224	5	10.8	10.9		
C30	8	5+25	260224	9.5	11.6			
C31	8	5+25	260224	8	11.0			
C32	8	5+25	260224	6.5	11.4			
C33	8	5+25	260224	5	11.4	11.4		
				AVG.	11.1			
				STD.DEV.	0.3			
C34	9	0–25	260216	9.5	10.7			
C35	9	0–25	260216	8	10.8			
C36	9	0–25	260216	6.5	11.6			
C37	9	0–25	260216	5	11.8	11.2		
C38	10	5+25	260216	9.5	11.4			
C39	10	5+25	260216	8	11.5			
C40	10	5+25	260216	6.5	11.3			
C41	10	5+25	260216	5	11.3	11.4		
				AVG.	11.3			
				STD.DEV.	0.4			
C42	11	0–25	260220	8	11.3		–	
C43	11	0–25	260220	10.0	–		5.8	
C43A	11	0–25	260220	6.5	11.3		6.2	
C44	11	0–25	260220	5	11.1	11.2	5.8	
C45	12	5+25	260220	10	–		5.7	
C45B	12	5+25	260220	10	11.2		5.7	
C46	12	5+25	260220	9.5	11.1		–	
C47	12	5+25	260220	8	10.8		5.6	
C48	12	5+25	260220	6.5	10.8		–	
C49	12	5+25	260220	5	10.8	10.9	–	
				AVG.	11.0		5.8	
				STD.DEV.	0.2		0.2	

TABLE 3. CORE THICKNESS RESULTS FOR PCC, LCB, AND PATB
CONTINUED

Core Number	Sample Area	Core Location Begining of Monitoring Section	Test Section	Offset from Shoulder (ft)	PCC Thickness (in.)	Average Thickness Beginning/End (in.)	LCB Thickness (in.)	PATB Thickness (in.)
C50	13	0–25	260215	7.5	11.6			
C51	13	0–25	260215	6	11.5			
C52	13	0–25	260215	4.5	11.5			
C53	13	0–25	260215	3	11.5	11.5		
C54A	14	5+26	260215	7.5	11.2			
C55	14	5+25	260215	6	10.9			
C56	14	5+25	260215	4.5	10.2			
C57	14	5+25	260215	3	11.0	10.8		
				AVG.	11.2			
				STD. DEV.	0.4			
C58	15	0–25	260223	7.5	11.8			–
C59	15	0–25	260223	6	11.4			4.0
C60	15	0–25	260223	4.5	9.8			–
C61	15	0–25	260223	3	11.3	11.1		–
C62	16	5+25	260223	9	10.7			–
C63	16	5+25	260223	7.5	11.0			–
C64	16	5+25	260223	6	11.2			–
C65	16	5+25	260223	4.5	11.2			–
C66	16	5+25	260223	3	10.9	10.9		–
				AVG.	11.0			4.0
				STD. DEV.	0.6			
C67	17	0–25	260222	7.5	8.8			–
C68	17	0–25	260222	6	9.1			–
C69	17	0–25	260222	4.5	8.5			–
C70	17	0–25	260222	3	8.6	8.8		–
C71	18	5+25	260222	7.5	8.0			–
C72	18	5+25	260222	6	8.5			–
C73	18	5+25	260222	4.5	8.3			4.0
C74	18	5+25	260222	3	7.9	8.2		–
				AVG.	8.5			4.0
				STD. DEV.	0.4			

TABLE 3. CORE THICKNESS RESULTS FOR PCC, LCB, AND PATB
CONTINUED

Core Number	Sample Area	Core Location Begining of Monitoring Section	Test Section	Offset from Shoulder (ft)	PCC Thickness (in.)	Average Thickness Beginning/End (in.)	LCB Thickness (in.)	PATB Thickness (in.)
C75	19	0–25	260214	6	9.3			
C76	19	0–25	260214	4.5	9.4			
C77	19	0–25	260214	3	9.4	9.4		
C78	20	5+25	260214	9	9.0			
C79	20	5+25	260214	7.5	8.8			
C80	20	5+25	260214	6	8.5			
C81	20	5+25	260214	4.5	8.3			
C82	20	5+25	260214	3	8.3	8.6		
				AVG.	8.9			
				STD. DEV.	0.4			
C83	21	0–25	260218	7.5	7.4		6.8	
C84	21	0–25	260218	6	7.2		6.9	
C85	21	0–25	260218	4.5	7.0		7.0	
C86	21	0–25	260218	3	6.8	7.1	–	
C87	22	5+25	260218	7.5	7.5		–	
C88	22	5+25	260218	6	7.1		–	
C89	22	5+25	260218	4.5	7.1		–	
C90	22	5+25	260218	3	6.8	7.1	–	
				AVG.	7.1		6.9	
				STD. DEV.	0.2		0.1	
C91	23	0–25	260219	7.5	11.1		6.3	
C92	23	0–25	260219	6	11.0		6.2	
C93	23	0–25	260219	4.5	10.7		6.4	
C94	23	0–25	260219	3	10.5	10.8	6.5	
C95	24	5+25	260219	10.5	11.0		6.3	
C96	24	5+25	260219	9	10.8		6.2	
C97	24	5+25	260219	7.5	10.9		–	
C98	24	5+25	260219	6	10.8		–	
C99	24	5+25	260219	4.5	10.6		–	
C100	24	5+25	260219	3	10.7		–	
C101	24	5+26	260219	7.5	–	10.8	6.3	
				AVG.	10.8		6.3	
				STD. DEV.	0.2		0.1	

TABLE 3. CORE THICKNESS RESULTS FOR PCC, LCB, AND PATB
CONTINUED

Core Number	Sample Area	Core Location Begining of Monitoring Section	Test Section	Offset from Shoulder (ft)	PCC Thickness (in.)	Average Thickness Beginning/End (in.)	LCB Thickness (in.)	PATB Thickness (in.)
MC1	M1	0−25	260259	7.5	11.8			
MC2	M1	0−25	260259	6	11.1			
MC3	M1	0−25	260259	4.5	11.2			
MC4	M1	0−25	260259	3	11.4	11.4		
MC5	M2	5+25	260259	7.5	11.0			
MC6	M2	5+25	260259	5.8	10.9			
MC7	M2	5+25	260259	4.3	11.0			
MC8	M2	5+25	260259	2.8	11.2	11.0		
				AVG.	11.2			
				STD. DEV.	0.3			

Data Collection and Materials Sampling and Testing Guidelines Deviations

Elevations

Elevation measurements were not taken at the required locations on the subgrade layers. The elevation surveys were performed by MDOT and were initially taken at 25 intervals (quarter stations) within the construction limits of each test section. Since all of the test sections with the exception of 260215 do not begin and end on a quarter, half, or full station it was necessary to interpolate the data points which were missed. To the best of our knowledge this was corrected before the embankment layers were completed. Elevation measurements were not made on the control section 260259.

The elevation measurements do not correlate well with the measured pavement thicknesses based on the cores which were taken and observations of the thickness of the PCC made at the edge of pavement. PCC and LCB cores were required to be taken in the field at various times after the completion of the layer. Although PATB cores were not required, there were some cores taken of this material as well. The thickness of each pavement layer at each test section based on the elevation measurements is provided in Appendix C as are the results of thickness measurements made at the pavement edge on 50 ft. intervals. These can be compared with the core thickness results reported in Table 3.

PCC

Due to scheduling conflicts, a sample of the concrete used in test section 260259 was not obtained. A sample of the same mix was obtained from a placement in a different location.

1.7 Automatic Weather Station

An automatic weather station (AWS) was not installed at the site at the time of construction. It will be installed during the winter of 1995 - 1996. Climatological data from the Toledo, Ohio airport, which is about 10 miles south of the site, may be used for the weather data collection period which was missed.

1.8 Traffic Data Collection Equipment

A weigh-in-motion system (WIM) and automatic vehicle classification (AVC) system was installed south of Consear Road between stations 237+45 and 238+05. An AVC only was installed north of Consear Road between stations 302+75 and 304+00 to aid in determining the difference between the traffic flows at the interchange. The WIM was a bending plate device and was manufactured by International Road Dynamics (IRD). The WIM was installed by Interstate

Highway Construction under the supervision of IRD. The WIM satisfies SHRP's traffic data collection requirements.

The AVCs consist of Diamond Class 1 piezoelectric sensors and a Diamond Tally 2001 Vehicle Classifier. Both were manufactured by Diamond Traffic Products . The AVCs were installed by Interstate Highway Construction. The original sensors at the site consisted of Dynax resistive axle sensors, however these were damaged after about a year of service and were replaced by the piezoelectric sensors.

1.9 Key Project Personnel

The Michigan DOT SHRP coordinator and LTPP contact for the project was David Church of the Materials and Technology (M & T) Division. He has since been replaced by Henry Quiroga. Mike Green of MDOT M & T was their field representative. The Michigan DOT project engineer was John T. Lavoy, P.E. and the assistant to the engineer was Curt Branham. The SPS-2 materials sampling and field testing was performed by Cary T. Keller of Soil and Materials Engineers, Inc. (SME). The laboratory testing was also performed under his supervision. The following personnel from the SHRP North Central Region were involved in this project: Richard Ingberg (Regional Engineer, FHWA-LTPP North Central Region), Gene Skok, Starr Kohn, Chuck Gemayel, Cary Keller, Rohan Perera, Eric Huff, and Sam Kandah.

A listing of the personnel, from the Michigan Department of Transportation and SHRP North Central Region who were involved in this project follows.

Michigan Department of Transportation

David Church
Mike Green
Materials and Technology (M & T) Division, MDOT
Testing and Research Building
State Secondary Complex
P.O. Box 30049
Lansing, MI 48909
(517) 322-5688

John T. Lavoy, P.E.
Curt Branham
15239 S. Monroe St.
Monroe, MI 48161

MDOT Field Inspectors

Ken Anible
Larry Beardsley
15239 S. Monroe Street
Monroe, NI 48161

FHWA-LTPP North Central Region Coordination Office

Richard Ingberg, P.E., Regional Engineer
North Central Region FHWA LTPP
6875 Washington Avenue South
P.O. Box 39108
Minneapolis, MN 55439-0108
(612) 942-3066

Eugene L. Skok, Jr., Ph.D.
Braun Intertec Corporation
6875 Washington Avenue South
P.O. Box 39108
Minneapolis, MN 55439-0108
(612) 942-3061

Starr D. Kohn, Ph.D., P.E.
Chuck A. Gemayel, P.E.
Cary T. Keller, P.E.
Rohan W. Perera, Ph.D.
Eric D. Huff, EIT
Sam N. Kandah, EIT

Soil and Materials Engineers, Inc.
43980 Plymouth Oaks Blvd.
Plymouth, MI 48170
(313) 454-9900

The general contractor for the project was Interstate Highway Construction and their project engineer was John Beard, P.E.. Their address is:

Interstate Highway Construction, Inc.
7135 South Tucson Way
P.O. Box 4356
Englewood, CO 80155

They performed the site earthwork, drainage, and concrete paving.

The subcontractor for placing the Permeable Asphalt Treated Base (PATB) was:

Gerken Materials
P.O. Box 607
Napoleon, Ohio 43545.

1.10 Summary of Construction Equipment and Activities

The following is a summary of key construction equipment used for each layer, construction sequence, and construction methods. Equipment types, plant types, manufacturer's and model numbers are provided where available. Construction was performed according to MDOT's Standard Specifications for Construction (1990) and Special Provisions in effect at that time (including project specific special provisions). The Special Provisions used for the project are contained in Appendix D. In general, the construction guidelines for the SPS-2 project were used to draft the project specifications.

Subgrade

Excavators, bulldozers, and graders were used to remove the existing sand subbase in preparation for placing the embankment clay. The prepared surface was graded and rolled with a 14 ton single drum static roller. The subgrade surface was proofrolled with a tractor drawn pneumatic tired proof roller which consisted of four pneumatic-tired wheels mounted on a rigid steel frame. The proofroller was ballasted with sand and operated at a gross load of 25 tons.

Embankment

Pan scrapers and end dump trucks were used to place the embankment clay on the subgrade which was then spread into level lifts by a bulldozer and grader. MDOT requirements limit the lift thickness to 9 inches. Compaction was performed using a 13 ton self-propelled sheepsfoot roller. The embankment surface was fine graded and trimmed to final elevation by a CMI Autograder. The embankment surface was then proofrolled with the proofroller described above.

DGAB

End dump trucks were used to place the DGAB on the embankment grade which was then spread into level lifts by a bulldozer and grader. Compaction was performed using a 14 ton single drum vibratory roller. The DGAB surface was fine graded and trimmed to final elevation by a CMI Autograder.

PATB

The surface of the DGAB was primed with MS-Op asphalt at a rate of 0.25 to 0.40 gal/sq. yd. The PATB mix was produced in a batch plant with a batch capacity of 3 tons. The material was brought to the site in 16 ton loads carried in covered end dump trucks. The trucks deposited the PATB directly into the hopper of a Barber Greene BG-225B paver. The single pass laydown width varied from 9' to 16', though most sections were paved at the 16' width. The material was compacted with 6 passes of a Galion Roll-O-Static roller with an estimated weight of 8 tons providing a compactive force of 0.5 to 1.0 tons per foot of roller width.

LCB

The LCB was batched at the IHC batch plant and delivered to the site in end dump trucks. The dump trucks deposited the LCB into the hopper of a CMI MTP-400 transport vehicle from the haul roads located off the mainline pavement. The transport conveyed the material onto the grade in front of the CMI SF 250 slip form paver. The LCB was consolidated with internal vibrators and vibrating screeds. Finishing was accomplished by machine troweling and hand troweling. The surface was not textured and wax based membrane curing compound was used for initial curing and a coat was reapplied before the placement of the PCC.

The SPS-2 construction guidelines do not address the issue of anchoring the dowel baskets to the lean concrete base. The dowel baskets were nailed to the lean concrete base and there were 3 nails per side of the dowel basket to maintain alignment of the dowel basket. Approval was obtained from LTPP for this procedure.

PCC

The PCC was batched at the IHC batch plant and delivered to the site in end dump trucks. The dump trucks deposited the PCC onto the conveyor belts of the CMI belt placer from the haul roads located off the mainline pavement. The placer spread the first layer of PCC to about 3/4 of the final depth, just above the joint dowel basket assemblies. The next layer of PCC was deposited onto the conveyor belts of the CMI 450 slipform paver. The PCC was consolidated with internal vibrators and vibrating screeds. Finishing was accomplished by machine troweling and hand troweling. The surface was first textured with a burlap drag and then was tined. A water based membrane curing compound was used for curing.

The initial sawcut for contraction joints was performed soon after placement. Since the bituminous shoulders were not placed for a few weeks after placement of the concrete, it was

observed at the pavement edge that cracks under the sawcuts did not necessarily occur under all of the joints before placement of the bituminous shoulders. The presence of cracks under contraction joints is documented below. The presence or absence of contraction joint cracks was observed in all test sections, with the exception of 260259 which had concrete shoulders placed soon after the mainline paving was completed.

Test Section	Number of Joints with Cracks
260213	11
260214	33
260215	About every 4th joint was cracked
260216	32
260217	Almost none of the joints were cracked
260218	About every 4th joint was cracked
260219	About every 4th joint was cracked
260220	33
260221	6
260222	About every 4th joint was cracked
260223	No records were kept of cracking
260224	11

The lack of cracking was probably related to the time of year that the concrete was placed, with relatively small temperature differentials between the day and night.

The joints were sealed with low modulus silicone sealant before traffic was allowed on the pavement. The asphalt concrete shoulders were constructed in October and the longitudinal shoulder joint was sealed with silicone sealant.

2.0 PROJECT DETAILS

Table 4 provides the layout of the test sections and provides pavement structure transition lengths. Table 5 provides the design features of the test sections.

2.1 As-Built Thicknesses

The as-built layer thicknesses are provided in Appendix C which provides thicknesses based on the elevation measurements performed. Table 3 (Section 1.5, Summary of Known Deviations from Guidelines) contains the results of the thicknesses of cores obtained from the project.

TABLE 4. LIMITS OF TEST SECTIONS

SHRP Designation	Test Section	Begining of Construction Limits	Begining of 600 ft Section	End of 600 ft Section	End of Construction Limits
17	260217	217+25	217+40	223+40	224+47
13	260213	224+79	225+15	231+15	231+15
21	260221	231+30	231+30	237+30	237+30
24	260224	237+45	238+05	244+05	244+05
16	260216	244+20	244+35	250+35	250+35
20	260220	250+50	250+65	256+65	256+65
15	260215	296+00	296+00	302+00	302+00
23	260223	304+70	304+70	310+70	310+70
22	260222	310+85	311+40	317+40	317+90
53*	260253	318+65	320+03	326+03	327+65
14	260214	328+40	328+40	334+40	334+40
18	260218	334+40	334+40	340+40	340+40
19	260219	340+85	341+15	347+15	347+30

* – Section Designed According to MDOT Normal Practices

TABLE 5. DESIGN FEATURES OF TEST SECTIONS

Test Section	Lane Width (ft)	PCC Flexural Strength (psi)	Layer Types and Thicknesses		
			Layer 1	Layer 2	Layer 3
260217	14	550	PCC 8"	LCB 6"	–
260213	14	550	PCC 8"	DGAB 6"	–
260221	14	550	PCC 8"	PATB 4"	DGAB 4"
260224	14	900	PCC 11"	PATB 4"	DGAB 4"
260216	14	900	PCC 11"	DGAB 6"	–
260220	14	900	PCC 11"	LCB 6"	–
260215	12	550	PCC 11"	DGAB 6"	–
260223	12	550	PCC 11"	PATB 4"	DGAB 4"
260222	12	900	PCC 8"	PATB 4"	DGAB 4"
260259*	12	550	PCC 10.5"	OGDC 4"	AGG 3"
260214	12	900	PCC 8"	DGAB 6"	–
260218	12	900	PCC 8"	LCB 6"	–
260219	12	550	PCC 11"	LCB 6"	–

NOTE:
* – Control Section

PCC – Portland Cement Concrete
LCB – Lean Concrete Base
DGAB – Dense Graded Aggregate Base
PATB – Permeable Asphalt Treated Base
AGG – Aggregate Base
OGDC – Open Graded Drainage Course

2.2 Construction Schedule

Construction began in April, 1993, with the removal of the existing asphalt concrete overlay and concrete layers. Table 6 provides the start and end dates for work items on each layer. This section discusses the general timing of the placement of the layers, and provides insight into construction problems not covered under the deviations. The core SHRP sections are only discussed.

Subgrade and Embankment

Work on the subgrade layers was completed by the middle of June and the placement and compaction of the embankment layers was completed by the end of June. The control section only required grading and compacting of the sand subbase. Undercuts of the existing subgrade were necessary in sections 260216 (3+00 - 4+15), 260222 (0-50 - 3+10), and 260223 (4+80 - 5+50) due to unstable soils revealed during the proofrolling. The undercuts extended to a depth of 1' and were about 36' wide. The undercuts were backfilled with compacted embankment borrow clay.

Areas of subgrade which should have been undercut included a small (15'x 20') area in test section 260221 near 2+50 and from 2+38 to 2+65 in test section 260224. Density testing on 260224 at 2+50 indicated the moisture content was well above optimum and the density requirements were not met.

During the materials sampling and testing, the splitspoon sample taken in section 260224 at 1+00 encountered a layer of clay with considerable organic content at a depth of 36 inches below the top of embankment. This layer was also encountered at 2+50, however it had a lower organic content.

All embankment layers were completed by August 10, 1993.

DGAB

The construction of the DGAB layers for the undrained sections was delayed after the embankment was completed (except for the placement of an uncompacted layer placed on 260215 and from 0+00 to 2+00 on 260214) until August. The months of July and August were very hot and had very little precipitation. During that time, the embankment clay dried out and desiccation cracks formed. After a work order was issued by MDOT (Figure 12), the embankment was reworked (scarified, watered, recompacted - 260213, 260216; watered - 260214, 260215) in an attempt to return it back to its original moisture content but this met with limited success. The DGAB layers in the undrained sections with the exception of 260216 were completed by the middle of August. Section 260216 was exposed for a month from August to September before it was covered with concrete. The DGAB on all undrained test sections was very dry prior to paving.

TABLE 6
PLACEMENT DATES FOR LAYERS

	SUBGRADE	SUBGRADE	EMBANKMENT	*EMBANKMENT	DGAB	DGAB	PATB	PATB	LCB	LCB	PCC
	START	END	START	END	START	END	START	END	START	END	START/END
260213	1-Jun-93	15-Jun-93	15-Jun-93	9-Aug-93	10-Aug-93	10-Aug-93					19-Sep-93
260214	14-May-93	22-May-93	22-May-93	10-Aug-93	**10-Jul-93	25-Aug-93					13-Sep-93
260215	17-May-93	22-May-93	16-Jun-93	25-Jun-93	***29-Jun-93	11-Aug-93					13-Sep-93
260216	14-May-93	3-Jun-93	3-Jun-93	9-Aug-93	10-Aug-93	10-Sep-93					21-Sep-93
260217	1-Jun-93	3-Jun-93	17-Jun-93	5-Aug-93					9-Sep-93	9-Sep-93	19-Sep-93
260218	14-May-93	22-May-93	22-May-93	10-Aug-93					16-Aug-93	26-Aug-93	13-Sep-93
260219	14-May-93	22-May-93	14-Jun-93	10-Aug-93					16-Aug-93	16-Aug-93	15-Sep-93
260220	14-May-93	2-Jun-93	3-Jun-93	9-Aug-93					10-Sep-93	10-Sep-93	21-Sep-93
260221	14-May-93	2-Jun-93	15-Jun-93	28-Jun-93	14-Jul-93	15-Jul-93	21-Jul-93	21-Jul-93			19-Sep-93
260222	13-May-93	26-May-93	26-May-93	28-May-93	13-Jun-93	15-Jul-93	16-Jul-93	16-Jul-93			13-Sep-93
260223	17-May-93	26-May-93	26-May-93	28-Jun-93	1-Jul-93	15-Jul-93	16-Jul-93	16-Jul-93			13-Sep-93
260224	14-May-93	2-Jun-93	3-Jun-93	29-Jun-93	29-Jul-93	29-Jul-93	17-Jul-93	17-Jul-93			21-Sep-93
260259			****18-May-93	4-Jun-93	4-Jun-93	4-Jun-93	18-Jun-93	18-Jun-93			21-Aug-93

NOTES:
* End dates for embankments on sections 260213,14,16,17,18,19, and 20 reflect the date of approval for placement of the next layer.
** Uncompacted DGAB was placed on embankment from station 0+50 to 2+00. The remainder of the material was placed about 5-Aug -93.
*** Uncompacted DGAB was placed on embankment throughout the test section. It was compacted and ready for the next layer on 11-Aug -93.
**** Embankment layer is existing subbase. Subgrade was not exposed during reconstruction.

1137 (2/86)

WORK ORDER

FILE 102-2

DISTRIBUTION Original — Contractor
2nd — District Field Engineer
3rd — Project Engineer
4th & 5th — Lansing Construction Engineer

*Indicate extra items of work with asterisk.

NO 015

CONTROL SECTION NO	JOB NO	FED NO
NH 58034	32750A	NH23-1(325)

CONTRACTOR
INTERSTATE HIGHWAY CONSTRUCTION CO.

SUBJECT:
ORDER CONTRACTOR TO CORRECT CLAY EMBANKMENT GRADE IN SHRP SECTIONS, K-17, K-13, K-16, K-20, K-15, K-14, K-18, AND K-19.

THE ABOVE SECTIONS CONTAIN DESSICATION CRACKS DISPERSED RANDOMLY THROUGHOUT AT APPROXIMATE DEPTHS OF 4' TO 10". CORRECT CRACKS BY SCARIFYING AND COMPACTING CLAY EMBANKMENT TO ELIMINATE CRACKS RELATIVE TO SPECIAL PROVISION FOR EMBANKMENT. SPEC. PG. 118-119.

CONTRACTOR SHALL MAINTAIN CLAY PER STANDARD SPECIFICATIONS 3.01.06, 3.01.07, 3.01.08 AND 4.50.05 AND ABOVE SPECIAL PROVISION TO PROVIDE CORRECT SUBGRADE WITH DENSITY AND MOISTURE CONTENT FOR PLACEMENT OF SUBSEQUENT PAVEMENT STRUCTURE LAYERS. ALL OF ABOVE WORK SHALL BE ACCOMPLISHED AT NO ADDITIONAL COST PER ABOVE SPECIFICATIONS. CONTRACTOR SHALL FOLLOW ABOVE PROCEDURES FOR SUBSEQUENT PROPOSED AND EXISTING PAVEMENT LAYERS (EG. 4" AND 6" DGAB) AS REQUIRED. DISCUSSED WITH DAVE CHURCH, (M&T) AND S.M.E..

EXTRA*

		ANTITY	UNIT	UNIT PRICE	COST
				NO CHANGE	
				EXT. COST	

CONTRACTOR DATE

PROJECT/RESIDENT ENGINEER DATE

John Lyday 7/20/96

John Lyday

Date 2-29-96 Drawn By ARR Scale Job PP 18400	BAY CITY KALAMAZOO LANSING PLYMOUTH TOLEDO	soil and materials engineers, inc.	WORK ORDER TO CORRECT EMBANKMENT DESSICATION MICHIGAN SPS-26 OTTAWA LAKE, MICHIGAN

Figure No. 12

The DGAB for the drained pavement sections was started at the end of May or June and was completed around the middle to the end of July.

All DGAB layers were completed by September 10, 1993.

PATB

The PATB layer was placed on the DGAB soon after its completion. Difficulties were encountered during the paving of section 260221 where rutting developed from 0-15 to 0+15 near the inner wheelpath and from 0-02 to 0+15 in the outer wheelpath. Several dump trucks had trafficked the area while lining up to supply the paver and caused ruts ranging from 1/2" to 2" deep. The rutted areas were graded off and rolled, but were still unstable.

Large quantities of PATB were rejected on 7/16/93 during the paving of 260222 and 260223 because the material was not coated with enough asphalt and appeared dusty and dry. The contractor was reported to have problems maintaining the required elevation because the paver was not using a stringline.

All PATB layers were completed by July 21, 1993.

LCB

The construction of the LCB layers was delayed after the embankment was completed (see comments . The months of July and August were very hot and had very little precipitation. During that time, the embankment clay dried out and desiccation cracks formed as previously discussed.

The LCB was placed between August and the middle of September on a very dry grade which was not moistened prior to paving. The LCB developed transverse shrinkage cracks soon after it was placed. Table 7 provides the location of the cracks for each test section with the exception of test section 260217.

The LCB surface was milled at the centerline longitudinal construction joint (between placements for the inside and outside lanes) and in several locations within the driving lane in the first 200' of test section 260218. The surface grooves were filled with grout and wax based curing compound was reapplied to prevent bonding with the PCC.

Bonding of the LCB and PCC was observed in 2 cores taken in test section 260217. There was no bonding reported in the other cores taken.

All LCB layers were completed by September 10, 1994.

PCC

Concrete paving operations began on September 13th and ended on September 21st with the exception of the control section 260259 which was paved on August 21st. The slump of the concrete placed ranged from 3/4" to 1" and the air contents averaged about 6% except at the locations noted earlier as construction deviations. Delivered concrete temperatures generally ranged from the mid 60s to the mid 70s. The weather at the time of placement was sunny with air

TABLE 7
LCB TRANSVERSE CRACKING

TEST SECTION	LOCATION	TEST SECTION	LOCATION
260218	0+40	260220	0+34
	0+78		1+32
	1+25		2+38
	1+72		3+15
	2+35		3+80
	2+82		4+78
	3+43	260217	(SEE NOTE)
	3+71		
	4+31		
	4+72		
	5+24		
	5+62		
260219	0−24		
	0+03		
	0+89		
	1+62		
	2+09		
	2+44		
	3+01		
	3+61		
	4+06		
	4+37		
	4+94		
	5+23		

NOTE: CRACK LOCATIONS NOT RECORDED. ABOUT 6 CRACKS IN 500 FT

temperatures generally in the mid 50s to mid 70s. However, there was a brief rain period during the placement on September 21st while paving section 260224. The rain began while the paving train was near 2+45 and ended when it was near 3+50. There was no noticeable effect on the finished surface of the concrete.

Observations of the transverse joints and sealants indicated that many of the transverse joints appeared to have been sawn with a slight skew on the order of 1 to 2 inches in 12 feet. The sealant was also observed to be recessed about 1/8" to 1/4" below the pavement surface.

2.3 LCB and PCC Mix Designs

Mix designs for the PCC mixtures were carried out by Bowser Morner Engineers located in Toledo, Ohio, for Interstate Highway Construction to obtain flexural strengths of 550 psi and 900 psi at 14 days (according to ASTM C78, third point loading) . They also performed the mix designs for the control section concrete which required a 14 day flexural strength of 600 psi. The approved mix designs for the 550 psi, 900 psi, and control PCC mixtures are shown in Tables 8, 9, and 10 respectively. Appendix E contains information related to the mix design such as aggregate absorptions, specific gravities, gradations, etc.

Table 8

550 PSI:

Cement	Medusa Type I	376 lbs.
Fine Aggregate	Bundy Sand & Gravel 2NS	1485 lbs. (SSD)
Coarse Aggregate	France Stone 6AA	1827 lbs. (SSD)
Water		211 lbs.
Air	Master Bldrs. MB - VR	1.0 oz/cwt
WRDA	Master Bldrs. Pozz 220N	3.0 oz/cwt
Total		3899 lbs

Table 9

900 PSI:

Cement	Medusa Type I	750 lbs.
Fine Aggregate	Bundy Sand & Gravel 2NS	1370 lbs. (SSD)
Coarse Aggregate	France Stone 6AA	1605 lbs. (SSD)
Water		285 lbs.
Air	Master Bldrs. MB - VR	1.7 oz/cwt
WRDA	Master Bldrs. Pozz 220N	3.0 oz/cwt
Total		4010 lbs

Table 10

State Mix 600 PSI:

Cement	Medusa Type I	451 lbs.
Fly Ash Class F	U.S. Ash, Avon Lake	113 lbs.
Fine Aggregate	Bundy Sand & Gravel 2NS	1278 lbs. (SSD)
Coarse Aggregate	Michigan Stone 6AA	1915 lbs. (SSD)
Water		290 lbs.
Air	Master Bldrs. MB - VR	3.0 oz/cwt
WRDA	Master Bldrs. Pozz 220N	3.0 oz/cwt
Total		4010 lbs

The original mix design for the lean concrete base was also performed by Bowser Morner. The field adjusted mix for the lean concrete base (compression strength of between 500 and 750 psi at 7 days) is shown in Table 11. Refer to Appendix E for additional mix design information.

Table 11

LCB

Cement	Medusa Type I	165 lbs.
Fine Aggregate	Bundy Sand & Gravel 2NS	1370 lbs. (SSD)
Coarse Aggregate	France Stone 6AA	1605 lbs. (SSD)
Water		285 lbs.
Air	Master Bldrs. MB - VR	1.7 oz/cwt
WRDA	Master Bldrs. Pozz 220N	3.0 oz/cwt
Total		4010 lbs

2.4 PATB Mix Design

The recommendations contained in the construction guidelines related to gradation and target asphalt content were used. Table 12 provides the mix design used for the project. The mix was not tested for vapor/moisture susceptibility.

Table 12

PATB Mix Design

Sieve Size	Percent Passing
1-1/2 in.	100
1 in.	95 - 100
1/2 in.	25 - 60
No. 4	0 - 10
No. 8	0 - 5
No. 200	0 - 2
Target Asphalt Content = 2 to 2.5%	

2.5 Materials Sampling and Testing

The materials sampling and testing (MST) requirements contained in the document "Specific Pavement Studies Materials Sampling and Testing Requirements for Experiment SPS-2 Strategic Study of Structural Factors for Rigid Pavements (Operational Memorandum No. SHRP-LTPP-OM-022) dated April, 1991, were used to develop a sampling and testing plan for the project. Plans and soil borings from the original construction were used and were supplemented with additional soil borings which were taken by MDOT to develop the MST plan. The original MST plan for the project was developed by Soil and Materials Engineers (SME), Inc. and was dated November, 1992. It was revised in April, 1993, and the final as-sampled plan was dated March 23, 1995. A copy of the MST plan can be obtained from the North Central Region office. The locations for field materials sampling and testing for each pavement layer in the test sections are summarized in Appendix F, Fig. 2 and Fig. 16 - 21. Appendix F also contains the following summary tables.

Table	Topic
3	Summary of Overall Sampling Requirements
4	Summary of Field Testing
5	Summary of Laboratory Tests on Subgrade, Embankment, DGAB, Subbase, PATBs
6	Laboratory Tests on Samples Molded in the Field
7	Laboratory Tests on Cores from LCB and PCC

Field Sampling and Testing

The sampling and testing were conducted in general accordance with the SHRP protocols. The field sampling and testing was conducted by Soil and Materials Engineers, Inc. (SME) with the exception of the 365 day cores which were taken by MDOT. Deviations to the sampling and testing requirements included obtaining split spoon samples to substitute for shelby tube samples which could not be obtained from the subgrade due to its hard nature and the presence of gravel and cobble size material.

The results of the field sampling and testing were forwarded to the North Central Region office in Minneapolis, Minnesota. In general, test results which indicated non-compliance with the project specifications have already been discussed as construction deviations. The results of testing on the fresh concrete and lean concrete base are provided in Table 13.

FWD Testing

FWD testing was conducted by SME on all layers except the surface layer of PCC which was tested by the North Central Region FWD. Testing was conducted on all pavement layers in the core experiment with the exception of the subgrade and the embankment on 260214 from sta 2+00 to 5+00. The subgrade, subbase, and DGAB on the state control section 260259 also were not tested. The subgrade in the control section was never exposed to allow for testing. Uncompacted DGAB was placed on the first 200' of 260214 immediately after the embankment was completed and before the testing could be performed. The subbase sand in 260259 was too unstable and was easily displaced by the FWD. For this reason, testing on the relatively thin (3") DGAB layer also was not performed.

Testing was performed along the center of the lane and along the outer wheel path as described in the SHRP Protocol P59. FWD testing on the layers placed before the PCC was performed using a Dynatest Model 8081 Heavy Falling Weight Deflectometer. Excessive deflections (>60 mils) or variances were encountered at the lower load levels at some locations on the embankment layers, the DGAB (especially on the thinner layers encountered on the drainable base sections and in areas where the deflections on the embankment layer were high), and on testing on the PATB due to its easily displaceable nature (imprints of the load plate were observed at some locations).

FWD testing was generally performed after approval of the layer and immediately before placement of the next layer. Due to the long delays associated with the completion of the embankment layer and the successive layer on some of the test sections discussed earlier, retesting was required on test sections 260213 and 260214. The remaining test sections which were reworked or required restoration and maintenance of the surface moisture were not tested until immediately before placement of the successive layer.

TABLE 13

PCC AND LCB FIELD TEST RESULTS

TEST SECTION	LAYER	AIR CONTENT (%)	SLUMP (IN.)	UNIT WT.(PCF)	YIELD	CEMENT FACTOR	CONCRETE TEMP. (°F)	AIR TEMP. (°F)
260213	PCC	6.1	1.0	146.6	27.0	4.00	62	60
260214	PCC	4.8	1.0	147.8	27.1	7.95	72	79
260215	PCC	5.2	0.8	148.0	26.5	4.08	64	72
260218	LCB	6.0	0.5	143.2	26.8	1.78	81	92
260219	LCB	6.0	0.5	143.2	27.3	1.75	80	83
	PCC	4.6	0.8	148.1	26.9	4.01	62	50
260220	LCB	6.0	0.8				64	66
	PCC	4.5	1.0	148.4	27.1	7.96	72	56
260224	PCC	5.0	1.0	148.3	26.9	8.00	68	54
260259	PCC	4.9	1.3	146.1	26.9	5.96	58	47

NOTES: 1) UNIT WEIGHT, YIELD, AND CEMENT FACTOR CALCULATED FROM BATCH WEIGHTS TAKEN FROM LOAD TICKETS AND MAY NOT AGREE WITH MIX DESIGN QUANTITIES DUE TO SLIGHT DIFFERENCES BETWEEN INDIVIDUAL BATCH WEIGHTS AND MIX DESIGN WEIGHTS
2) CEMENT FACTOR FOR TEST SECTION 260259 BASED ON WEIGHT OF CEMENT AND FLY ASH

Plate Load Bearing Testing

Static Plate Load Bearing testing (SHRP Protocol P58) was conducted on the prepared embankment surface on three of the test sections with a DGAB base (260213, 260214, 260215) and on three of the test sections with a LCB base (260217, 260219, 260220). Testing was also conducted on the DGAB layer at the above locations. Tables 17 and 22 in Appendix F provide the locations for the plate load bearing tests. Testing of the PATB was required under the 1991 guidelines but was later dropped and this testing was not conducted. The testing was performed in general accordance with SHRP Protocol P58.

The results of the plate load bearing testing are provided in Table 14. Due to the variable nature of the embankment which contained gravel and cobble sized material and the timing of the testing (immediately after placement of layer, after layer had been reworked, etc.) there was a poor correlation between the test locations at the same location. Comments which may help to explain this variability are provided in Table 13.

Laboratory Testing

The laboratory test plan for the samples obtained from each pavement layer is summarized in Tables 5, 6, and 7 in Appendix F. All laboratory testing was performed by Soil and Materials Engineers Inc., except for the following tests:

1. Static modulus of elasticity of PCC cores, air content of hardened PCC, and all tests on 365 day cores. 365 day testing of LCB. These tests were performed by the MDOT.

2. Resilient modulus tests of subgrade, embankment, and DGAB. The necessary samples were forwarded to the FHWA-LTPP contractor (Braun Intertec, Inc.)

3. Coefficient of thermal expansion of concrete. Samples were forwarded to the FHWA.

There were no samples shipped to the Materials Reference Library since there was no requirement at that time for their sampling.

Some of the results of the laboratory testing performed by SME and MDOT have already been discussed, especially those indicating non-compliance with the project specifications. The results of the laboratory testing performed by SME and MDOT were forwarded to the North Central Region office in Minneapolis, Minnesota.

Based on a review of the PCC laboratory test results on cylinders and cores from both ends of the test section, the strength of the concrete placed in test section 260219 is well below that of the remaining test sections constructed with the 550 psi concrete.

2.6 Profile Index

The profile index, as determined from California type profilograph traces, of the PCC surface for the different sections are summarized below in Table 15. The profilograph testing and

TABLE 14

PLATE LOAD BEARING TEST RESULTS

TEST SECTION	LAYER	AVERAGE TOTAL DEFLECTION (IN.)	UNCORRECTED MODULUS OF SOIL REACTION (PSI/IN.)	CORRECTED MODULUS OF SOIL REACTION (PSI/IN.)
260213	EMBANKMENT	0.032	315	275
	DGAB	0.036	280	250
260214	EMBANKMENT	0.069	145	145
	DGAB	0.015	655	480
260215	EMBANKMENT	0.035	285	255
	DGAB	0.051	195	180
260217	EMBANKMENT	0.039	255	230
260219	EMBANKMENT	0.020	500	390
260220	EMBANKMENT	0.024	415	340

NOTES:
1) TESTS ON 260213, 260217, 260220 TAKEN ON SURFACE OF REWORKED EMBANKMENT
2) TEST ON 260214 TAKEN ON EMBANKMENT IMMEDIATELY AFTER PLACEMENT BEFORE THE LAYER STARTED DRYING OUT. TEST ON DGAB TAKEN ABOVE EMBANKMENT WHICH HAD DRIED OUT AND REQUIRED RESTORATION AND MAINTENANCE OF SURFACE MOISTURE
3) TEST ON 260215 TAKEN ON EMBANKMENT IMMEDIATELY AFTER PLACEMENT AND BEFORE LAYER OF UNCOMPACTED DGAB WAS PLACED.
4) TEST ON 260219 TAKEN ON SURFACE OF EMBANKMENT WHICH HAD DRIED OUT AND THEN REQUIRED RESTORATION AND MAINTENANCE OF SURFACE MOISTURE

trace reduction was performed by Interstate Highway Construction. All sections satisfied the SHRP requirement of a profile index of less than 10 inches per mile. Diamond grinding of 260213 was necessary to remove a must-grind bump, the location of the grinding is provided in the table.

Table 15

California Profilograph Results

Test Section	Profile Index (in.)
260213	2 (Note 1)
260214	2
260215	2
260216	0
260217	2
260218	2
260219	2
260220	0
260221	1
260222	1
260223	1
260224	1
260259	1

Notes: 1) Diamond grinding performed from 0+00 to 0+30 from 10' to 14' from edge of pavement.

2.7 Initial Performance

Condition surveys and FWD testing were performed on the pavement immediately following opening to traffic in December, 1993. There were no distresses observed at that time. The results of the condition surveys were forwarded to the North Central Region office in Minneapolis, Minnesota.

The site was visited again in December, 1994 and June, 1995. Summary letters documenting the condition of the test sections are contained in Appendix G. The following is a brief summary of the significant items observed:

1994

1) Longitudinal joint seal damage of the lane/shoulder joint extended the entire length of each test section with the exception of 260221, 260213, and 260224 which only had isolated joint seal damage. Test section 260259, which has tied concrete shoulders, was not exhibiting this distress.

2) Pumping of the longitudinal joint was observed in test sections 260213, 260215, 260216, 260220, and 260224.

3) Transverse joint sealant damage was occurring in test section 260214.

4) Some mid-panel transverse cracks, corner breaks, and longitudinal cracks were observed in test section 260218. Evidence of pumping and faulting was observed at some of the cracks. Longitudinal cracks over the dowel bars were observed at some joints.

1995

1) Longitudinal joint seal damage of the lane/shoulder joint extended the entire length of each test section, with the exception of 260259.

2) Pumping of the longitudinal joint and some transverse joints was observed in most of the undrained test sections constructed with a DGAB base and on all of the test sections with a LCB base. There was no pumping observed at the time of the condition survey on 260216 and on 260221 - 260224 which were constructed with a PATB base.

3) Some transverse joint sealant damage was occurring in several of the test sections ranging from a low of 0% of the total length of the joints (30% of the test sections) to a high of 8.4% on 260214. According to the LTPP Distress Identification Manual, joint seal damage is rated as low if less than 10% damage is observed.

4) Test section 260218 is experiencing some structural distress. Table 16 provides a breakdown of the distresses.

Table 16

MAJOR DISTRESS QUANTITIES ON SECTION 260218

SEVERITY	TRANSVERSE CRACKING (NO. OF CRACKS)	LONGITUDINAL CRACKING (LENGTH (METERS)	CORNER BREAKS (NO. OF BREAKS)
LOW	4	16.5	2
MEDIUM	7	3.3	1
HIGH	1	0	0

The quantities provided above are in addition to the large amount of pumping observed at the longitudinal shoulder joint. Evidence of pumping was observed at several of the transverse cracks and faulting of 2 to 5 mm was recorded. Some of the low severity longitudinal cracking observed was related to cracks occurring over the dowel bars and were most pronounced in the slabs which also had the transverse cracking and corner breaks.

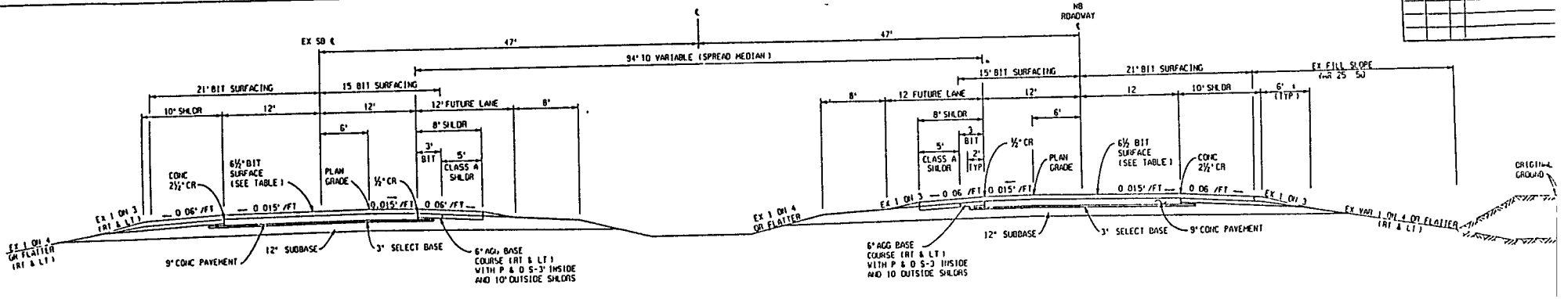
The longitudinal joint seal failure described above occurred soon after construction and began as a small crack with some light spalling in the asphalt concrete adjacent to the sealant. It has since deteriorated from two winters of freeze/thaw action to its present condition.

The amount and severity of pumping at the site has increased since it was first observed in 1994. The drained base sections performed better than the undrained sections, although there was some evidence of pumping within the drained base sections in the 1994 survey. The most severe pumping occurred on the thinner (8 in.) test sections constructed on LCB and it was reduced in the thicker pavements due to the reduced stresses. The effect of water on the pumping is accentuated on test sections 260218 and 260219 which are located on a superelevated section which drains toward the outside shoulder and thus has twice the amount of water entering the pavement structure. Fines from the LCB were observed at the longitudinal joint and it appears that the LCB may be deteriorating.

APPENDIX A

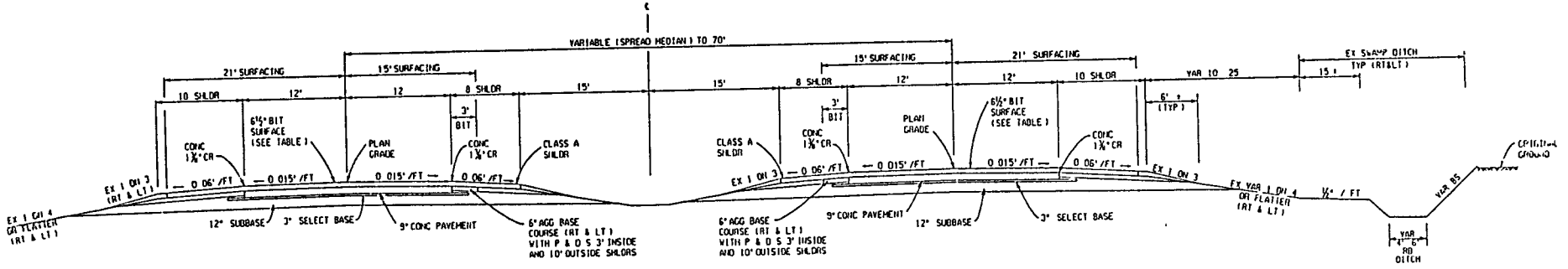
PLAN, PROFILE, TYPICAL SECTIONS

AUTH	DATE	NO	REVISION



EXISTING DUAL FREEWAY
SECTION TO APPLY:

STA 118+01.01 (POB) TO STA 326+98.98 NB ROWY
STA 118+01.01 (POB) TO STA 330+60.94 SB ROWY



EXISTING DUAL FREEWAY
SECTION TO APPLY:

STA 327+58.98 TO STA 435+00 NB ROWY
STA 331+20.94 TO STA 435+00 SB ROWY

NOTE:

THE FOLLOWING INFORMATION DENOTES THE PROPERTIES OF THE EXISTING BIT-41 JOB OVERLAY AS THEY WERE CALLED FOR WHEN CONSTRUCTED

A) TOP COURSE - 1¾' 20AA MODIFIED (>60% CRUSHED) @ 5 6% BITUMINOUS
B) LEVEL COURSE - 1¾' 20AA MODIFIED (>60% CRUSHED) @ 5 12 BITUMINOUS
C) BASE COURSE - 2' 20C @ 5 0% BITUMINOUS
D) SEPARATION COURSE - 2' 20C @ 3 5% BITUMINOUS W/15% RAP

EXISTING SURFACING TABLE

BIT BOND COAT @ 0 10 GAL PER SYD - MAX
BIT SEPARATION COURSE EST @ 440 LBS PER SYD (4' THICK)
85 100 ASPH PEN - PLACE IN TWO COURSES (36 WIDTH)
BIT BOND COAT @ 0 05 GAL PER SYD - USE BETWEEN SURFACING COURSES
HIGH STABILITY BIT SURFACE MIXTURE NO 11 @ 270 LBS PER SYD (2½ THICK) 85 100 ASPH PEN TWO COURSED (36' WIDTH)

THE CONTRACTOR SHALL BE AWARE THAT THIS INFORMATION DOES NOT GUARANTEE THE CONTENTS AND MDOT DOES NOT ACCEPT RESPONSIBILITY FOR ANY DEVIATIONS RATHER, THIS INFORMATION IS PROVIDED TO ASSIST THE CONTRACTOR IN DETERMINING THE FEASIBILITY OF REUSE THE CONTRACTOR SHALL BE RESPONSIBLE TO DETERMINE WHETHER EXISTING BITUMINOUS MATERIAL IS SUITABLE FOR REUSE IN MEETING THE SPECIFICATIONS REQUIRED ON THIS PROJECT.

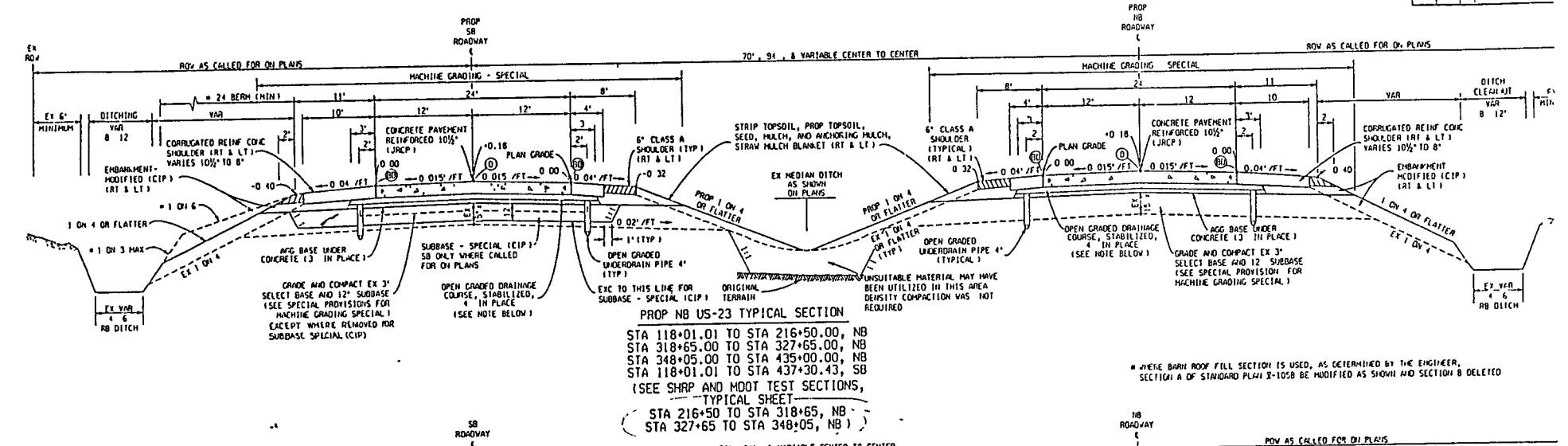
NOTES:

1. P & O S MEANS PRIME AND DOUBLE SEAL AND WAS USED TO STABILIZE GRAVEL SHOULDERS WITH A SPRAYED ON PETROLEUM BASE TAR

2 MEDIAN WIDTHS ARE AS FOLLOWS:
94 FROM STA 118 01 01 TO STA 304+60,
VARIABLE FROM 94 TO 510 TO 70 FROM
STA 304+60 TO STA 369+04 42 AND
70 FROM STA 369+04 42 TO EOE

3 EXISTING SUPERELEVATIONS
FOR THE NB CURVES ARE AS FOLLOWS:

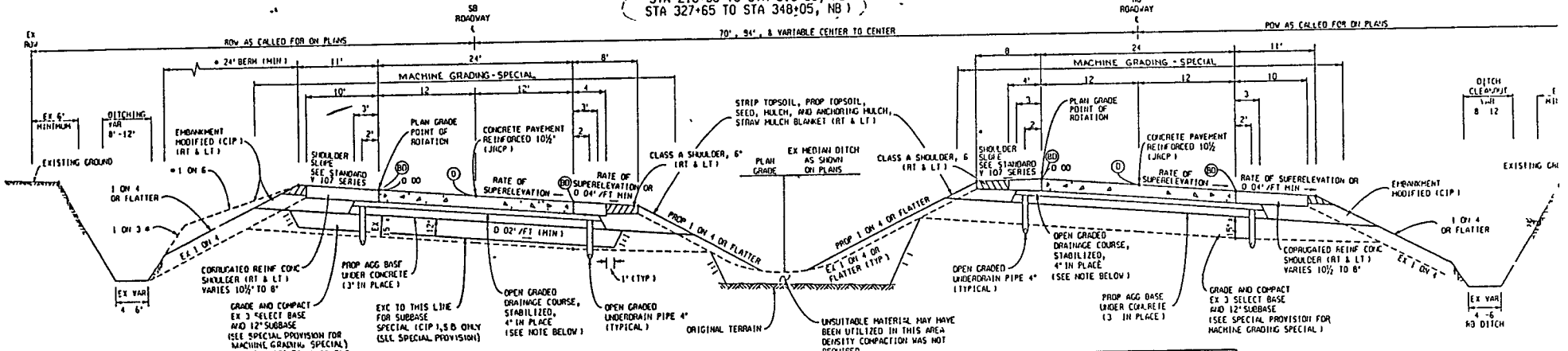
0 02 /FT FROM	STA 126+71 21 TO STA 149+27 50
	STA 157+39 62 TO STA 179+89 93
	STA 248+26 15 TO STA 252 21 15
	STA 288+40 07 TO STA 296 90 07
	STA 331+63 56 TO STA 368+76 58
0 04 /FT FROM	STA 398 07 73 TO STA 422 56 06
	STA 472+47 90 TO STA 494+24 38



PROP NB US-23 TYPICAL SECTION

STA 118+01.01 TO STA 216+50.00, NB
STA 318+65.00 TO STA 327+65.00, NB
STA 348+05.00 TO STA 435+00.00, NB
STA 118+01.01 TO STA 437+30.43, SB
(SEE SHRP AND MOOT TEST SECTIONS, TYPICAL SHEET
STA 216+50 TO STA 318+65, NB
STA 327+65 TO STA 348+05, NB)

* WHERE BARN ROOF FILL SECTION IS USED, AS DETERMINED BY THE ENGINEER, SECTION A OF STANDARD PLAN X-105B BE MODIFIED AS SHOWN AND SECTION B DELETED



PROP NB US-23 TYPICAL SECTION
SUPERELEVATED SECTION

STA 118+01.01 TO STA 216+50.00, NB
STA 348+05.00 TO STA 435+00.00, NB
STA 118+01.01 TO STA 437+30 43, SB
(SEE SHRP AND MOOT TEST SECTIONS, TYPICAL FOR MATERIAL AND BASE MODIFICATIONS, STA 216+50 TO STA 348+05, NB)

NOTES (CONT'D)

ALL SODDED SLOPES AND DITCHES SHALL BE FERTILIZED AND SEEDED IN ACCORDANCE WITH SECTION 6 53 OF THE 1990 STANDARD SPECIFICATIONS.

THE OPEN GRADED UNDERDRAIN SHALL NOT BE WRAPPED WITH GEOTEXTILE.

ONLY "I" CONNECTIONS SHALL BE USED BETWEEN OPEN GRADED UNDERDRAINS AND UNDERDRAIN OUTLETS

VARIABLE BACKSLOPE IS DEFINED AS A VARYING SLOPE FROM BACK OF DITCH TO A POINT 6 INCHES INSIDE THE R O W LINE THIS SLOPE IS VARIABLE FROM A 1 ON 6 MINIMUM TO A 1 ON 2 MAXIMUM

AN ADDITIONAL LINE OF OPEN GRADED UNDERDRAIN PIPE, 4" SHALL BE PLACED 2 OUTSIDE THE EDGE OF METAL OF FULL WIDTH ACCELERATION AND DECELERATION LANES FROM THE START OF THE SHOULDER TRANSITION TO A POINT AT THE BEGINNING OR ENDING OF TAPER

TAPER OUTSIDE CONCRETE SHOULDERS TO 8" THICKNESS MINIMUM, AS DIRECTED BY THE ENGINEER

THE DEPTH OF THE EXISTING BASE AND SUBBASE MAY VARY FROM

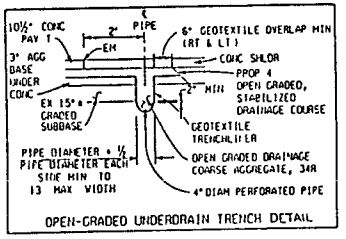
FOR DITCHES, OTHER THAN SHOWN ON THESE TYPICALS, SEE STANDARD PLAN V 105 SERIES

ALL UNSODDED SLOPES AND DITCHES SHALL BE MULCHED AT THE RATE OF 3 TONS PER ACRE, UNLESS EXCELSIOR MULCH BLANKET IS PLACED

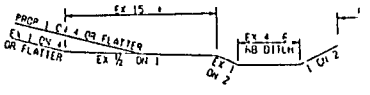
TRUCKS WILL NOT BE PERMITTED TO DRIVE ON THE OPEN GRADED DRAINAGE COURSE

IF CONTRACTOR CHOOSES THE PORTLAND CEMENT OPTION, A 6" DIAMETER OPEN GRADED UNDERDRAIN PIPE WILL BE REQUIRED THE INCREASE IN THE OPEN GRADED UNDERDRAIN PIPE WILL NOT BE PAID FOR SEPARATELY, BUT WILL BE INCLUDED IN THE PAY ITEM OF "OPEN GRADED DRAINAGE COURSE, 4" IN PLACE " FOR EITHER OPTION THE UNDERDRAIN PIPE WILL BE MEASURED AND PAID FOR SEPARATELY AS "OPEN GRADED UNDERDRAIN PIPE, 4 IN ACCORDANCE WITH SECTION 6 02 10 OF THE 1990 STANDARD SPECIFICATION

*SPECIAL AGGREGATE MIXES OF CONCRETE ON SB WILL BE REQUIRED (GROUPS A E), AS SHOWN ON PLANS AND IN PROPOSAL



OPEN-GRADED UNDERDRAIN TRENCH DETAIL



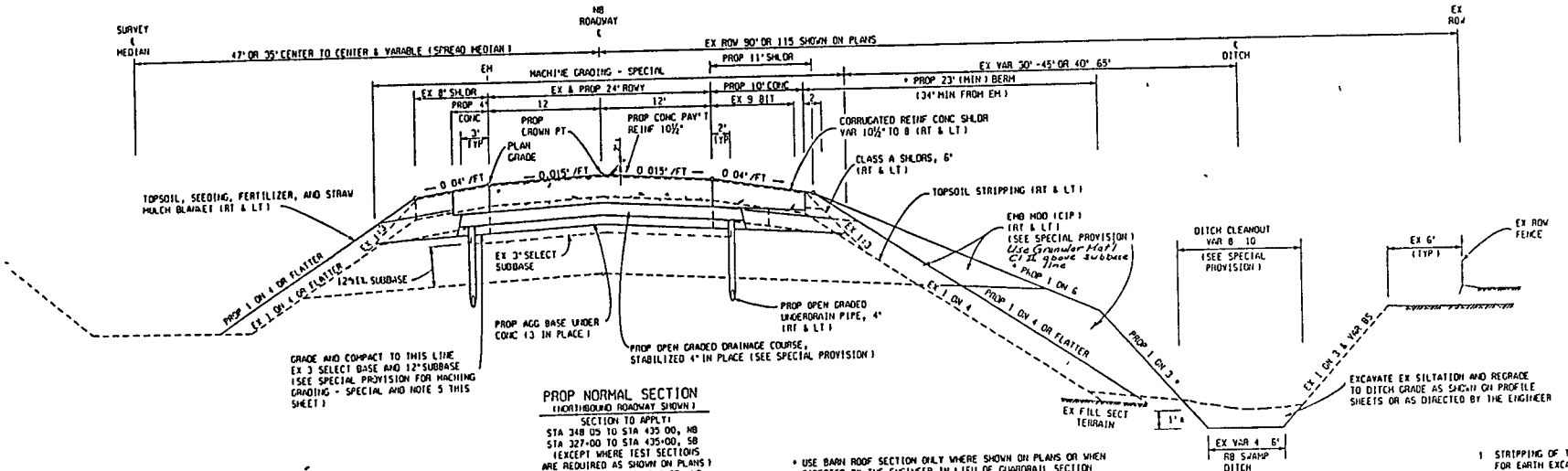
(ORIGINAL SWAMP DITCH (RT & LT))

JOINT LEGEND FOR PAVEMENT JOINTS

B - LONGITUDINAL BULKHEAD CONSTRUCTION JOINT ACCORDING TO STANDARD PLAN 11 41 SERIES

D LONGITUDINAL LANE TIE JOINT WITH TIE BARS, ACCORDING STANDARD PLAN 11 - 41 SERIES

2D - OPTIONAL B OR D



PROP NORMAL SECTION
(NORTHBOUND ROADWAY SHOWN)

SECTION TO APPLY:
STA 348+05 TO STA 435+00, NB
STA 327+00 TO STA 435+00, SB
(EXCEPT WHERE TEST SECTIONS ARE REQUIRED AS SHOWN ON PLANS)
STA 327+00 TO STA 348+05, NB

* USE BARN ROOF SECTION ONLY WHERE SHOWN ON PLANS OR WHEN DIRECTED BY THE ENGINEER IN LIEU OF GUARDRAIL SECTION OR FILLING IN DITCHES, NOTABLY, IN AREAS OF HIGH SIDE SLOPE AND CULVERT EXTENSIONS WHERE 1 ON 4 ARE NOT ATTAINABLE THIS BERM DETAIL REPLACES SECTION A OF STD PLAN 1105.8

NOTE

1 STRIPPING OF TOPSOIL SHALL BE INCLUDED WITH PAYMENT FOR EARTH EXCAVATION

2 WHERE EXISTING SUBBASE CROWN IS OFFSET 6" LEFT FROM POB 10 STA 327+60+ BALANCE GRADING OF 3" SELECT MATERIAL AS DIRECTED BY THE ENGINEER THE ITEM OF BASE UNDER CONC 3" IN PLACE HAS BEEN PROVIDED TO PAY ANY ADDITIONAL AGGREGATE NEEDED TO MEET PROPOSED GRA

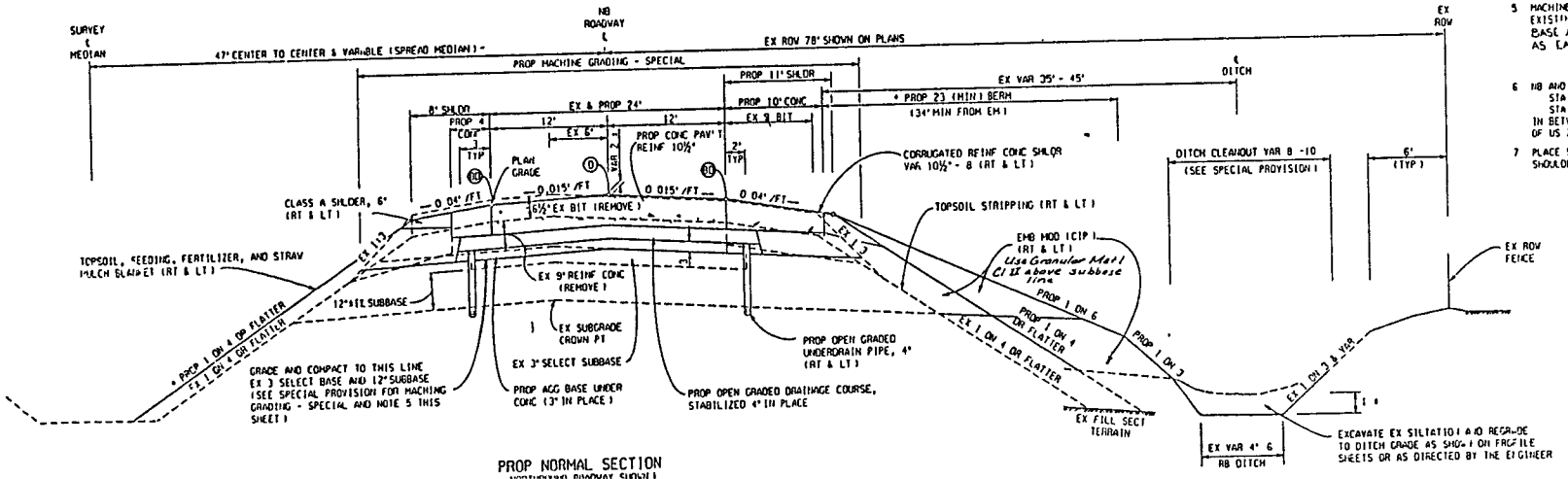
3 TRANSVERSE JOINTS SHALL BE SPACED AT 27' MAXIMUM FOR REINFORCED CONCRETE PAVEMENT (JRCP) ON NDOT SECTION

4 REQUIREMENT FOR STEPPING SLOPES SHALL BE WAIVED WHE 1 ON 4 OR FLATTER EXCEPT IN AREAS OF WIDENING FOR

5 MACHINE GRADING - SPECIAL SHALL APPLY TO ALL AREAS EXISTING BASE AND SUBBASE ARE TO REMAIN REMOVAL OF BASE AND SUBBASE WHERE REQUIRED WILL BE PAID AS EARTH EXCAVATION

6 NB AND SB ARE PARALLEL ROADWAYS AS FOLLOWS:
STA 118+01.01 TO STA 304+54.17, SB AT 94' ℄ TO ℄
STA 368+77.22 TO POE, NB AT 70' ℄ TO ℄
IN BETWEEN PARALLEL SECTIONS IS THE SPREAD MEDIAN, OF US 223

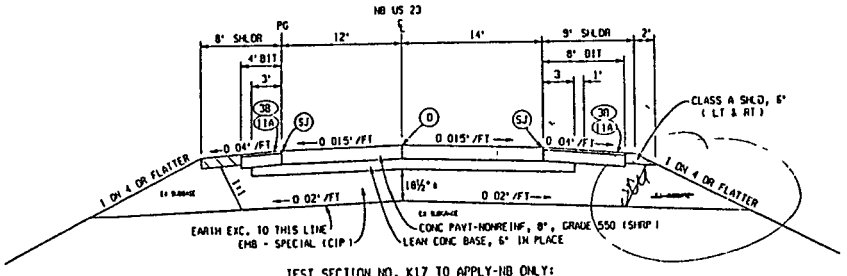
7 PLACE STRAW MULCH BLANKET ADJACENT TO INSIDE AND OU SHOULDER FOR 6' WIDTH



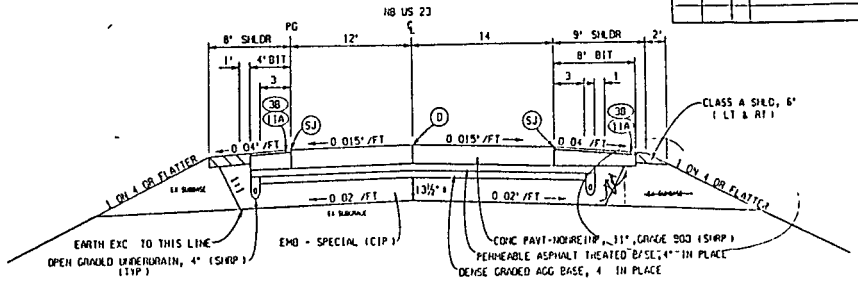
PROP NORMAL SECTION
(NORTHBOUND ROADWAY SHOWN)

SECTION TO APPLY:
STA 118+01.01 TO STA 216+50, NB
STA 118+01.01 TO STA 327+00, SB
(EXCEPT WHERE TEST SECTIONS ARE REQUIRED AS SHOWN ON PLANS)
STA 216+50 TO STA 327+00, NB

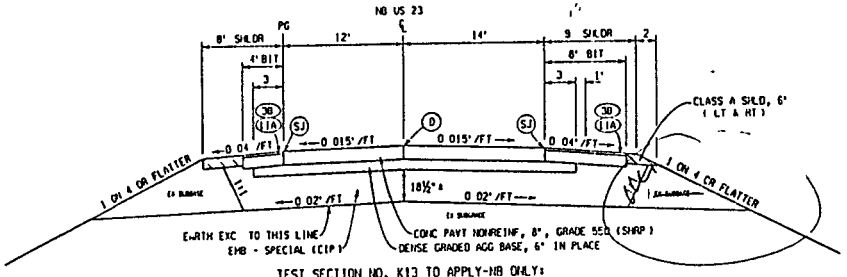
AUTH	DATE	NO	REVISION



TEST SECTION NO. K17 TO APPLY-NB ONLY:
STA. 217+25 TO STA 224+46 16 (802)

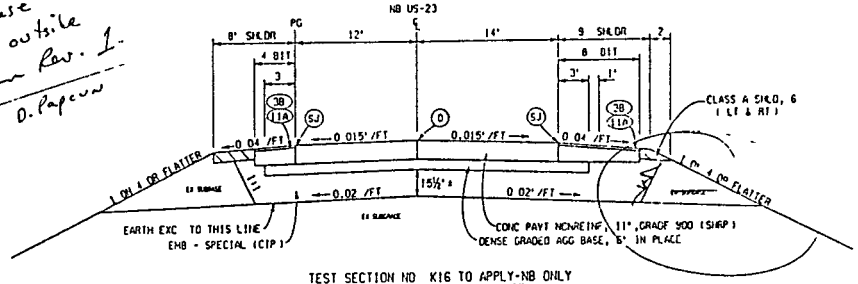


TEST SECTION NO K24 TO APPLY-NB ONLY
STA 237+45 TO STA. 244+05

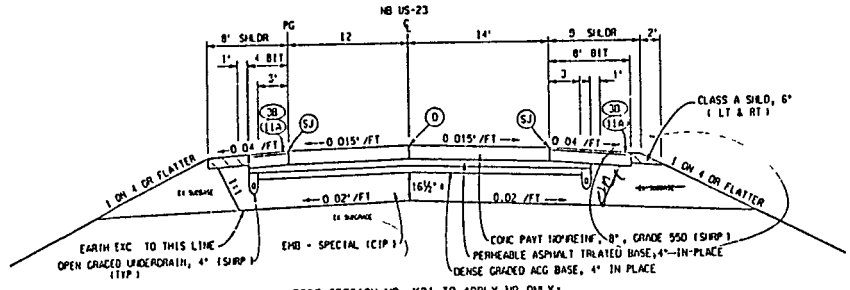


TEST SECTION NO. K13 TO APPLY-NB ONLY:
STA. 224+77 01 (802) TO STA. 231+15

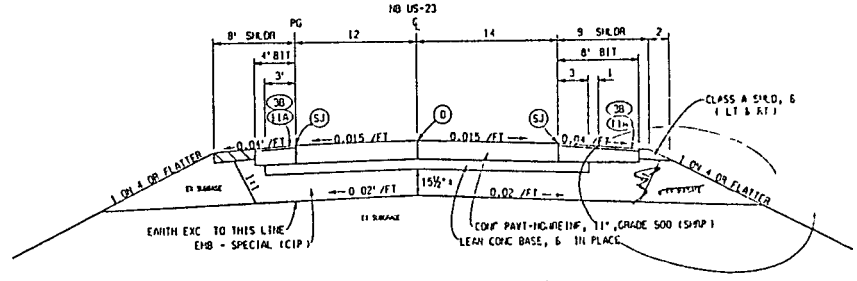
Exc ex subbase to slope on outside Slds Per Plan Rev. 1.
D. Papcun



TEST SECTION NO K16 TO APPLY-NB ONLY
STA 244+20 TO STA. 250+35



TEST SECTION NO. K21 TO APPLY NB ONLY:
STA 231+30 TO STA 237+30



TEST SECTION NO. K20 TO APPLY NB ONLY
STA 250+50 TO STA. 256+65

NOTES:

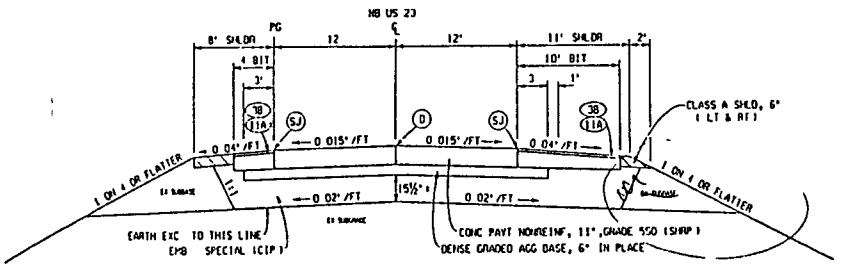
1. ANY WORK OF SHAPING OUTSIDE THE 1 ON 1 TO ACCOMODATE PROPOSED SHOULDER MATERIALS SHALL BE INCLUDED WITH EARTH EXCAVATION
2. WHERE CONC PAVT IS 11", TAPER BIT BASE (11A) ON OUTSIDE SHOULDER TO 6½". WHERE CONC PAVT IS 8", PLACE BIT BASE (11A) UNIFORMLY AT 6½".
3. THE DEPTH OF THE EXISTING BASE AND SUBBASE MAY VARY FROM WHAT IS SHOWN ON PLANS. THE INTENT IS TO REMOVE ALL THAT IS IN PLACE WITHIN THE LIMITS OF ALL SHRP AND MDOT TEST SECTIONS ON NB ROADWAY, AS DESIGNATED BY THE ENGINEER.
4. TRANSVERSE JOINT SPACING SHALL BE 15'. REFER TO SHEET NO. 8 FOR JOINT SPACING AND TRANSITION BETWEEN TEST SECTION DETAILS.
5. USE TURF ESTABLISHMENT ITEMS AS SHOWN ON NB & SB DUAL ROADWAY TYPICAL SHEETS. QUANTITIES ARE SHOWN ON NOTE SHEET FOR ENTIRE PROJECT
6. LIMITS OF SUBBASE EXCAVATION SHALL BE ONE FT FROM OUTSIDE EDGE OF UNDERDRAIN TRENCH FOR SHRP TEST SECTIONS WITH UNDERDRAIN; BUT SHALL BE AT THE PROPOSED EDGE OF PAVED SHOULDER ON NON-DRAINABLE SHRP SECTIONS
7. STRIPE 14' PAVEMENT 12' RIGHT OF CENTERLINE FOR DRIVING LANE.

JOINT LEGEND

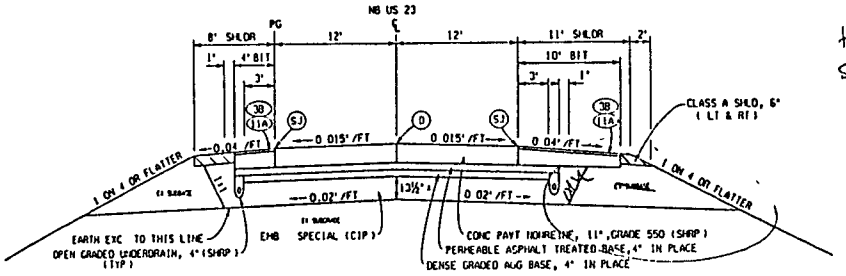
(D) LONGITUDINAL LANE TIE JOINT

(SJ) SEALING LONGITUDINAL SHOULDER JOINT (SHRP) SEE SPECIAL PROVISION

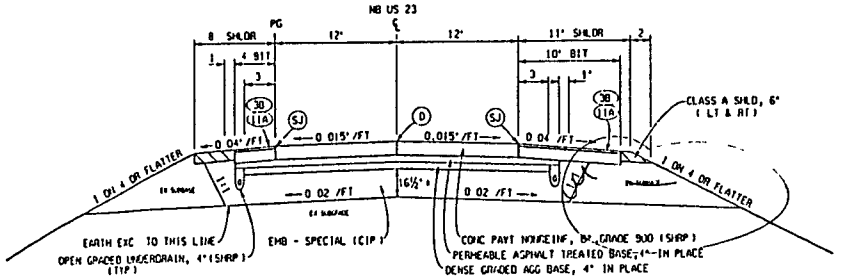
BITUMINOUS APPLICATION ESTIMATE



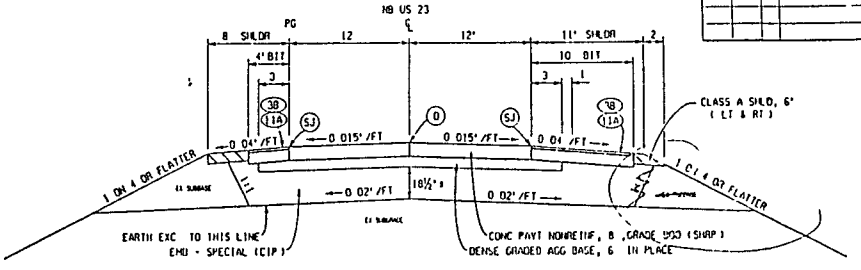
TEST SECTION NO K15 TO APPLY-NB ONLY:
STA 296+00 TO STA. 302+00
STA. 302+75 TO STA. 303+95 (ON EX SUBBASE-NO EXC)



TEST SECTION NO. K23 TO APPLY-NB ONLY:
STA 304+70 TO STA. 310+70

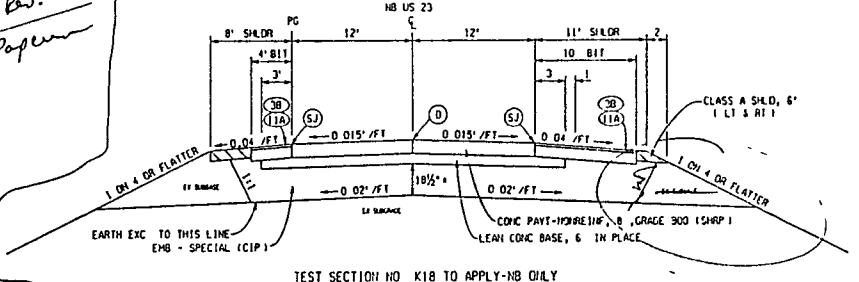


TEST SECTION NO K22 TO APPLY-NB ONLY
STA. 310+85 TO STA. 317+90

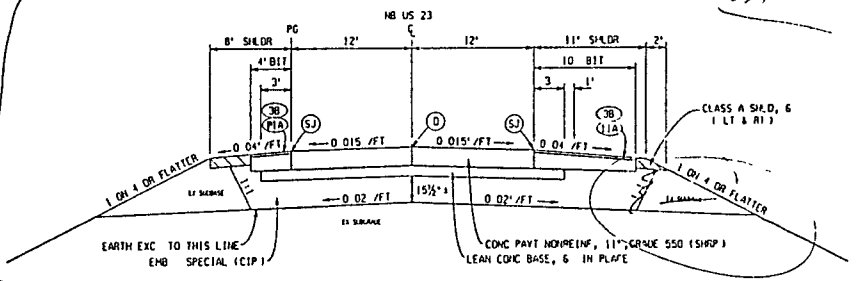


TEST SECTION NO K14 TO APPLY NB ONLY
STA 328+40 TO STA. 334+40

Exc. ex. subbase to slope on outside shlds. per Plan Rev. 1
D. Popeun



TEST SECTION NO K18 TO APPLY-NB ONLY
STA 334+40 TO STA 340+40

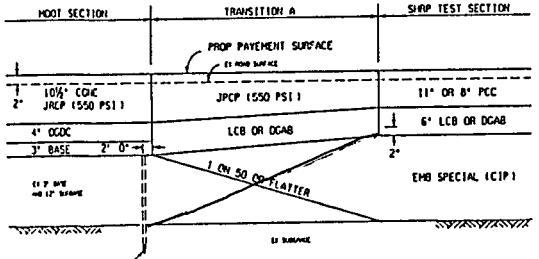


TEST SECTION NO K19 TO APPLY-NB ONLY:
STA 340+85 TO STA 347+30

NOTES

1. ANY WORK OF SHAPING OUTSIDE THE 1 ON 1 TO ACCOMODATE PROPOSED SHOULDER MATERIALS SHALL BE INCLUDED WITH EARTH EXCAVATION
2. WHERE CONC PAVT IS 11", TAPER BIT BASE ON OUTSIDE SHOULDER TO 6½". WHERE CONC PAVT IS 8", PLACE BIT BASE UNIFORMLY AT 6½".
3. CONSTRUCT FROM STA 302+75 TO STA 303+95 BY EXTENDING SHRP SECTION NO K15, EXCEPT THAT THIS SECTION WILL BE CONSTRUCTED ON EXISTING SUBBASE MATERIAL. THE PAVEMENT WILL INCLUDE AN AUTOMATIC VEHICLE CLASS DEVICE (SEE SPECIAL PROVISION), AS DIRECTED BY THE ENGINEER
4. CONSTRUCT PAVEMENT (BETWEEN SHRP SECT K22 & K14) FROM STA 318+65 TO STA 327+65 WITH JRCP ITEMS, AND USING EXISTING AGG BASE MATERIALS AS SHOWN ON PLANS
5. THE DEPTH OF THE EXISTING BASE AND SUBBASE MAY VARY FROM WHAT IS SHOWN ON PLANS. THE INTENT IS TO REMOVE ALL THAT IS IN PLACE WITHIN THE LIMITS OF ALL SHRP AND MOOT TEST SECTIONS ON NB ROADWAY, AS DESIGNATED BY THE ENGINEER
6. TRANSVERSE JOINT SPACING SHALL BE 15'. REFER TO SHEET NO 8 FOR JOINT SPACING AND TRANSITION BETWEEN TEST SECTION DETAILS
7. USE TURF ESTABLISHMENT ITEMS AS SHOWN ON NB & SB DUAL ROADWAY TYPICAL SHEETS. QUANTITIES ARE SHOWN ON NOTE SHEET FOR ENTIRE PROJECT.
8. LIMITS OF SUBBASE EXCAVATION SHALL BE ONE FT FROM OUTSIDE EDGE OF UNDERDRAIN TRENCH FOR SHRP TEST SECTIONS WITH UNDERDRAIN; BUT SHALL BE AT THE PROPOSED EDGE OF PAVED SHOULDER ON NON DRAINABLE SHRP SECTIONS

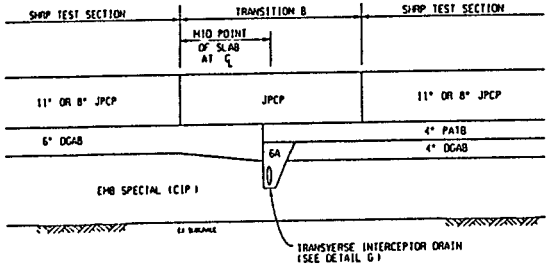
ELECTRONIC REPLICATION ESTIMATE



TRANSITION DETAIL A

TO APPLY NB ONLY:

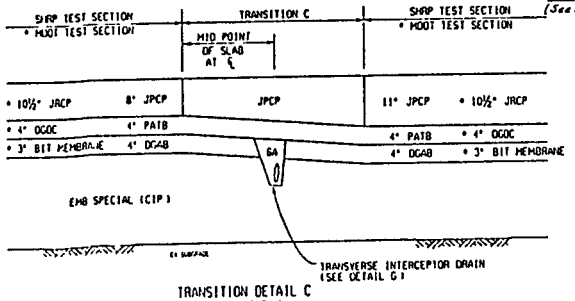
STA 216+50 (NORMAL TYP.)	TO STA 217+25 (SHRP. NO. K17)
STA. 256+65 (SHRP. NO K20)	TO STA. 257+40 (MDOT NO 1)
STA 264+96 (MDOT NO 1)	TO STA. 265+77 (MDOT NO 2)
STA 286+83 (MDOT NO 5)	TO STA. 287+64 (MDOT NO. 6)
STA 295+25 (MDOT NO 6)	TO STA. 296+00 (SHRP NO K15)
STA 317+90 (SHRP NO K22)	TO STA 318+65 (NORMAL TYP.)
STA 327+65 (NORMAL TYP.)	TO STA. 328+40 (SHRP NO K14)
STA 347+30 (SHRP NO. K19)	TO STA 348+05 (NORMAL TYP.)



TRANSITION DETAIL B

TO APPLY NB ONLY:

STA 231+15 (SHRP NO K13)	TO STA 231+30 (SHRP NO. K21)
STA 244+05 (SHRP NO K24)	TO STA. 244+20 (SHRP NO K16)

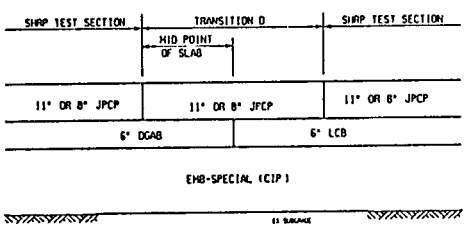


TRANSITION DETAIL C

TO APPLY NB ONLY:

STA 237+30 (SHRP NO K23) TO STA 237+45 (SHRP NO K24)

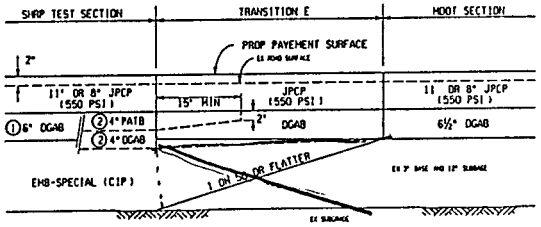
Revised SK 5/16/97



TRANSITION DETAIL D

TO APPLY NB ONLY:

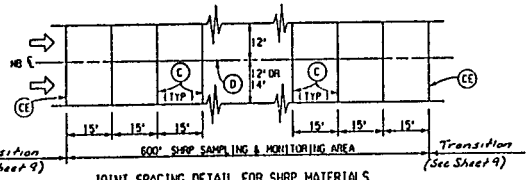
STA 250+35 (SHRP NO K16)	TO STA 250+50 (SHRP NO K20)
STA. 340+40 (SHRP NO K18)	TO STA. 340+85 (SHRP NO K19)



TRANSITION DETAIL E

TO APPLY NB ONLY:

① STA 302+00 (SHRP NO. K15)	TO STA. 302+75 (EXT NO K15)
② STA. 303+95 (EXT NO K15)	TO STA. 304+70 (SHRP NO K23)



JOINT SPACING DETAIL FOR SHRP MATERIALS SAMPLING AND PERFORMANCE MONITORING AREAS

NOTE: JOINT SPACING WITHIN SHRP TEST SECTIONS SHALL BE 15 FEET. WITHIN SHRP TEST SECTIONS A 600 FOOT SAMPLING AND MONITORING AREA WILL BE DESIGNATED BY THE DEPARTMENT. THIS 600 FOOT SECTION MUST START AND END WITH A JOINT. THERE ARE TO BE NO CONSTRUCTION OR EXPANSION JOINTS WITHIN THE 600 FOOT SAMPLING AND MONITORING AREA.

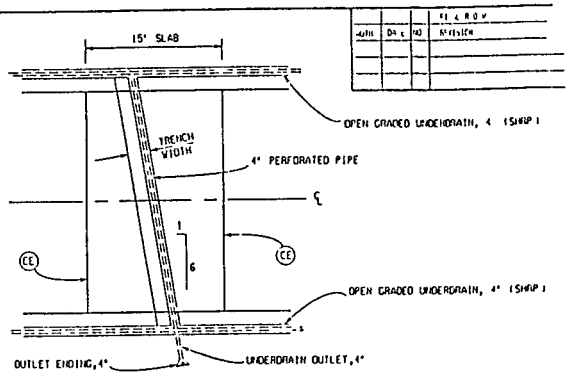
ADJUST JOINT SPACING OF JPCP OUTSIDE THE LIMITS OF THE 600 FT SHRP SECTIONS WHERE NECESSARY TO 10 FT MIN., AS DIRECTED BY THE ENGINEER.

NOTES.

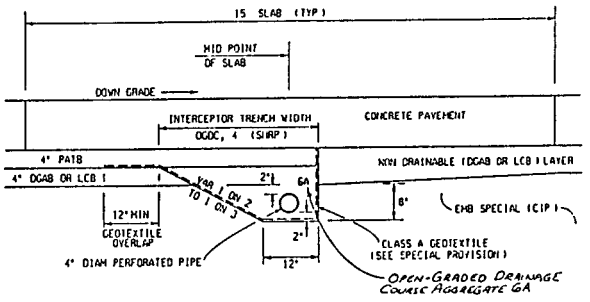
1. PLACE TRANSVERSE JOINT AT EACH END OF TRANSITION ZONES AT ALL TRANSITIONS, EXACT LOCATION WHERE MATERIAL CHANGE OCCURS, WILL BE AS DIRECTED BY THE ENGINEER.
2. IT IS INTENDED THAT THICKNESS VARIATIONS BE ACCOMPLISHED WITH DENSE GRADED AGGREGATE BASE AND EMBANKMENT - SPECIAL (CIP), AS SHOWN. HOWEVER, THE ENGINEER HAS THE OPTION TO REVISE THE CONSTRUCTION CONSTRAINTS IN TRANSITIONS. ANY REDUCTION IN LAYER THICKNESS TO 2" MINIMUM OR INCREASE TO 8" MAXIMUM SHALL BE INCLUDED WITH THE CONTRACT ITEM AT NO CHANGE IN THE UNIT PRICE.

LEGEND

- (C) CONTRACTION JT,C (SILICONE SEALED, 1" DOWELS)
- (D) LONGITUDINAL JOINT, D
- (E) EXPANSION JOINT, E2
- (CE) C OR E2, AS DIRECTED BY THE ENGINEER
- DGAB - DENSE GRADED AGGREGATE BASE
- JPCP - JOINTED PLAIN CONCRETE PAVEMENT
- JRCP - JOINTED REINFORCED CONCRETE PAVEMENT
- LCB - LEAN CONCRETE BASE
- OGDC - OPEN GRADED DRAINAGE COURSE
- PATB - PERMEABLE ASPHALT TREATED BASE



TRANSVERSE INTERCEPTOR DRAIN PLAN VIEW

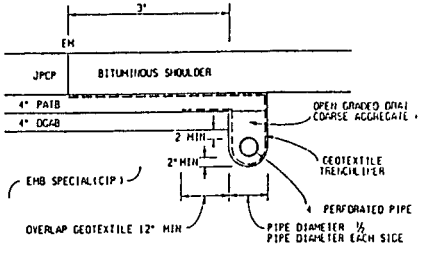


TRANSVERSE INTERCEPTOR DRAIN DETAIL G

SHRP TEST SECTIONS APPLY - NB ONLY

FOR LOCATIONS SEE TRANSITION DETAIL B & C

PLACE INTERCEPTOR DRAIN IN TRANSITION ZONE BETWEEN DRAINED AND UNDRAINED BASE STRUCTURE TEST SECTIONS AND INSTALLED ON THE DOWN SLOPE END OF THE PERMEABLE BASE LAYERS. PLACE INTERCEPTOR DRAIN AT APPROX 10 DEGREE SKEW TO ROADWAY CENTERLINE. TRANSVERSE INTERCEPTOR SHALL NOT BE PAID FOR SEPARATELY BUT PAID FOR AS OGDC, 4" (SHRP).



OPEN GRADED UNDERDRAIN TRENCH (SHRP)

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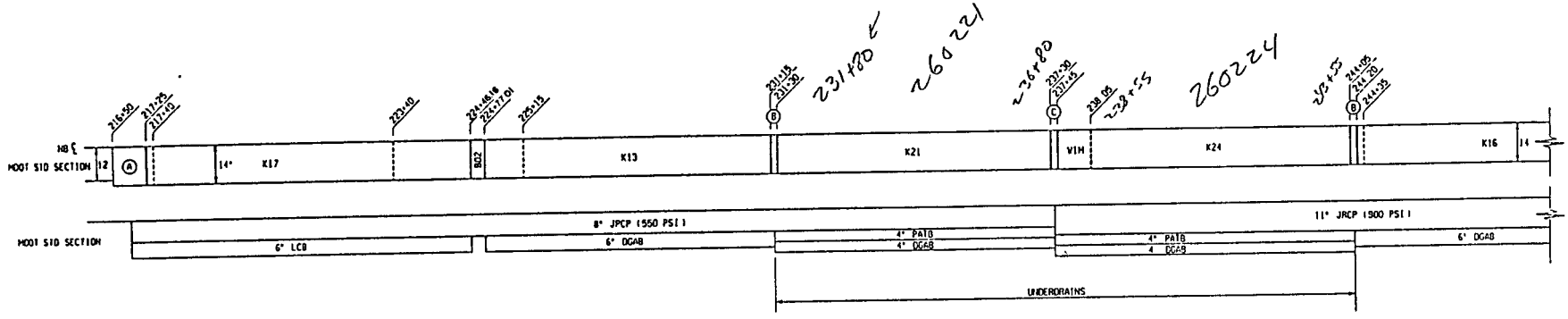

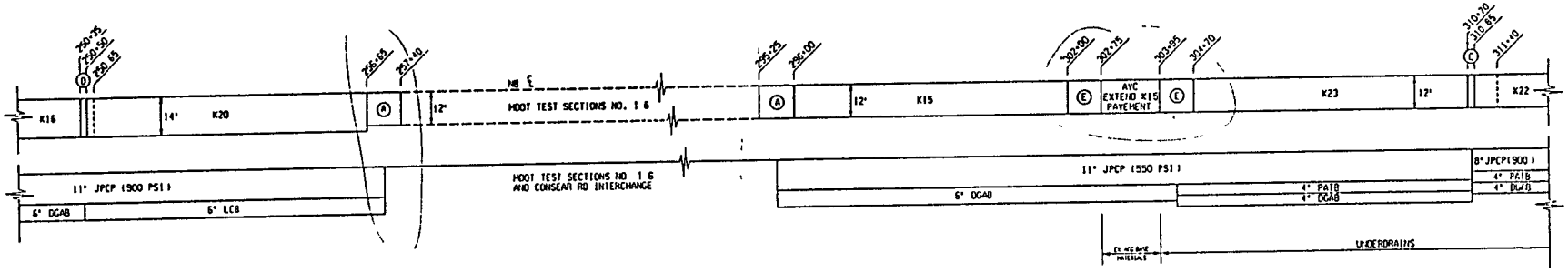

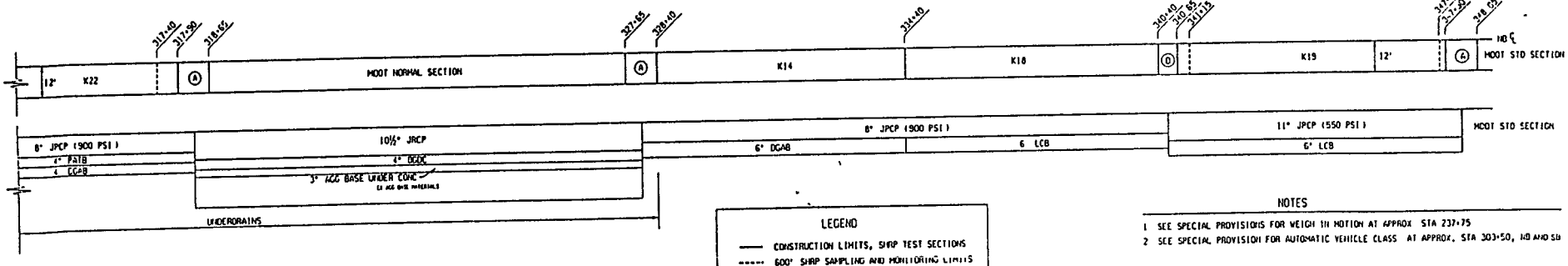

LEGEND

——— CONSTRUCTION LIMITS, SHRP TEST SECTIONS
----- 600' SHRP SAMPLING AND MONITORING LIMITS
JPCP - JOINTED PLAIN CONCRETE PAVEMENT
JRCP - JOINTED REINFORCED CONCRETE PAVEMENT
LCB - LEAN CONCRETE BASE
DGAB - DENSE GRADED AGGREGATE BASE
DGDC - OPEN GRADED DRAINAGE COURSE

NOTES

1 SEE SPECIAL PROVISIONS FOR WEIGH IN MOTION AT APPROX STA 237+75
2 SEE SPECIAL PROVISION FOR AUTOMATIC VEHICLE CLASS AT APPROX. STA 303+50, NB AND SB

[illegible]	ENVIRON IMPACT STMT	
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[illegible]	SURVEY, PLOTTER & SCELT, INC.	YEAR 5 91
[illegible]	YEAR DATUM	
[illegible]	COMPLETED	
[illegible]	FINAL PLANS BY J.P.H. CHRISTY	
[illegible]		DATE 09 25 91
[illegible]	AND (MDOT) D J PAPCUN	DATE 10 15 91

GENERAL PLAN NOTES

UNDERGROUND UTILITIES

FOR PROTECTION OF UNDERGROUND UTILITIES AND IN CONFORMANCE WITH PUBLIC ACT 53, 1974, THE CONTRACTOR SHALL DIAL 1 800 482-7171 A MINIMUM OF THREE FULL WORKING DAYS, EXCLUDING SATURDAYS, SUNDAYS, AND HOLIDAYS PRIOR TO BEGINNING EACH EXCAVATION IN AREAS WHERE PUBLIC UTILITIES HAVE NOT BEEN PREVIOUSLY LOCATED MEMBERS WILL THEN BE ROUTINELY NOTIFIED THIS DOES NOT RELIEVE THE CONTRACTOR OF THE RESPONSIBILITY OF NOTIFYING UTILITY OWNERS WHO MAY NOT BE A PART OF THE "MISS DIG" ALERT SYSTEM

CONTRACTORS WORKING OUTSTATE SHOULD CONTACT THE MAINTENANCE REPRESENTATIVE AT THE NEAR DISTRICT OFFICE TO HAVE LIGHTING SYSTEMS STAKED.

ADJUSTING MONUMENT BOXES

IT IS THE INTENT THAT ALL GOVERNMENT CORNERS ON THIS PROJECT BE PRESERVED AND THAT, WHERE NECESSARY, MONUMENT BOXES BE PLACED OR ADJUSTED, WHETHER SHOWN OR NOT

HAND FINISHING

HAND FINISHING OF CONCRETE POURS TO BE STRUCK OFF AND CONSOLIDATED BY HAND METHODS WILL BE PERMITTED ON VARIABLE WIDTH LANES AND LANES FORMED BY FLEXIBLE FORMS FOR SHORT RADIUS CURVES, AS DIRECTED BY THE ENGINEER

PEAT EXCAVATION AT CULVERTS

AT THE TIME OF PEAT EXCAVATION, THE SPECIFIC TREATMENT CALLED FOR ON PLANS AT ANY GIVEN SWAMP SHALL BE WIDENED OUT AT CULVERTS TO PROVIDE STABLE FOUNDATION FOR THE ENTIRE LENGTH OF CULVERT, INCLUDING HEADWALLS OR END SECTIONS

SLOPES

CLASS B SLOPES WILL BE REQUIRED ON THIS PROJECT.

BEDDING AND FILLING

BEDDING AND FILLING AROUND PIPE CULVERTS SHALL BE DONE AS SPECIFIED ON STANDARD PLAN IV 82 SERIES

PAVEMENT EXPANSION JOINTS

EXPANSION JOINT QUANTITIES ARE AN ESTIMATE ONLY AND ARE BASED UPON THE ASSUMPTION THAT PAVING [illegible] OCCUR IN THE PERIOD BETWEEN APRIL 15 AND SEPTEMBER 15 . THE CONTRACTOR IS ADVISED TO ORDER EXPANSION AND CONTRACTION JOINT MATERIAL BASED ON THE TIME PERIOD WHEN IT IS EXPECTED PAVING WILL ACTUALLY OCCUR, AND NOT NECESSARILY ON THE BASIS OF PLAN QUANTITIES

CIRCULAR CULVERT EXTENSIONS

THE EXTENSION OF EXISTING CIRCULAR AND ELLIPTICAL CONCRETE CULVERTS ON THIS PROJECT MAY REQUIRE EXTRA WORK TO OBTAIN A TIGHT SEAL AT THE JOINT CONNECTING NEW CULVERT PIPE TO EXISTING CULVERT PIPE THE JOINT BETWEEN THE EXISTING AND NEW PIPES SHALL BE COMPLETELY FILLED WITH MORTAR TO FORM A TIGHT SEAL. ANY EXTRA WORK REQUIRED TO OBTAIN TIGHT JOINTS WILL NOT BE PAID FOR SEPARATELY BUT WILL BE INCLUDED IN COMPENSATION FOR EXTENDING CULVERTS.

OLD PLANS

THE FOLLOWING OLD PLANS WERE REFERRED TO IN THE DESIGN OF THIS PROJECT.

S8034 CD, V 41 1, 1957
RF58034 00786A, 1975
MS58034 18877A, 1981

IN ADDITION, OTHER OLD PLANS THAT PREDATE THIS PROJECT MAY BE AVAILABLE THESE PLANS MAY BE REVIEWED IN THE LANSING DESIGN OFFICE DURING NORMAL WORKING HOURS

PAVEMENT REMOVAL QUANTITIES

PAVEMENT REMOVAL AS SHOWN ON THE PLANS SHALL BE AT THE DISCRETION OF THE ENGINEER IF IN HIS JUDGEMENT, AREAS OF PAVEMENT MAY BE LEFT IN PLACE, OR ADDITIONAL AREAS ADDED, TO PROVIDE THE PROPER CROSS-SECTION AND BASE, ADJUSTMENTS CAN BE MADE IN THE QUANTITIES

SOIL EROSION MEASURES

APPLY TEMPORARY SEED AND MULCH AS SOON AS POSSIBLE. CRITICAL DITCH GRADES SHALL BE FINISHED WITH EITHER SOD OR SEED/MULCH AS DIRECTED BY THE ENGINEER

EARTHWORK

EARTHWORK QUANTITIES ARE COMPUTED BY CONVENTIONAL SURVEY METHODS.

POST HOLES

POST HOLES WITHIN 3' OF EXISTING CULVERTS SHALL BE IN DRILLED HOLES AND SHALL NOT BE DRIVEN

GUARDRAIL

GUARDRAIL SHALL BE ANCHORED FLUSHED TO EXISTING BRIDGE RAILING UNTIL PAST APPROACH SLOPES BEFORE FLARING TO SHOULDER

EMBANKMENT WIDENING

WIDENING LESS THAN 5' SHALL BE CONSIDERED PART OF THE WORK OF CONSTRUCTING ROADWAY EMBANKMENTS AND WILL NOT BE PAID FOR SEPARATELY

EXISTING UNDERDRAINS

[illegible] EXISTING UNDERDRAINS IN RAMP GORE AREAS WITH OPEN GRADED

PUBLIC UTILITIES

THE EXISTING UTILITIES LISTED BELOW AND SHOWN ON THESE PLANS REPRESENT THE BEST INFORMATION AVAILABLE THIS INFORMATION DOES NOT RELIEVE THE CONTRACTOR OF THE RESPONSIBILITY TO BE SATISFIED AS TO IT'S ACCURACY AND THE LOCATION OF EXISTING UTILITIES

NAME OF OWNER	KIND OF UTILITY
MICHIGAN BELL TELEPHONE CO. ATTN: ROY PALMGREN 444 MICHIGAN AVENUE, ROOM 635 DETROIT, MI 48226-11103 PHONE: (313) 496 8305 FAX: (313) 496-9315	TELEPHONE
CONSUMERS POWER COMPANY ATTN: W. H ZIMMERMAN LAND AND ROW DEPARTMENT 1955 PARNALL RD , ROOM JSC-202A JACKSON, MI 49201 PHONE: (517) 788-1533	ELECTRIC
BUCKEYE PIPELINE COMPANY ATTN: MR J J CROFFY P.O BOX 368 EMMAUS, PA 18049 0368 PHONE: (215) 967 3131 EXT 399 LIMA, OHIO OFFICE: ATTN: E W CONLEY PHONE: (419) 223 4015	GAS

OWNERS OF PUBLIC UTILITIES WILL NOT BE REQUIRED BY THE DEPARTMENT TO MOVE ADDITIONAL POLES AND STRUCTURES THAT ARE NOT WITHIN GRADING OR STRUCTURE LIMITS IN ORDER TO FACILITATE THE OPERATION OF CONSTRUCTION EQUIPMENT, UNLESS IT IS DETERMINED BY THE ENGINEER THAT SUCH POLE LINE OR STRUCTURES CONSTITUTE A HAZARD TO THE PUBLIC OR ARE EXTRAORDINARILY DANGEROUS TO THE CONTRACTOR'S OPERATIONS

GENERAL PLAN NOTES

SHOULDER CORRUGATIONS

CORRUGATIONS WILL NOT BE PLACED ON RAMP SHOULDERS BEYOND PROPOSED 2' POINT.

GEOTEXTILE LINER FOR EROSION CONTROL

WHERE RIPRAP, SPILLWAYS OR COBBLE DITCHES ARE USED, THEY SHALL BE UNDERLAID WITH GEOTEXTILE MATERIAL AND PAYMENT INCLUDED WITH THE RESPECTIVE CONTRACT BID ITEM WHICH IT IS USED

CULVERT MATERIAL AND EXTENSIONS

CULVERT EXTENSIONS AND/OR END SECTIONS SHALL BE OF SAME MATERIAL AS EXISTING CULVERT. PROPOSED OFFSET SHALL BE AS DIRECTED BY THE ENGINEER TO SUIT EXISTING DRAINAGE CONDITIONS.

POLES

THE EXACT LOCATION OF POLES WILL BE DETERMINED BY THE ENGINEER.

PLAN ELEVATION

ELEVATIONS SHOWN ON THESE PLANS ARE ON USC&GS DATUM.

STATIONING

STATIONING ON THIS PROJECT WAS TAKEN FROM OLD PLANS AND PAVEMENT STENCILED STATIONING AND IS NOT NECESSARILY CORRECT

DELINEATOR POST

THE CONTRACTOR SHALL REMOVE AND STOCKPILE EXISTING DELINEATOR POSTS AT THE PROJECT SITE, AS DETERMINED BY THE ENGINEER
THIS WORK SHALL BE CONSIDERED AS INCLUDED IN THE COST OF PLACING NEW DELINEATOR POSTS.

SIGNS

ANY MDOT SIGNS REQUIRING RELOCATION DUE TO CONSTRUCTION OPERATIONS SHALL BE SALVAGED AND RESET BY THE CONTRACTOR AT LOCATIONS DESIGNATED BY THE ENGINEER. THIS WORK WILL BE CONSIDERED INCLUDED IN PAYMENT FOR OTHER CONTRACT ITEMS

DRAINAGE MARKER POSTS

DRAINAGE MARKER POST ARE TO PLACED AT HEADWALLS AND CULVERT END SECTIONS ON CULVERTS 36" IN DIAMETER OR LESS, AND AT ALL OUTLET ENDINGS OUTSIDE THE LIMITS OF THE PAVED DRAINAGE MARKER POSTS SHOULD NOT BE PLACED IN MEDIANS EXCEPT ON SPREAD ROADWAYS DRAINAGE MARKER POSTS SHALL CONFORM TO STEEL DELINEATOR POSTS OR STEEL LINE FENCE POSTS AT LEAST 6' LONG, AS CALLED FOR IN SECTION 5 11 02 OF THE 1984 STANDARD SPECIFICATIONS

RAMP RADII

RADII AT RAMP TERMINALS ARE UPGRADED TO ACCOMMODATE WB-50 AT STERNS & CONSEAR ROADS AND WB 63 AT US 223

UNDERCLEARANCE

A MINIMUM UNDERCLEARANCE OF 14' 0" MEASURED ALONG THE FACE OF PIER AT THE OUTSIDE SHOULDER AND 14' 6" MINIMUM AT THE ROADWAY, SHALL BE REQUIRED AT ALL CROSSROAD STRUCTURES (STERNS, CONSEAR, AND US-223) ADJUSTMENTS TO OBTAIN REQUIRED CLEARANCES SHALL BE MADE IN THE EXISTING AGGREGATE BASE MATERIALS. REFER ALSO TO SHEET "A1 FOR TRANSITION DETAILS

TOPSOIL STRIPPING

STRIPPING OF TOPSOIL SHALL BE INCLUDED WITH QUANTITIES FOR EARTH EXCAVATION

TRANSVERSE PAVEMENTS JOINTS

NOTES APPLYING TO STANDARD PLANS

WHERE THE FOLLOWING ITEMS ARE CALLED FOR ON PLANS, THEY ARE TO BE CONSTRUCTED ACCORDING TO THE STANDARD PLAN GIVEN BELOW OPPOSITE EACH ITEM UNLESS OTHERWISE INDICATED

CONCRETE CURB AND CONCRETE CURB & GUTTER	II-30D
APPROACH CURB & GUTTER, DOWNSPOUTS (FOR BRIDGE BARRIER ON RURAL HIGHWAYS)	II 32C (SPECIAL DET)
TRANSVERSE PAVEMENT JOINTS	II 39K
LOAD TRANSFER ASSEMBLIES FOR TRANSVERSE JOINTS	II 40G
LONGITUDINAL PAVEMENT JOINTS	II 41G
TYPICAL JOINT LAYOUTS FOR CONCRETE PAVEMENT	II 42F
LOCATION OF TRANSVERSE JOINTS IN CONCRETE PAVEMENT	II 43D
CONCRETE PAVEMENT REPAIR	II-44G
CONVENTIONAL PAVEMENT REINFORCEMENT	II 45C (SPECIAL DET)
TEMPORARY CONCRETE BARRIER	II 52F (SPECIAL DET)
GUARDRAIL BULLNOSE	III-56B (SPECIAL DET)
GUARDRAIL ENDINGS WITH CABLE ANCHORAGE	III 58K
GUARDRAIL AT BRIDGES AND EMBANKMENTS	III-59G
BEAM GUARDRAIL - TYPES A,B,BD,T & TD	III-60G
GUARDRAIL ANCHORAGE - BRIDGE,DETAILS	III 67D (SPECIAL DET)
W-BEAM BACKED GUARDRAIL INSTALLATION	III-72A (SPECIAL DET)
GRANULAR BLANKET, UNDERDRAINS, AND OUTLET ENDING FOR UNDERDRAINS	IV-80D
BEDDING AND FILLING AROUND PIPE CULVERTS	IV 82E
OUTLET HEADWALLS	IV 85D
PRECAST CONCRETE END SECTION FOR PIPE CULVERT	IV 86C
HEADWALLS FOR REINFORCED ELLIPTICAL CONCRETE CULVERTS	IV 87B
54" & 60" HEADWALLS FOR CIRCULAR PIPE CULVERTS	IV 90C
CULVERT SLOPED END SECTION	IV 95A (SPECIAL DET)
SOIL EROSION & SEDIMENTATION CONTROL MEASURES	V-96D
SODDING AND SEEDING	V 100B
WOVEN WIRE FENCE	V 101C(SPECIAL DET)
INSTALLATION OF WOVEN WIRE FENCE (AT STRUCTURES)	V 102B
GRADING CROSS SECTIONS	V 105B
SUPERELEVATION AND PAVEMENT CROWNS	V-107D
SHOULDERS FREEWAYS	V-112K
LANE CLOSURES AND CROSSOVERS (RURAL)	V-113C
LIGHTED ARROWS AND BARRICADES	VI-125H
PLACEMENT OF TEMPORARY CONCRETE BARRIER	VI-126E
DELINEATOR INSTALLATIONS	VI-127D
STEEL GRATE FOR PRECAST CONC END SECTION	4 (SPECIAL DET)

GENERAL PLAN NOTES

CLEARING FOR TREES

REMOVE INDIVIDUAL TREES AND SELECTIVELY CLEAR TREELINES, AS DIRECTED BY THE ENGINEER, BASED ON THE FOLLOWING CRITERIA FOR PROPOSED SLOPES:

1 ON 4 SLOPES: CLEAR TO 40 FT FROM EOH
1 ON 5 SLOPES: CLEAR TO 38 FT FROM EOH
1 ON 6 SLOPES: CLEAR TO 32 FT FROM EOH

REMOVING TREES LESS THAN 8 INCHES SHALL BE INCLUDED WITH DITCH CLEANOUT (SEE SPECIAL PROVISION)

THE FOLLOWING ITEMS ARE ESTIMATED FOR THE ENTIRE PROJECT TO CORRECT POSSIBLE UNSTABLE OR UNSUITABLE SUBGRADE CONDITIONS WHERE DESIGNATED BY THE ENGINEER:

SUBGRADE UNDERCUTTING TYPE II	10000 CYD
SUBGRADE UNDERDRAIN 6	2400 LFT
UNDERDRAIN OUTLET 6"	200 LFT
OUTLET ENDING 6"	10 EACH

THE FOLLOWING DELINEATOR ITEMIZATION IS FOR INFORMATION ONLY AND APPLY TO QUANTITIES ESTIMATED FOR REFLECTORS & POSTS AS SHOWN ON THIS SHEET

MISCELLANEOUS ESTIMATES

THE FOLLOWING ITEMS OF WORK SHALL BE DONE AS THEY APPLY THROUGHOUT T EXCEPT WHERE SHOP TEST SECTIONS ARE LOCATED ON NORTHBOUND ROADWAY ARE NOT DETAILED OR INCLUDED ON THE PLAN AND PROFILE SHEETS:

1 BANT	CONSUMERS POWER LINE EXTENSION (S
1 EACH	FIELD OFFICE
250 CYD	EMBANKMENT (CIP)
1 LSUM	CLEANING PAVT (RAMPS & CROSSROAD
49283 LFT	CONTRACTION JOINT C
23918 LFT	CONTRACTION JOINT C3
4412 LFT	EXPANSION JOINT E2
2177 LFT	EXPANSION JOINT E4
114095 LFT	EXTERNAL LONGITUDINAL PAVT JOINT
348 EACH	OR MARKER POST
2616 LFT	UNDERDRAIN OUTLET, 4"
218 EACH	OUTLET ENDING, 4"
156258 SYD	PAVT RIDING QUALITY
24 LNMI	PAVT RIDING QUALITY MEASUREMENT
533 SYD	BUMP GRINDING
1 LSUM	MOBILIZATION
6000 HRS	OJT TRAINING
650 EACH	DELINEATOR REFLECTOR
414 EACH	DELINEATOR POST
1 LSUM	MINOR TRAF DEVICES
1 LSUM	FLAG CNTRL
4 EACH	LIGHTED ARROW, TYPE A FURN
4 EACH	LIGHTED ARROW, TYPE A OPERATED
710 EACH	BARRICADE, TYPE II, LIGHTED - FU
700 EACH	BARRICADE, TYPE II, LIGHTED OPE
65 EACH	BARRICADE, TYPE III, LIGHTED FU
60 EACH	BARRICADE, TYPE III, LIGHTED - OP
400000 LFT	REM PAVT MRKG, LONGITUDINAL
600 SFT	SIGN, TYPE A TEMP
2100 SFT	SIGN, TYPE B TEMP
77400 LFT	TEMP PAVT MRKG, TYPE NR, FAST DRY PAINT, 4", WHITE
104400 LFT	TEMP PAVT MRKG, TYPE NR, FAST DRY PAINT, 4", YELLOW
83000 LFT	REGULAR DRY PAVT MRKG, 4", WHITE
66000 LFT	REGULAR DRY PAVT MRKG, 4 YELLOW
23000 LFT	REGULAR DRY PAVT MRKG, 6 , WHITE
8000 LFT	REGULAR DRY PAVT MRKG, 12 , WHITE
9000 LFT	REGULAR DRY PAVT MRKG, 6", YELLOW
800 EACH	RAISED PAVT MARKER, RETROREFLECTA CRYSTAL MONO DIRECTIONAL
160 EACH	TEMP RAISED PAVT MARKERS, YELLOW
16 EACH	REPLACE PAVT MARKERS, YELLOW
240 EACH	TEMP RAISED PAVT MARKERS, WHITE
16 EACH	REPLACE PAVT MARKERS, WHITE
800 EACH	BARRIER REFLECTORS
300 EACH	FURNISH AND INSTALL VERTICAL PANE
70000 LFT	TEMP CONC BARRIER
143128 LFT	TEMP PAVT MRKG, TYPE B, TAPE, 4"
137400 LFT	TEMP PAVT MRKG, TYPE B, TAPE, 4" YELLOW
53 EACH	CULVERT CLEANOUT
1 LSUM	PROJECT CLEANUP
1000 LFT	FAST DRY PAVT MRKG, 12", GORE
15000 LFT	MOVING TEMP CONC BARRIER*
1 EACH	LIGHTED ARROW, TYPE A - STAND

THE FOLLOWING QUANTITIES SHALL BE USED THROUGHOUT THE PROJECT, AS DIR BY THE ENGINEER, FOR EROSION AND SEDIMENTATION CONTROL AND TURF ESTAB

4000 LFT	SILT FENCE
20 EACH	SEDIMENT TRAP
300 LFT	CHECK DAMS
200 CYD	SEDIMENT EXCAV - MAINTENANCE
17 UNIT	WATER
25 EACH	REM TREE, 8-18"
2825 SYD	CLASS B SODDING
9000 LBS	ROADSIDE SEEDING - MODIFIED *
84 LBS	CEREAL RYE SEEDING
14760 LBS	CHEMICAL FERTILIZER NUTRIENT
65 TON	MULCH
33 ACRE	ANCHORING MULCH
9833 SYD	MULCH BLANKETS
83085 SYD	STRAW MULCH BLANKETS
258105 SYD	TOPSOIL SURFACE, 4"

* ESTIMATED AT 150#/ACRE

THE FOLLOWING QUANTITIES ARE ESTIMATED FOR CULVERT EXTENSIONS, WHERE I THE ENGINEER, THROUGHOUT THE PROJECT:

50 CYD	TRENCH UNDERCUT AND BACKFILL
60 CYD	CULV BEDDING
10 CYD	ROCK EXCAV

SHRP NOTES

SHRP AND MDOT TEST SECTIONS

THIS PROJECT CONTAINS SPECIAL REQUIREMENTS FOR MATERIAL AND TESTING TO CONSTRUCT 12 SHRP (STRATEGIC HIGHWAY RESEARCH PROGRAM) AND 6 MDOT TEST SECTIONS ON THE NORTH BOUND ROADWAY, FROM STA 216+50 TO STA 348+05, AS SHOWN ON THE PLANS. THE FOLLOWING NOTES PERTAIN TO THESE AREAS ONLY:

1. REMOVAL OF EXISTING 3" SELECT BASE AND 12" SUBBASE SHALL BE PAID FOR AS EARTH EXCAVATION. THE REMOVED MATERIAL, IF SUITABLE, MAY BE USED AS EMBANKMENT MODIFIED (CIP) WHERE APPLICABLE THROUGHOUT THE PROJECT.

2. ONCE THE PAVEMENT IS REMOVED, THE ENGINEER WILL PERFORM A SUBGRADE INSPECTION. SUBGRADE UNDERCUTTING TYPE I SPECIAL AND EMBANKMENT SPECIAL (CIP) WILL BE USED WITH SELECTED CLAY MATERIAL HAVING AT LEAST 60% PASSING THE NO. 200 SIEVE AND A PLASTICITY INDEX (PI) OF 10 OR GREATER (ASTM D4318). SEE SPECIAL PROVISIONS.

3. SHRP PAVEMENT SHALL CONSIST OF NONREINFORCED, DOWEL JOINED CONCRETE (JPCP) WITH MAXIMUM JOINT SPACING AT 15'. EXPANSION JOINTS SHALL NOT BE LOCATED WITHIN THE TEST SECTION (APPROX 600'), BUT SHALL BE LOCATED IN THE TRANSITION AREAS, AS DIRECTED BY THE ENGINEER, (SEE ALSO JOINT LAYOUT DETAIL ON SHEET *81). FOR PURPOSES OF ESTIMATING QUANTITIES, EXPANSION JOINTS SHALL BE SPACED AT 330'.

4. AN AUTOMATIC VEHICLE CLASSIFIER (AVC) DEVICE SHALL BE INSTALLED IN THE NORTH BOUND ROADWAY AT APPROX STA 303, AS SHOWN ON PLAN SHEET *25 AND DESCRIBED IN THE SPECIAL PROVISIONS.

5. WEIGH-IN-MOTION (WIM) DEVICE SHALL BE INSTALLED ON THE NB ROADWAY PAVEMENT AT APPROX STA 237+75, AS SHOWN ON PLAN SHEET *21, AND DESCRIBED IN THE SPECIAL PROVISIONS.

6. THE CONTRACTOR SHALL BE AWARE THAT SHRP SECTIONS FROM STA 216+50 TO STA 257+40 REQUIRE A 14' OUTSIDE LANE AT 0.015'/FT CROWN AND REDUCE BIT. SHOULDER TO 7', AS SHOWN ON PLANS. EXTEND UNDERLYING AGGREGATE BASES TO SUPPORT 14' PAVEMENT.

7. OUTLETS FOR UNDERDRAINS SHALL NOT EXCEED 250 LFT APART, (RT & LT.) TRANSVERSE INTERCEPTOR SHALL BE LOCATED ONLY IN TRANSITION AREAS, AS SHOWN ON THE DR WHERE WHERE DIRECTED BY THE ENGINEER.

8. BITUMINOUS SHOULDERS IN TEST SECTIONS SHALL BE CORRUGATED.

9. SHRP SECTIONS MAY BE EXTENDED BEYOND 600 LFT, AS SHOWN ON THE PLANS OR AS DIRECTED BY THE ENGINEER, IN ORDER TO FACILITATE CONSTRUCTION THROUGH AREAS WHERE EXISTING CONDITIONS ARE NOT SUITABLE FOR TESTING.

10. THE DEPTH OF THE EXISTING BASE AND SUBBASE MAY VARY FROM WHAT IS SHOWN ON THE PLANS. THE INTENT IS TO REMOVE ALL THAT IS IN PLACE WITHIN THE LIMITS OF ALL SHRP AND MDOT DESIGNATED TEST SECTIONS ON THE NORTHBOUND ROADWAY, A DIRECTED BY THE ENGINEER. REFER TO SHRP AND MDOT TEST SECTION TYPICALS ON SHEETS 5-7. THE SOUTHBOUND ROADWAY WILL REQUIRE REMOVAL OF THE TOP 12", WHERE DESIGNATED ON THE PLANS FOR SUBBASE SPECIAL (CIP).

SHRP AND MDOT TEST SECTIONS ON NB C.

MISCELLANEOUS ESTIMATES

THE FOLLOWING ITEMS OF WORK SHALL BE DONE AS THEY APPLY THROUGHOUT THE 18 TEST SECTION AREAS FROM STA 216+50 TO STA 348+05. THESE ITEMS ARE NOT DETAILED OR INCLUDED ON THE PLAN AND PROFILE SHEETS:

EXPANSION JOINT, E2	696 LFT
SEALING LONGITUDINAL SHOULDER JOINT (SHRP)	18,690 LFT
PROOF ROLLING (SHRP)	125 HOURS
PAVEMENT RIDE QUALITY (SHRP)	25,816 SYD
UNDERDRAIN OUTLET, 4"	836 LFT
OUTLET ENDING, 4"	76 EACH

THE FOLLOWING ITEMS ARE ESTIMATED ENTIRELY FOR THE SHRP & MDOT TEST SECTIONS, 18 ONLY, TO CORRECT POSSIBLE UNSUITABLE SUBGRADE CONDITIONS WHERE DESIGNATED BY THE ENGINEER, IN TEST AREAS WHERE EXISTING SUBBASE IS REMOVED:

SUBGRADE UNDERCUTTING - TYPE I - SPECIAL	7,000 CYD
EMBANKMENT SPECIAL (CIP)	4,500 CYD
* SUBGRADE UNDERCUTTING - TYPE II	150 CYD

* APPLIES TO MDOT TEST SECTIONS 1 AND 6 WHERE EXISTING SUBBASE IS NOT REMOVED

THE FOLLOWING ITEMS APPLY THROUGHOUT THE PROJECT TO THE RELOCATION OF EXISTING PERMANENT MDOT SIGNS AS SHOWN ON SIGNING PLAN SHEETS AND IN ACCORDANCE WITH SECTION 6.26 OF THE 1990 STANDARD SPECIFICATIONS FOR CONSTRUCTION, TO PROPOSED LOCATIONS AS DIRECTED BY THE ENGINEER.

REMOVAL OF SIGN, TYPE I	6 EACH
REMOVAL OF SIGN TYPE II	12 EACH
REMOVAL OF SIGN, TYPE III	66 EACH
REMOVAL OF STEEL BREAK AWAY FOUNDATION	8 EACH
SALVAGED SIGN, TYPE I	6 EACH
SALVAGED SIGN TYPE II	12 EACH
SALVAGED SIGN TYPE III	66 EACH
COLUMN, BREAK-AWAY W8 x 13	8 EACH
FOUNDATION, BREAK-AWAY, W8 x 13	8 EACH
TRANSPORTING SALVAGED MDOT SIGN MATERIALS	1 LSUM

STERNS RD

AUTH	DATE	ID	REVISION

EX RAMP A CURVE DATA
Δ 19°12 00" LT
D 03°01 49"
R 1931 27
T 125 73
L 211 45
E 8 96
PC 09+66 63
PI 10+73 36
PT 11+78 08
SUPER 0 07 /FT

EX RAMP B CURVE DATA
Δ 15°52 00"
D 02°00 00"
R 2864 79
T 399 22"
L 793 33
E
PC 05+17 77
PI 09+16 93
204+98 38
PT 13+11 10
208+89 68
EX SUPER 0 03"/FT

PROP RAMP B CURVE DATA
Δ 13°57 37"
D 04°00 00"
R 1432 39'
T 175 34'
L 348 94'
E 10 69'
PC 06+39 76
PI 08+15 12
PT 09+88 72
205+67 71, 22' LT SB EM
SUPER 0 045'/FT
TRANS LENGTH 165'
FULL SUPER FROM
STA 6+95 TO
STA 9+34

EX RAMP D CURVE DATA
Δ 15°59 00" RT
D 02°00 00"
R 2864 79
T 402 20'
L 799 17'
E 28 10'
PC 183+57 98
PI 187+60 10
PT 13+08 31, RAMP
191+46.88, NB US 23
SUPER 00 03 /FT

PROP RAMP D CURVE DATA
Δ 14°04 02"
D 04°00 00"
R 1432 39
T 176 73'
L 351 63
E 10 86'
PC 08+34 01
186+82 47, 22 RT NB EM
PI 10+10 74
PT 11+85 69
SUPER 0 045'/FT
TRANS LENGTH 165'
FULL SUPER FROM
STA 8+89 00 TO
STA 11+31 00

EX RAMP C CURVE DATA
Δ 13°01 00" RT
D 09°04 49"
R 631 00'
T 105 69'
L 209 43'
E 08 798'
PC 06+26 89
PI 07+32 58
PT 08+36.32
204+33 73, 71' RT SURVEY ℄
SUPER 00 07'/FT

PROP SB MAINLINE QUANTITIES
STA 175+00 TO STA 205+00

22088 SYD	REM PAVT
11545 SYD	OPEN GRADED DR CSE, STAB, (4" IN PLACE)
2283 SYD	CLASS A SHOULDER 6"
11878 SYD	AGG BASE UNDER CONC (3" IN PLACE)
7278 LFT	OPEN GRADED UNDERDRAIN PIPE, 4"
26 STA	DITCH CLEANOUT
3041 CYD	EMBANKMENT - MODIFIED (CIP)
880 CYD	EARTH EXCAV
1400 SYD	MISC CONC PAVT - REINF 10½"

PROP RAMP A,B,C & D QUANTITIES

1834 SYD	REM PAVT
83 CYD	CLASS A SHOULDER (LN)
473 TON	BIT MIXTURE - 3B
1219 TON	BIT MIXTURE - 11A
1118 CYD	EARTH EXCAV
1039 SYD	AGG BASE UNDER BIT (4" IN PLACE)
1243 CYD	EMBANKMENT - MODIFIED (CIP)
244 SYD	CLASS A SHOULDER 6"
15 TON	HAND PATCHING
35 STA	TRENCHING

PROP RAMP A CURVE DATA
Δ 10°14 45 LT
D 07°00 00"
R 818 51'
T 131 44
L 260.65
E 10 49
PC 09+60.95
185+09 93, 16' LT SB EM
PI 10+92 38
PT 12+21 59
SUPER 0 07'/FT
TRANS LENGTH 225'
FULL SUPER FROM
STA 10+25 TO
STA 11+47

GROUP E QUANTITIES
(SEE PREVIOUS PLAN SHEETS)
PROP SUBBASE SPECIAL (CIP)

GROUP D QUANTITIES
EX SUBBASE

GROUP D QUANTITIES
STA 177+50 TO STA 205+00

28 STA	MACHINE GRADING - SPECIAL
7333 SYD	CONC PAVT (GROUP D) REINF, 10½"
4055 SYD	CONC SHLDR (GROUP D) REINF

SECTION 34 & 27
18S ,R6E
WHITEFORD TWP MONROE CO

RECONSTRUCT DISJOINTED CULVERT AND ERODED SLOPE, AS DIRECTED BY ENGR, AT STA 6+00 RAMP B LT

1 EACH REM CULV END
8 LFT CLASS B CULV (CONC), 18"
1 EACH CULV END SECTION CONC, 18"
7 SYD CLASS B SODDING

RECONSTRUCT BROKEN CULVERT END SECTION, AS DIRECTED BY THE ENGR, AT STA 177+50 NB

1 EACH REM CULV END
8 LFT CLASS B CULV (CONC), 12"
1 EACH CULV END SECTION CONC, 12"
10 SYD CLASS B SODDING

RECONSTRUCT BROKEN CULVERT END SECTION, AS DIRECTED BY THE ENGR, AT STA 185+50 NB

1 EACH REM CULV END
8 LFT CLASS B CULV (CONC), 12"
1 EACH CULV END SECTION CONC, 12"
5 SYD CLASS B SODDING

REM EX BIT & CONC PAVT, BIT SHLDRS
CONSTRUCT 24' CONC PAVT WITH CONC SHLDRS ON BOTH ROADWAYS

RECONSTRUCT BROKEN CULVERT END SECTION, AS DIRECTED BY THE ENGR, AT STA 5+00 RAMP C

1 EACH REM CULV END
8 LFT CLASS B CULV (CONC), 18"
1 EACH CULV END SECTION CONC, 18"
5 SYD CLASS B SODDING

GUARD RAIL THIS SHEET

SHEET NO	REM BEAM GUARD RAIL	GALV BEAM GUARD RAIL TYPE T	GUARD RAIL ANCH BRIDGE DET 1 3	GUARD RAIL ANCH BRIDGE DET 1 4	LENGTH OF PARALLEL TYPE T GUARD RAIL	LENGTH OF 1 ON 15 FLARED TYPE T GUARD RAIL	TWIN BEAM ANCH CABLE DEPART END	GUARD RAIL ANCHORAGE CABLE	GALV BEAM GUARD RAIL TYPE B	GALV CURVED BEAM GUARD RAIL TYPE B	REFLECT WASHERS
	LFT	LFT	EACH	EACH	LFT	LFT	EACH	EACH	LFT	LFT	EACH
10	63	444			334	50		1			7
11	44	319			244	75		1			8
12	44	319			412		1	1	263	87	20
13	838	412			412		1				8
14	425	412			412						8
15	425	412			462	50		1	88	87	9
16	125	533			431		1				9
17	425	431			344		1		88	63	13
18	463	244	1		419	75		1	88	63	18
19	70	494	1						88	63	6
18	145		1						75	63	6
17	195		1					1	88	87	8

NOTES:

1. RAMP QUANTITIES ARE ESTIMATED FROM THE ROADWAY 2' POINT TO THE PROPOSED TERMINAL SPRING POINT
2. TRANSITION RAMP & ACCEL TAPER ALONG CURVE AT 1:25
3. RAMP TERMINALS AND CROSSROAD QUANTITIES ARE SHOWN ON DETAIL SHEET NO

PROPOSED BULLNOSE QUANTITIES

325 LFT	REM BEAM GUARDRAIL

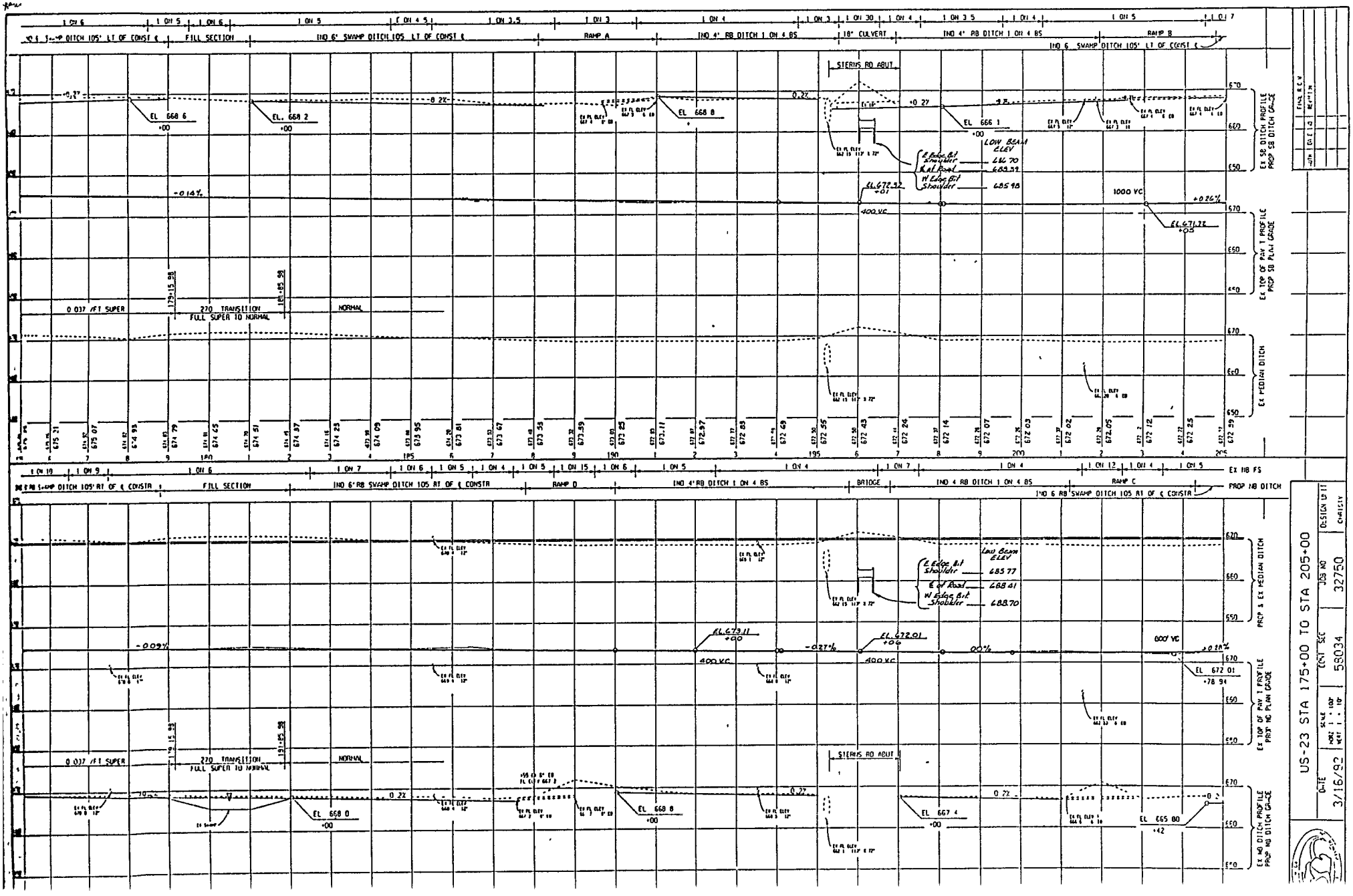
PROP NB MAINLINE QUANTITIES
STA 175 00 TO STA 205 00

22026 SYD	REM PAVT
30 STA	MACHINE GRADING - SPECIAL
8000 SYD	CONC PAVT REINF 10½"
4232 SYD	CONC SHOULDERS REINF
11582 SYD	OPEN GRADED DR CSE, STAB, (4" IN PLACE)
2283 SYD	CLASS A SHOULDER 6
11915 SYD	AGG BASE UNDER CONC (3" IN PLACE)
7121 LFT	OPEN GRADED UNDERDRAIN PIPE, 4"
25 STA	DITCH CLEANOUT
1592 CYD	EMBANKMENT MODIFIED (CIP)
2074 CYD	EARTH EXCAV
1267 SYD	MISC CONC PAVT - REINF 10½"

PROP RAMP C CURVE DATA
Δ 18°09 43" RT
D 07°00 00"
R 818 51'
T 130 83
L 259 46'
E 10 39
PC 105+78 87
PI 107+07 70
PT 108+50 33
204+33 37, 15'RT NB, EM
SUPER 00 07'/FT
TRANS LENGTH 225'
FULL SUPER FROM
STA 6+54 TO
STA 7+63

STERNS RD

CONSTRUCTION SHEET



US-23 STA 175+00 TO STA 205+00

DATE	SCALE	CONT SEC	JOB NO	DESIGN UNIT
3/16/92	HORZ 1" = 100' VERT 1" = 10'	58034	32750	CHATEAU

DATE	NO	REVISION

SECTION 27
18b ,AGE
WHITEFORD TWP MONROE CO

REMOVE END SECTION, EXTEND CULV AND PLACE NEW END SECTION, STA 209+00, LT OF SB

1 EACH	REM CULV END
24 LFT	CLASS B CULV (CONC), 12"
1 EACH	CULV END SECTION CONC, 12"
5 SYD	RIPRAP, PLAIN
5 SYD	CLASS B SODDING

GROUP D QUANTITIES
STA 205+00 TO STA 235+00

7915 SYD	CONC PAV'T (GROUP D) REINF, 10½"
4763 SYD	CONC SHLDR (GROUP D) REINF
3565 CYD	EARTH EXCAV
4606 CYD	SUBBASE - SPECIAL (CIP)

PROP SB RDWY MAINLINE QUANTITIES
STA 205+00 TO STA 235+00
STA 9+00 TO STA 214+25 60, RAMP B & CORE

20636 SYD	REM PAVT
1179 SYD	MISC CONC PAVT - REINF 10½"
5 STA	MACHINE GRADING - SPECIAL
11072 SYD	OPEN GRADED DR. CSE, STAB, (4" IN PLACE)
2308 SYD	CLASS A SHOULDER 6"
11402 SYD	AGG BASE UNDER CONC (3" IN PLACE)
5936 LFT	OPEN-GRADED UNDERDRAIN PIPE, 4"
29 5 STA	DITCH CLEANOUT
1450 CYD	EARTH EXCAV
1796 CYD	EMBANKMENT - MODIFIED (CIP)

RECONSTRUCT BROKEN CULVERT END SECTION, AS DIRECTED BY ENGR, AT STA 217+00 RT OF SB

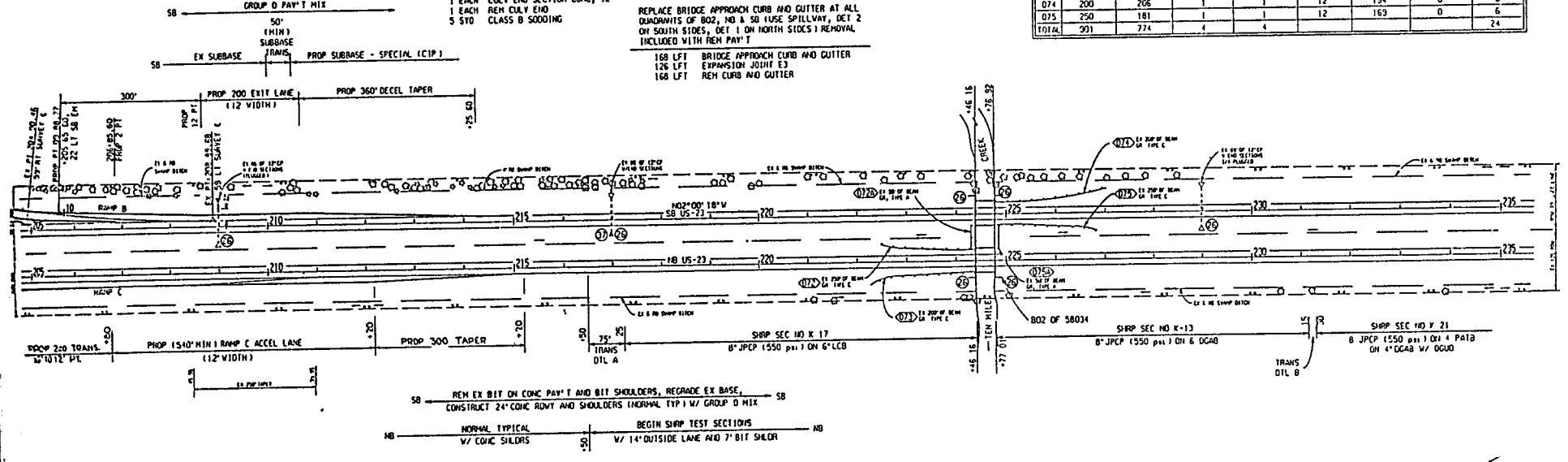
4 LFT	CLASS B CULV (CONC), 12"
1 EACH	CULV END SECTION CONC, 12"
1 EACH	REM CULV END
5 SYD	CLASS B SODDING

REPLACE BRIDGE APPROACH CURB AND GUTTER AT ALL QUADRANTS OF B02, NB & SB (USE SPILLWAY, DET 2 ON SOUTH SIDES, DET 1 ON NORTH SIDES) REMOVAL INCLUDED WITH REM PAV'T

168 LFT	BRIDGE APPROACH CURB AND GUTTER
126 LFT	EXPANSION JOINT E3
168 LFT	REM CURB AND GUTTER

GUARD RAIL-THIS SHEET

TAG NO	REM BEAM GUARD RAIL	GALV BEAM GUARD RAIL TYPE T	GUARD RAIL ANCH BRIDGE DET T 4	GUARD RAIL ANCHORAGE CABLE	LENGTH OF PARALLEL TYPE T GUARD RAIL	LENGTH OF 1 ON 15 FLARED TYPE T GUARD RAIL	WHITE BEAM ANCH CABLE (REPAT END	REFLECT WASHERS
	LFT	LFT	EACH	EACH	LFT	LFT	EACH	EACH
072	250	181	1	1	12	169	0	6
073	201	206	1	1	12	194	0	6
074	200	206	1	1	12	194	0	6
075	250	181	1	1	12	169	0	6
TOTAL	901	774	4	4				24



PROP NB RDWY MAINLAND QUANTITIES
(EXCEPT SHRP SECTION ITEMS)
STA 205+00 TO STA 235+00
STA 7+20 TO STA 216+50, RAMP C & CORE

20750 SYD	REM PAVT
12 STA	MACHINE GRADING - SPECIAL
2947 SYD	CONC PAVT - REINF 10½"
1331 SYD	MISC CONC PAVT - REINF 10½"
1789 SYD	CONC SHOULDERS - REINF
5364 SYD	OPEN-GRADED DR. CSE, STAB, (4" IN PLACE)
2308 SYD	CLASS A SHOULDER 6"
5492 SYD	AGG BASE UNDER CONC (3" IN PLACE)
3150 LFT	OPEN GRADED UNDERDRAIN PIPE, 4"
29 5 STA	DITCH CLEANOUT
887 TON	BIT MIXTURE - 11A
206 TON	BIT MIXTURE - 3B
3151 CYD	EMBANKMENT - MODIFIED (CIP)
1450 CYD	EARTH EXCAV

PROP SHRP SECTION K-17 AND TRANS A QUANTITIES
STA 216+50 TO STA 221+46 16, NB RDWY

4321 CYD	EARTH EXCAV
1651 CYD	EMBANKMENT - SPECIAL (CIP)
2834 SYD	LEAN CONC BASE 16" IN PLACE)
2302 SYD	CONC PAV'T - NONREINF 8" (GRADE 550 SHRP)
1300 LFT	CONTRACTION JOINT C (SILICONE SEALED, 1¼" DOWELS)

PROP SHRP SECTION K 13 AND TRANS B QUANTITIES
STA 224+77 01 TO STA 231+30, NB RDWY

4000 CYD	EARTH EXCAV
4351 CYD	EMBANKMENT - SPECIAL (CIP)
2322 SYD	DENSE GRADED AGG BASE (6" IN PLACE)
1886 SYD	CONC PAV'T - NONREINF 8" (GRADE 550 SHRP)
1066 LFT	CONTRACTION JOINT C (SILICONE SEALED, 1¼ DOWELS)

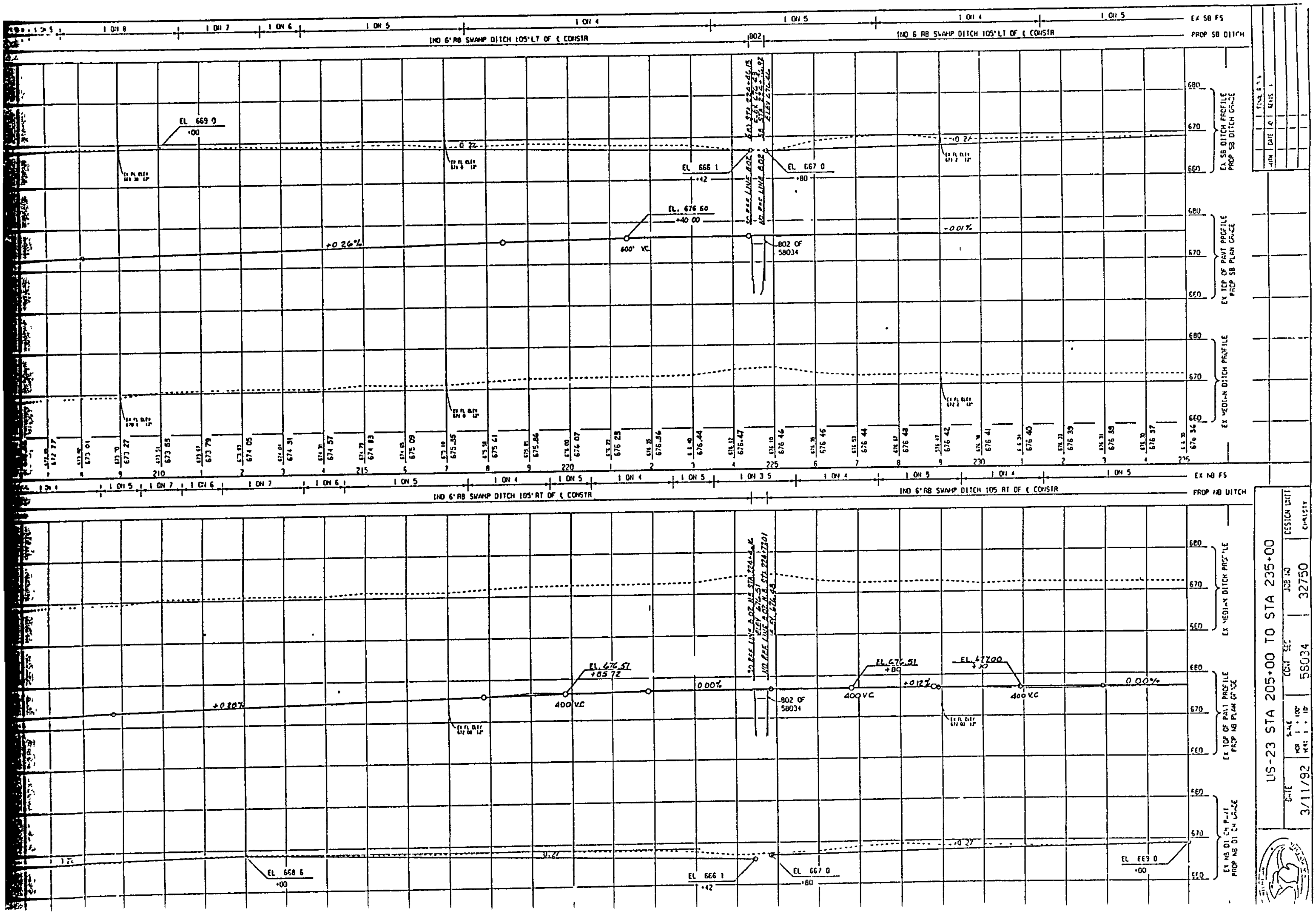
PROP SHRP SECTION K 21 AND TRANS C QUANTITIES
STA 231+30 TO STA 237+45, NB RDWY

841 CYD	EARTH EXCAV
1053 CYD	EMBANKMENT - SPECIAL (CIP)
2187 SYD	DENSE GRADED AGG BASE (4" IN PLACE)
2187 SYD	FERMEABLE ASPHALT TREATED BASE 14" IN PLACE)
1777 SYD	CONC PAV'T - NONREINF 8" (GRADE 550 SHRP)
1324 LFT	OPEN GRADED UNDERDRAIN, 4 (SHRP)
1066 LFT	CONTRACTION JOINT C (SILICONE SEALED, 1¼" DOWELS)

NOTES:

1. WARP PAVEMENT AND SHOULDER APPROACHES 60 LFT TO B02, AS DIRECTED BY THE ENGINEER, AT NB AND SB TO MATCH EXISTING PARABOLIC DECK SURFACE.
2. LOCATE TRANSVERSE PAVEMENT EXPANSION JOINTS, E2, AS DIRECTED BY THE ENGINEER
3. TRANSITION SHOULDERS AT 1:25 TO MATCH EXISTING DECK SECTION AT B02, NB AND SB

CONSTRUCTION SHEET



EX SB FS
PROP SB DITCH
IND 6' RB SWAMP DITCH 105' LT OF ⊄ CONSTR
EX SB DITCH PROFILE
PROP SB DITCH GRADE
EL 669.0
+00
EL 666.1
+42
EL 667.0
+80
EX TOP OF PAVT PROFILE
PROP SB PLAN GRADE
EL. 676.60
+40.00
+0.26%
600' VC
-0.01%
802 OF 58034
EX MEDIAN DITCH PROFILE
EX NB FS
PROP NB DITCH
IND 6' RB SWAMP DITCH 105' RT OF ⊄ CONSTR
EX MEDIAN DITCH PROFILE
EX TOP OF PAVT PROFILE
PROP NB PLAN GRADE
EL. 676.51
+05.72
400 VC
+0.20%
0.00%
EL. 676.51
+80
+0.12%
EL. 677.00
400 VC
0.00%
802 OF 58034
EX NB DITCH PAVT
PROP NB DITCH GRADE
EL 668.6
+00
EL 666.1
+42
EL 667.0
+80
EL 669.0
+00
0.27
-0.27
US-23 STA 205+00 TO STA 235+00
DATE 3/11/92
CONT SEC 58034
JOB NO 32750
DESIGN UNIT

AUTH	DATE	NO	FINAL P.O.J. REVISION

NB US-23
CURVE DATA
Δ=00°39' 30 00" RT
D=00°10'00 02"
R=34330 48
T=197 23'
L=394.46'
E=
PC =248+61 51
PI =250+58 74
PT =252+55 97
(NO SUPERELEVATION)

SB US-23
CURVE DATA
Δ=00°39' 30 00" RT
D=00°09 59 18"
R=34424 48"
T=197 77'
L=395 54'
E=
PC =248+61 41
PI =250+59.18
PT =252+56 95
(NO SUPERELEVATION)

SECTION 27&22
T8S ,R6E
WHITEFORD TWP MONROE CO

GROUP D QUANTITIES
STA 235+00 TO STA 247+50

1806 CYD	EARTH EXCAV
2257 CYD	SUBBASE - SPECIAL (CIP)
3333 SYD	CONC PAV'T (GROUP D) REINF, 10½"
1944 SYD	CONC SHLDR (GROUP D) REINF

RECONSTRUCT BROKEN CULVERT
END SECTION, AS DIRECTED BY
ENGR, AT STA 237+00 RT OF SB

6 LFT	CLASS B CULV (CONC), 12"
1 EACH	CULV END SECTION CONC, 12"
1 EACH	REM CULV END
5 SYD	CLASS B SODDING

50' (MIN) SUBBASE TRANS

GROUP D QUANTITIES ON PROP SUBBASE - SPECIAL (CIP) | GROUP C QUANTITIES ON EX SUBBASE

RECONSTRUCT DISJOINTED
CULV AND ERODED SLOPE,
AS DIRECTED BY THE ENGR,
AT STA 253+00 LT OF SB

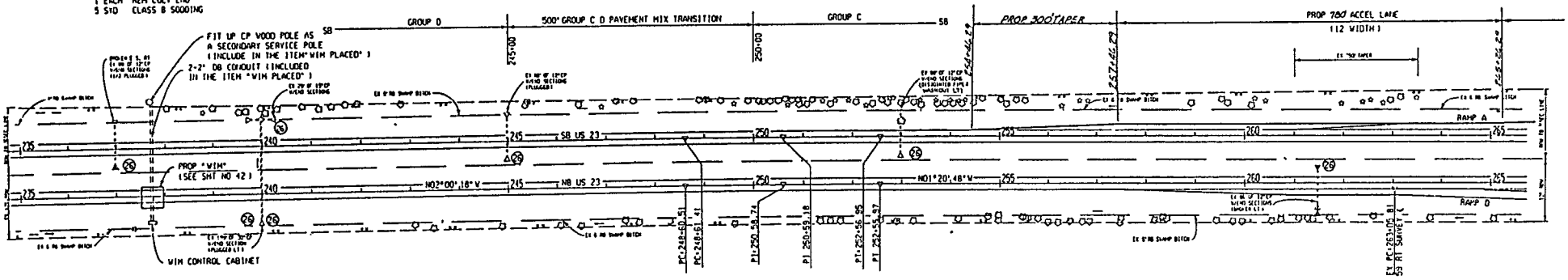
25 CYD	EMBANKMENT (CIP)
8 LFT	CLASS B CULV (CONC), 12"
1 EACH	REM CULV END
5 SYD	CLASS B SODDING
1 EACH	CULV END SECTION-CONC, 12"

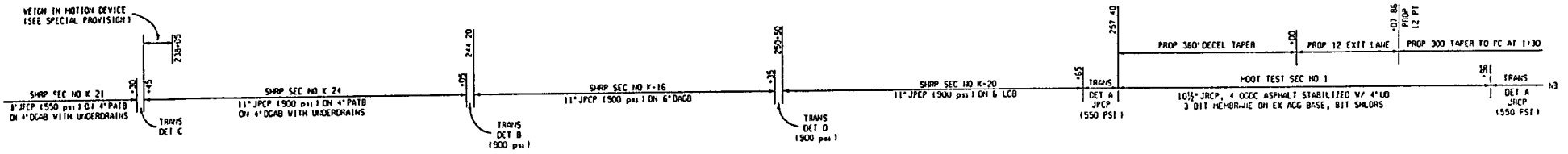
GROUP C QUANTITIES
STA 247+50 TO STA 265+00

17 4 STA	MACHINE GRADING - SPECIAL
5633 SYD	CONC PAV'T (GROUP C) REINF, 10½"
2722 SYD	CONC SHLDR (GROUP C) REINF

SB MAINLINE QUANTITIES
STA 235+00 TO STA 265 00 &40
STA 256+25 TO STA 11+00 RAMP A

21067 SYD	REM PAVT
11545 SYD	AGG BASE UNDER CONC (3" IN PLACE)
11545 SYD	OPEN GRADED DR CSE, ST#8, (4" IN PLACE)
6675 LFT	OPEN GRADED UNDERDRAIN PIPE, 4"
2333 SYD	CLASS A SHOULDER 6"
2311 CYD	EMBANKMENT - MODIFIED (CIP)
30 STA	DITCH CLEANOUT
1775 CYD	EARTH EXCAV
1545 SYD	MISC CONC PAVT - REINF 10½





SHRP SEC NO 21 AND
TRANS C QUANTITIES
TO STA 237+45
SEE PREVIOUS PLAN SHEET

SHRP SEC NO 24 AND TRANS B QUANTITIES
STA 237+45 TO STA 244+20

1747 2047

1200 CYD	EARTH EXCAV
1500 CYD	EMBANKMENT - SPECIAL (CIP)
1777 SYD	CONC PAV'T - NONREINF 11" (GRADE 900 SHRP) *
2400 SYD	PERMEABLE ASPHALT TREATED BASE (4" IN PLACE)
2409 SYD	DENSE GRADED AGG BASE (4" IN PLACE)
537 LFT	OPEN GRADED UNDERDRAIN, 4" (SHRP)
1118 LFT	CONTRACTION JOINT C (SILICONE SEALED, ½" DOWELS) *

* DELETE IN AREAS WHERE WIM

SHRP SEC NO 16 QUANTITIES
STA 244+20 TO STA 250+35

1695 2034

1344 CYD	EARTH EXCAV
1660 CYD	EMBANKMENT - SPECIAL (CIP)
1777 SYD	CONC PAV'T - NONREINF 11" (GRADE 900 SHRP)
2187 SYD	DENSE GRADED AGG BASE (6" IN PLACE)
1040 LFT	CONTRACTION JOINT C (SILICONE SEALED, ½" DOWELS)

SHRP SEC NO 20 AND
TRANS A & D QUANTITIES
STA 250+35 TO STA 257+40

1895 2270

1541 CYD	EARTH EXCAV
1926 CYD	EMBANKMENT - SPECIAL (CIP)
2037 SYD	CONC PAV'T - NONREINF 11" (GRADE 900 SHRP)
2507 SYD	LEAN CONC BASE (6" IN PLACE)
1144 LFT	CONTRACTION JOINT C (SILICONE SEALED, ½ DOWELS)

REPLACE EX END SECTIONS AND EXTEND
CULVERT AT STA 261+50, RT OF NB

2 EACH	REM CULV END
16 LFT	CLASS B CULV (CONC), 12"
2 EACH	CULV END SECTION CONC, 12"
5 SYD	RIPRAP, PLAIN
10 SYD	CLASS B SODDING
50 CYD	EMBANKMENT (CIP)

HOOT SEC NO 1 QUANTITIES
STA 257+40 TO STA 264+96 WB AND
STA 257+40 TO STA 9+05 RAMP D AND CORE

2016 SYD	CONC PAVT - REINF 10½"
1572 SYD	MISC CONC PAVT - REINF 10½"
4373 SYD	OPEN GRADED DR CSE, ST#8, (4" IN PLACE)
1920 LFT	OPEN-GRADED UNDERDRAIN PIPE, 4"
7 6 STA	MACHINE GRADING - SPECIAL
4373 SYD	BIT MEMBRANE, (3" IN PLACE)

NB MAINLINE QUANTITIES
STA 235+00 TO STA 265+00

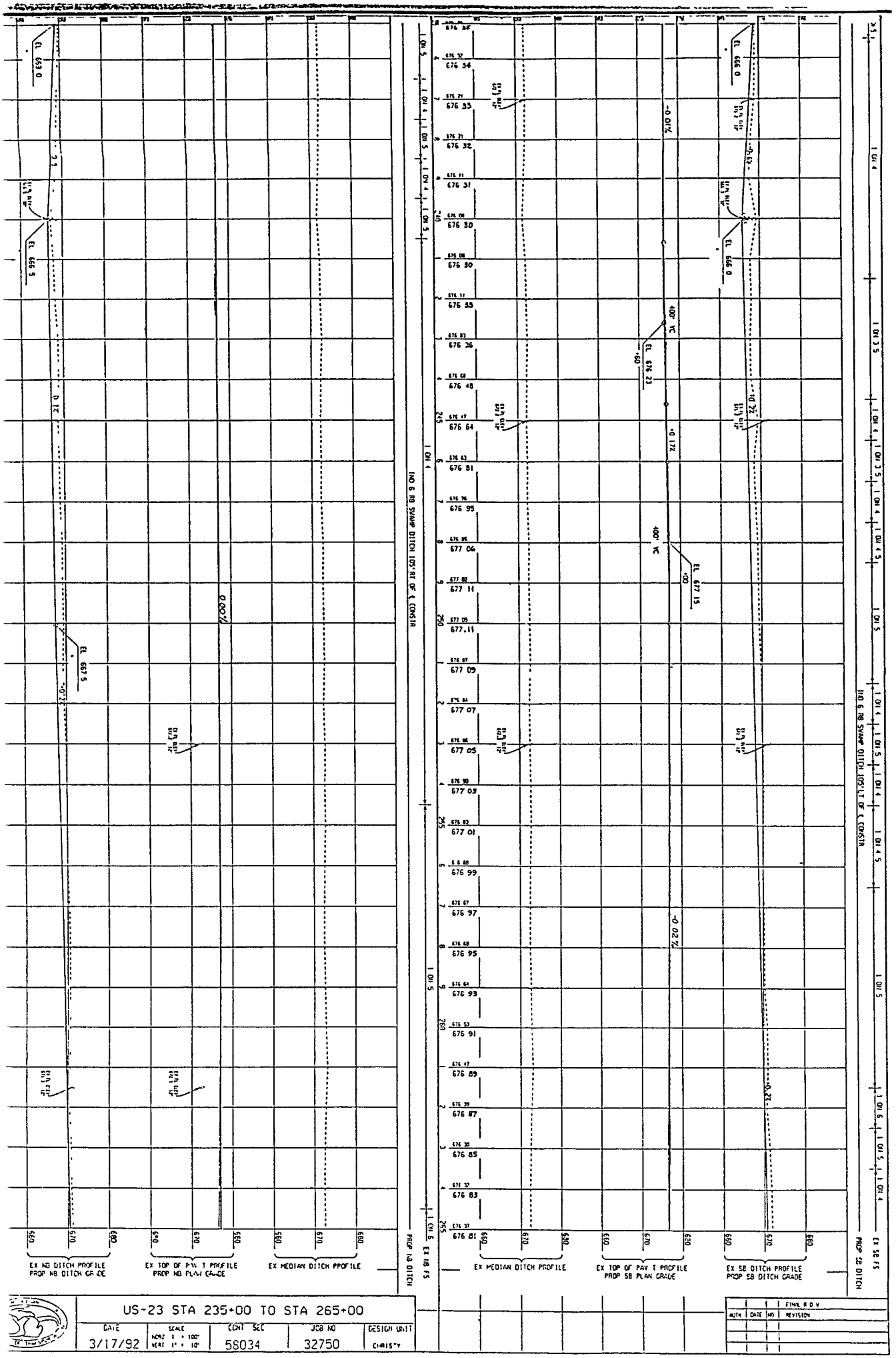
2040 SYD	REM PAVT
330 TON	BIT MIXTURE - 3D
1711 TON	BIT MIXTURE - 1IA
2333 SYD	CLASS A SHOULDER 6"
4366 CYD	EMBANKMENT - MODIFIED (CIP)
30 STA	DITCH CLEANOUT
1775 CYD	EARTH EXCAV

PLACE WEIGH-IN MOTION DEVICE
BETWEEN STA 237+45 TO 239+05,
NB ONLY, AS DIRECTED BY THE ENGINEER

1 LSUM WEIGH IN MOTION, EQUIPMENT FURNISHED
1 LSUM WEIGH IN MOTION, EQUIPMENT PLACED

NOTE:
1 USE BITUMINOUS SHOULDERS ALONG OUTSIDE OF RAMP D.

CONSTRUCTION

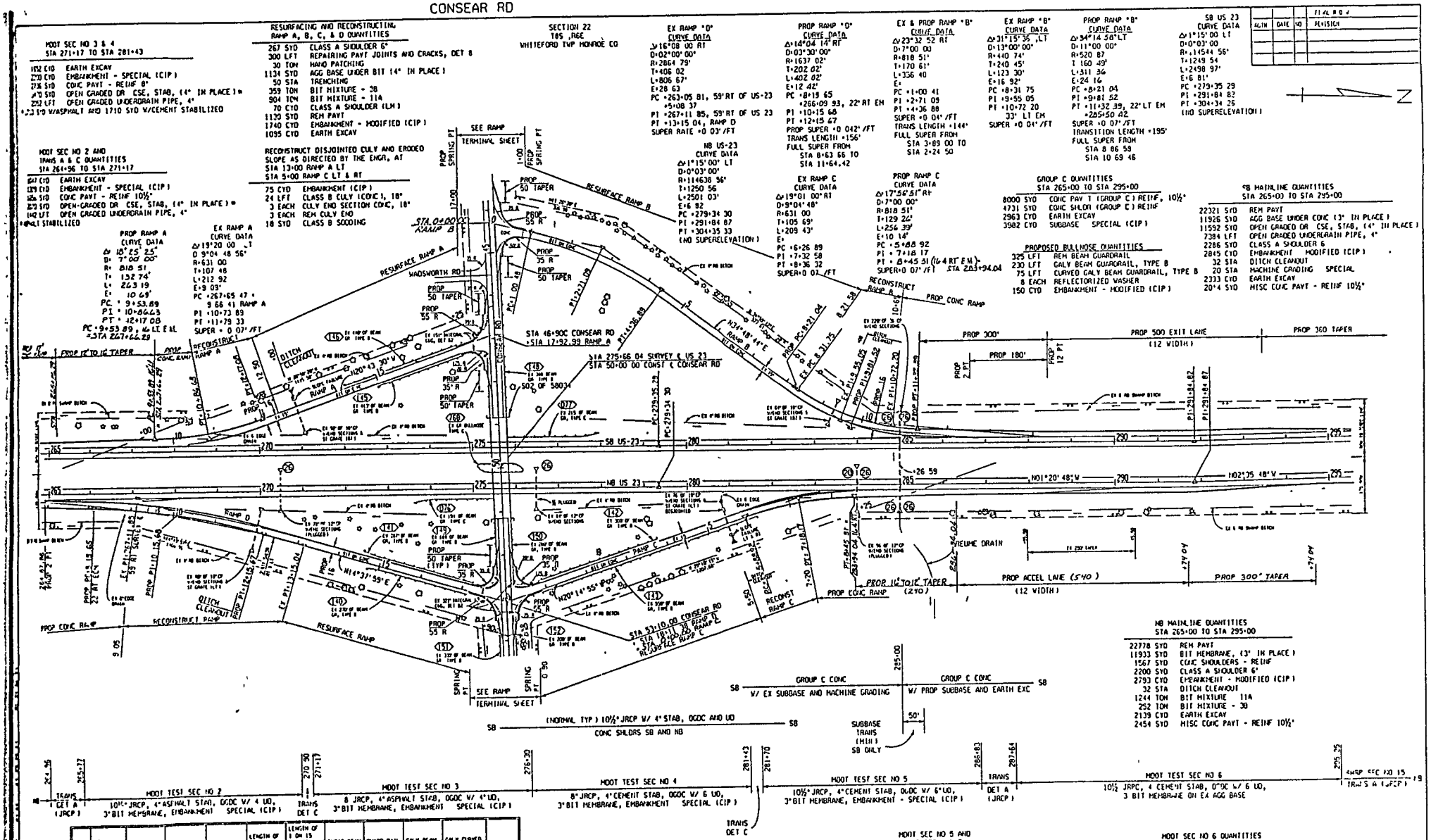


US-23 STA 235+00 TO STA 265+00

DATE	SCALE	CONT SEC	JOB NO	DESIGN UNIT
3/17/92	HORZ 1" = 100' VERT 1" = 10'	58034	32750	CHRISTY

AUTH	DATE	NO	REVISION
			FINAL R O W

CONSEAR RD



MDOT SEC NO 3 & 4
STA 271+17 TO STA 281+43

1172 CYD	EARTH EXCAV
2220 CYD	EMBANKMENT - SPECIAL (CIP)
2134 SYD	CONC PAVT - REINF 8"
470 SYD	OPEN GRADED DR CSE, STAB, (4" IN PLACE) *
252 LFT	OPEN GRADED UNDERDRAIN PIPE, 4"

* 23 SYD W/ASPHALT AND 1710 SYD W/CEMENT STABILIZED

MDOT SEC NO 2 AND TRANS A & C QUANTITIES
STA 264+96 TO STA 271+17

1647 CYD	EARTH EXCAV
1373 CYD	EMBANKMENT - SPECIAL (CIP)
1836 SYD	CONC PAVT - REINF 10½"
323 SYD	OPEN-GRADED DR CSE, STAB, (4" IN PLACE) *
140 LFT	OPEN GRADED UNDERDRAIN PIPE, 4"

* ONLY STABILIZED

RESURFACING AND RECONSTRUCTION
RAMP A, B, C, & D QUANTITIES

267 SYD	CLASS A SHOULDER 6"
300 LFT	REPAIRING PAVT JOINTS AND CRACKS, DET 8
30 TON	HAND PATCHING
1134 SYD	AGG BASE UNDER BIT (4" IN PLACE)
50 STA	TRENCHING
359 TON	BIT MIXTURE - 3B
904 TON	BIT MIXTURE - 11A
70 CYD	CLASS A SHOULDER (ELM)
1120 SYD	REM PAVT
1740 CYD	EMBANKMENT - MODIFIED (CIP)
1095 CYD	EARTH EXCAV

RECONSTRUCT DISJOINTED CULV AND ERODED SLOPE AS DIRECTED BY THE ENGR, AT
STA 13+00 RAMP A LT
STA 5+00 RAMP C LT & RT

75 CYD	EMBANKMENT (CIP)
24 LFT	CLASS B CULV (CONC), 18"
3 EACH	CULV END SECTION CONC, 18"
3 EACH	REM CULV END
18 SYD	CLASS B SODDING

SECTION 22
T8S ,R6E
WHITEFORD TWP MONROE CO

EX RAMP "D" CURVE DATA
Δ=16°08 00" RT
D=2°02'00"
R=2864 79'
T=406 02
L=806 67'
E=28 63
PC =263+05 81, 59'RT OF US-23
PT =271+11 85, 59'RT OF US 23
PI =267+11 85, 59'RT OF US 23
PT =13+15 04, RAMP D
SUPER RATE =0 03'/FT

NB US-23 CURVE DATA
Δ=1°15'00" LT
D=0°03'00"
R=114638 56'
T=1250 56
L=2501 03'
E=6 82
PC =279+34 30
PI =291+84 87
PT =304+35 33
(NO SUPERELEVATION)

PROP RAMP "D" CURVE DATA
Δ=14°04 14" RT
D=3°30'00"
R=1637 02'
T=202 02'
L=402 02'
E=12 42'
PC =8+19 65
=266+09 93, 22'RT EM
PI =10+15 68
PT =12+15 67
PROP SUPER =0 042'/FT
TRANS LENGTH =156'
FULL SUPER FROM
STA 8+63 66 TO
STA 11+64.42

EX & PROP RAMP "B" CURVE DATA
Δ=23°32 52 RT
D=7°00 00
R=810 51'
T=170 61'
L=356 40
E=
PC =1+00 41
PI =2+71 09
PT =4+36 88
SUPER =0 04'/FT
TRANS LENGTH =144'
FULL SUPER FROM
STA 3+89 00 TO
STA 2+24 50

EX RAMP "B" CURVE DATA
Δ=31°15'35" LT
D=13°00'00"
R=440 74'
T=240 45'
L=123 30'
E=16 92'
PC =8+31 75
PI =9+55 05
PT =10+72 20
33' LT EM
SUPER =0 04'/FT

PROP RAMP "B" CURVE DATA
Δ=34°14 56"LT
D=11°00 00"
R=520 87
T 160 49'
L=311 36
E=24 16
PC =8+21 04
PI =9+81 52
PT =11+32 39, 22' LT EM
=285+50 42
SUPER =0 07'/FT
TRANSITION LENGTH =195'
FULL SUPER FROM
STA 8 86 59
STA 10 69 46

SB US 23 CURVE DATA
Δ=1°15'00 LT
D=0°03'00
R=.14544 56'
T=1249 54
L=2498 97'
E=6 81'
PC =279+35 29
PI =291+84 82
PI =304+34 26
(NO SUPERELEVATION)

EX RAMP C CURVE DATA
Δ=19°01 00" RT
D=8°04'48"
R=631 00
T=105 69'
L=209 43'
E=
PC =6+26 89
PI =7+32 58
PI =8+36 32
SUPER=0 07'/FT

PROP RAMP C CURVE DATA
Δ=17°56 51" RT
D=7°00 00"
R=818 51'
T=129 24'
L=256 39'
E=10 14'
PC =5+68 92
PI =7+18 17
PI =8+45 31 (16 4 RT EM)
SUPER=0 07'/FT STA 283+94.04

EX RAMP A CURVE DATA
Δ=19°20 00 LT
D 9°04 48 56"
R=631 00
T=107 48
L=212 92
E=9 03'
PC =267+65 47 *
9 66 41 RAMP A
PI =10+73 89
PT =11+79 33
SUPER = 0 07'/FT

PROP RAMP A CURVE DATA
Δ= 18° 25' 25"
D= 7° 00' 00"
R= 818 51'
T= 132 74'
L= 263 19
E= 10 69'
PC = 9+53.89
PI = 10+86.63
PT = 12+17 08
PC =9+53 89, 46 LT EM
=STA 267+66.29

GROUP C QUANTITIES
STA 265+00 TO STA 295+00

8000 SYD	CONC PAV T (GROUP C) REINF, 10½"
4731 SYD	CONC SHLDR (GROUP C) REINF
2963 CYD	EARTH EXCAV
3982 CYD	SUBBASE SPECIAL (CIP)

PROPOSED BULLNOSE QUANTITIES

325 LFT	REM BEAM GUARDRAIL
230 LFT	GALV BEAM GUARDRAIL, TYPE B
75 LFT	CURVED GALV BEAM GUARDRAIL, TYPE B
8 EACH	REFLECTORIZED WASHER
150 CYD	EMBANKMENT - MODIFIED (CIP)

SB MAINLINE QUANTITIES
STA 265+00 TO STA 295+00

22321 SYD	REM PAVT
11926 SYD	AGG BASE UNDER CONC (3" IN PLACE)
11592 SYD	OPEN GRADED DR CSE, STAB, (4" IN PLACE)
2284 LFT	OPEN GRADED UNDERDRAIN PIPE, 4"
2286 SYD	CLASS A SHOULDER 6
2845 CYD	EMBANKMENT MODIFIED (CIP)
32 STA	DITCH CLEANOUT
20 STA	MACHINE GRADING SPECIAL
2333 CYD	EARTH EXCAV
2014 SYD	MISC CONC PAVT - REINF 10½"

NB MAINLINE QUANTITIES
STA 265+00 TO STA 295+00

22778 SYD	REM PAVT
11933 SYD	BIT MEMBRANE, (3" IN PLACE)
1567 SYD	CONC SHOULDERS - REINF
2200 SYD	CLASS A SHOULDER 6"
2793 CYD	EMBANKMENT - MODIFIED (CIP)
32 STA	DITCH CLEANOUT
1244 TON	BIT MIXTURE 11A
252 TON	BIT MIXTURE - 3B
2139 CYD	EARTH EXCAV
2454 SYD	MISC CONC PAVT - REINF 10½"

SB — GROUP C CONC W/ EX SUBBASE AND MACHINE GRADING | GROUP C CONC W/ PROP SUBBASE AND EARTH EXC — SB

(NORMAL TYP) 10½" JRCP W/ 4" STAB, OGDC AND UD
CONC SHLDRS SB AND NB

SUBBASE TRANS (MEET) SB ONLY

264+96	265+27	270+30	271+17	276+30	281+43	281+70	286+83	287+64	295+25			
TRANS DET A (JRCP)	MDOT TEST SEC NO 2 10½" JRCP, 4" ASPHALT STAB, OGDC W/ 4 UD, 3" BIT MEMBRANE, EMBANKMENT SPECIAL (CIP)	TRANS DET C	MDOT TEST SEC NO 3 8 JRCP, 4" ASPHALT STAB, OGDC W/ 4" UD, 3" BIT MEMBRANE, EMBANKMENT SPECIAL (CIP)	MDOT TEST SEC NO 4 8" JRCP, 4" CEMENT STAB, OGDC W/ 6 UD, 3" BIT MEMBRANE, EMBANKMENT SPECIAL (CIP)	TRANS DET C	MDOT TEST SEC NO 5 10½" JRCP, 4" CEMENT STAB, OGDC W/ 6" UD, 3" BIT MEMBRANE, EMBANKMENT - SPECIAL (CIP)	TRANS DET A (JRCP)	MDOT TEST SEC NO 6 10½ JRPC, 4 CEMENT STAB, 0"OC W/ 6 UD, 3 BIT MEMBRANE ON EX AGG BASE	4HSP SEC NO 15 TRANS A (JRCP)			

TAG NO	REM BEAM GUARD RAIL	CULV BEAM GUARD RAIL TYPE T	GUARD RAIL ANCH BRIDGE DET F 3	GUARD RAIL ANCH BRIDGE DET F 4	LENGTH OF PARALLEL TYPE T GUARD RAIL	LENGTH OF 1 OR 15 FLARED TYPE T GUARD RAIL	THRIE BEAM ANCH CABLE DEPART D10	GUARD RAIL ANCHORAGE CABLE	GALV BEAM GUARD RAIL TYPE B	GALV CURVED BEAM GUARD RAIL TYPE B	REFLECT WASHERS
6	191	157		1	88	113		1			6
77	219	181		1	88	113		1		-	7
140	270	231			181	50					7
141	267	231			156	75		1			8
142	393	459			88		1				13
143	550	537			537		1				13
145	413	476			476		1		88	63	12

NOTE:
1. USE CONC SHLDRS ON NB BETWEEN RAMP CORE AREAS ON OUTSIDE LANE (STA 267+00 TO STA 281+00) AND INSIDE SHOULDERS FOR MDOT SECTIONS 1 6
2. EXTEND GROUP C PAVEMENT TO INCLUDE RAMP LANE TO 2 PT, SB ONLY
3. EXTEND EARTH EXCAVATION FOR SUBBASE - SPECIAL (CIP), SB, OR EMBANKMENT SPECIAL (CIP), NB, TO OUTSIDE SLOPE WHERE WIDENING FOR RAMPS

MDOT SEC NO 5 AND TRANS DET A & C
STA 281+43 TO STA 287+64

1049 CYD	EARTH EXCAV
1311 CYD	EMBANKMENT - SPECIAL (CIP)
1656 SYD	CONC PAVT - REINF 10½"
2711 SYD	OPEN GRADED DR CSE, STAB, (4" IN PLACE) * *
1746 LFT	OPEN GRADED UNDERDRAIN PIPE, 4" *

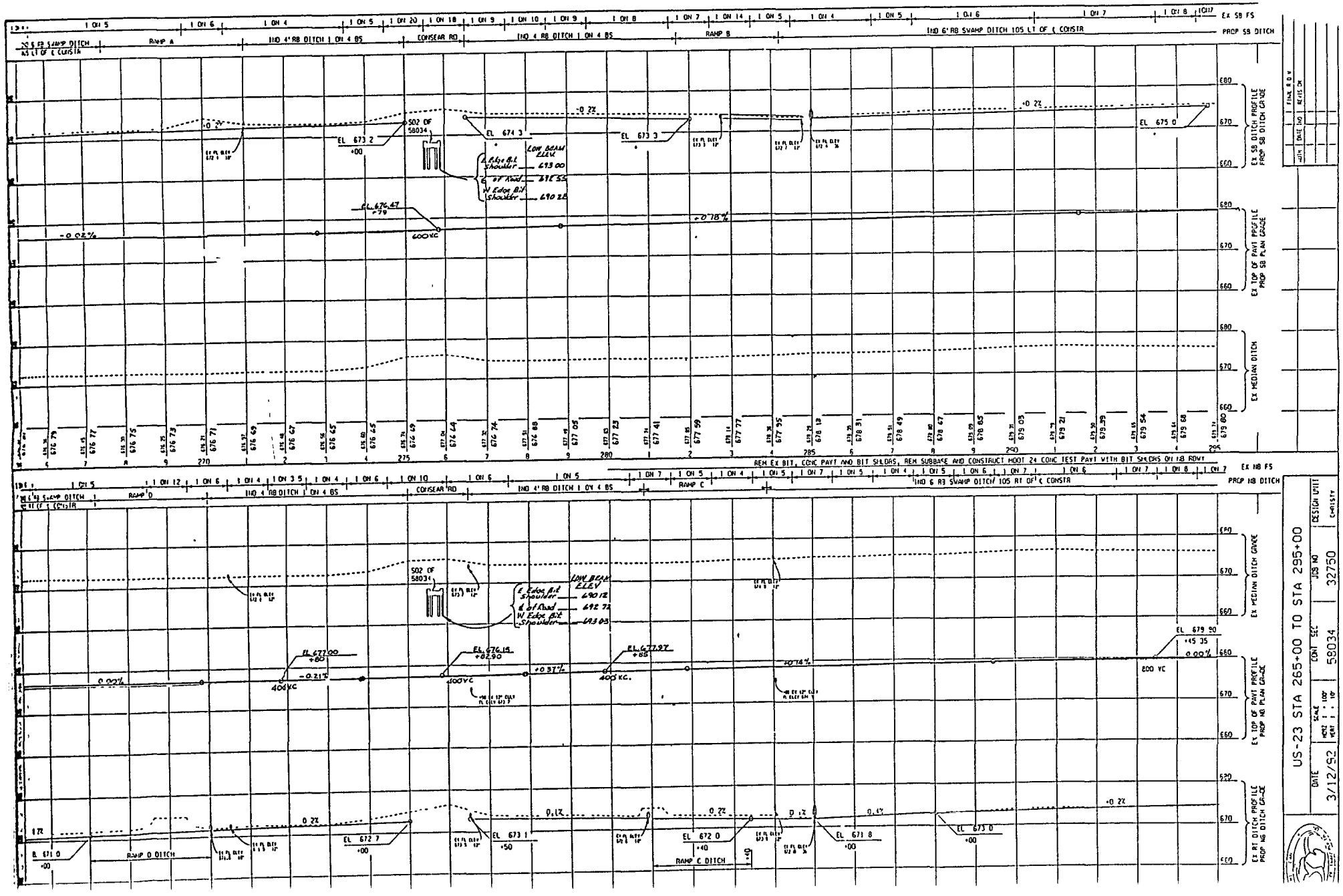
* CEMENT STABILIZED
* * USE 6 FOR CEMENT STABILIZED SECTION

MDOT SEC NO 6 QUANTITIES
STA 287+64 TO STA 295+25

2029 SYD	CONC PAVT - REINF 10½"
3351 SYD	OPEN GRADED DR CSE, STAB, (4" IN PLACE)
2203 LFT	OPEN GRADED UNDERDRAIN PIPE, 4"
8 STA	MACHINE GRADING - SPECIAL

* CEMENT STABILIZED

CONSTRUCTION SHEET


EX SB FS
PROP SB DITCH
RAMP A
RAMP B
CONSEAR RD
INCL 4' RB DITCH 1 ON 4 BS
INCL 6' RB SWAMP DITCH 105 LT OF ℄ CONSTR
EX SB DITCH PROFILE
PROP SB DITCH GRADE
EX TOP OF PAVT PROFILE
PROP SB PLAN GRADE
EX MEDIAN DITCH
REM EX BIT, CONC PAVT AND BIT SHLDRS, REM SUBBASE AND CONSTRUCT MOOT 24 CONC TEST PAVT WITH BIT SHLDRS ON NB RDWY
EX NB FS
PROP NB DITCH
RAMP C
RAMP D
INCL 6' RB SWAMP DITCH 105 RT OF ℄ CONSTR
EX MEDIAN DITCH GRADE
EX TOP OF PAVT PROFILE
PROP NB PLAN GRADE
EX RT DITCH PROFILE
PROP NB DITCH GRADE
RAMP D DITCH
RAMP C DITCH
SO2 OF 58034
LOW BEAM ELEV
E Edge B.T. Shoulder
℄ of Road
W Edge B.T. Shoulder
693 00
691 55
690 28
690 12
692 72
693 03
600 VC
400 VC
800 VC
EL 673 2
EL 674 3
EL 673 3
EL 675 0
EL 676.47
EL 677.00
EL 676.19
EL 677.97
EL 679 90
EL 671 0
EL 672 7
EL 673 1
EL 672 0
EL 671 8
EL 673 0
-0 02%
+0 2%
+0 78%
-0 21%
+0 97%
+0 14%
0 00%
0 2%
0 1%
0 4%
US-23 STA 265+00 TO STA 295+00
DATE 3/12/92
SCALE HORZ 1" = 100' VERT 1" = 10'
CONT SEC 58034
JOB NO 32750
DESIGN UNIT CHRISTY

SB MAINLINE QUANTITIES
STA 295+00 TO STA 325+00

[illegible] SYD	REM PAVT
[illegible] SYD	AGG BASE UNDER CONC (3" IN PLACE)
[illegible] SYD	OPEN GRADED DR. CSE, STAB, (4 IN PLACE)
[illegible] LFT	OPEN GRADED UNDERDRAIN PIPE, 4"
[illegible] SYD	CLASS A SHOULDER 6"
[illegible] CYD	EMBANKMENT - MODIFIED (CIP)
30 STA	DITCH CLEANOUT
[illegible] CYD	EARTH EXCAV

MDOT GROUP C TEST SECTION QUANTITIES
STA 295+00 TO STA 317+50 (SB ONLY)

3249 CYD	EARTH EXCAV
4061 CYD	SUBBASE - SPECIAL (CIP)
6000 SYD	CONC PAV'T (GROUP C) REINF, 10½"
3250 SYD	CONC SHLDR (GROUP C) REINF

MDOT GROUP B TEST SECTION QUANTITIES
STA 317+50 TO STA 325+00 (SB ONLY)

1083 CYD	EARTH EXCAV
1354 CYD	SUBBASE - SPECIAL (CIP)
2000 SYD	CONC PAV'T (GROUP B) REINF, 10½"
1083 SYD	CONC SHLDR (GROUP B) REINF

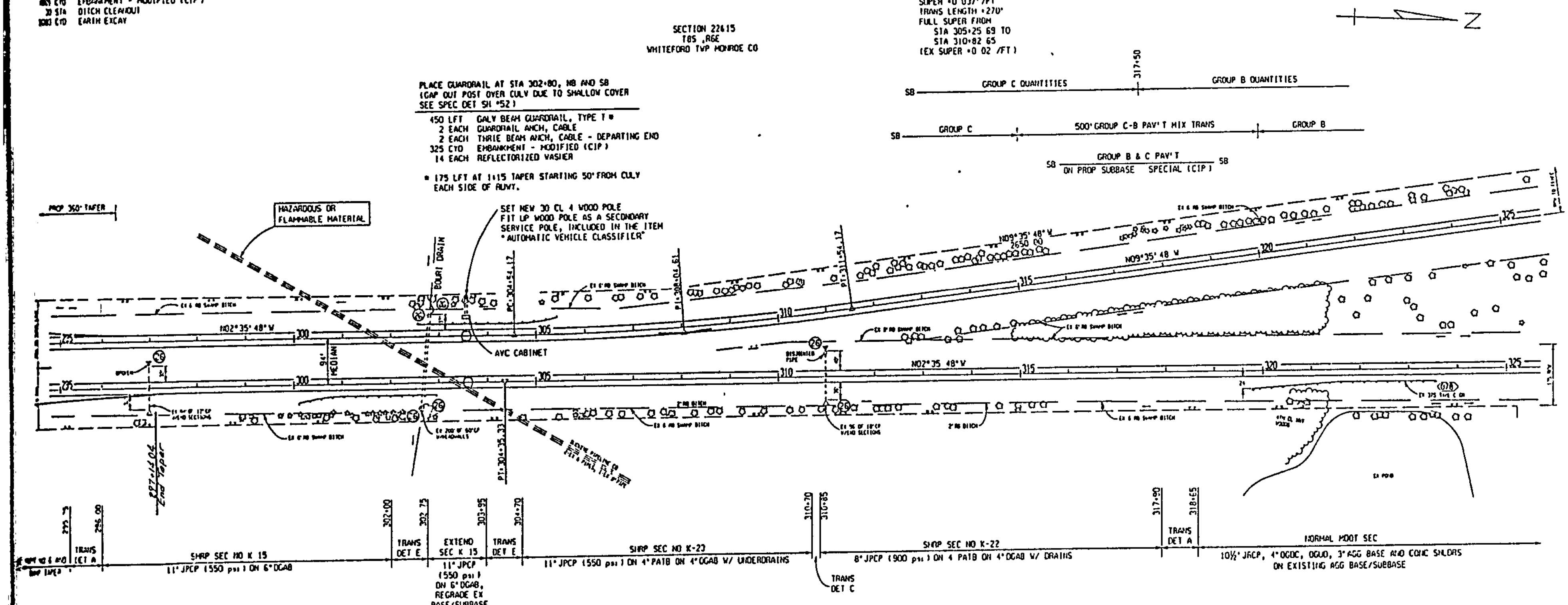
SB US-23
CURVE DATA
Δ=07°00 00 00" LT
D=01°00 00 00
R=5729 58
T=350 44'
L=700 00'
E=
PC =304+54 17
PI =308+04 61
PT =311+54 17
SUPER =0 037'/FT
TRANS LENGTH =270'
FULL SUPER FROM
STA 305+25 69 TO
STA 310+82 65
(EX SUPER =0 02 /FT)

SECTION 22&15
T8S ,R6E
WHITEFORD TWP MONROE CO

PLACE GUARDRAIL AT STA 302+80, NB AND SB
(GAP OUT POST OVER CULV DUE TO SHALLOW COVER
SEE SPEC DET SH *52)

450 LFT	GALV BEAM GUARDRAIL, TYPE T *
2 EACH	GUARDRAIL ANCH, CABLE
2 EACH	THRIE BEAM ANCH, CABLE - DEPARTING END
325 CYD	EMBANKMENT - MODIFIED (CIP)
14 EACH	REFLECTORIZED WASHER

* 175 LFT AT 1:15 TAPER STARTING 50' FROM CULV EACH SIDE OF RDWY.



* REM EX BIT, CONC PAV'T AND BIT SHLDRS, AND REGRADE SB RDWY SUBBASE

CONSTRUCT 24' CONC PAV'T WITH CONC SHLDRS ON SB RDWY
CONSTRUCT SHRP SECS AT 24 CONC PAV'T W' BIT SHLDRS ON NB RDWY

* EXCEPT AT MDOT GAP SECS

SHRP SEC NO K 15, TRANS A & E QUANTITIES
STA 295+25 TO STA 302+75

[illegible] CYD	EARTH EXCAV
[illegible] CYD	EMBANKMENT - SPECIAL (CIP)
[illegible] SYD	DENSE GRADED AGG BASE (6" IN PLACE)
[illegible] SYD	CONC PAV T - NONREINF 11" (GRADE 550 SHRP)
[illegible] LFT	CONTRACTION JOINT C (SILICONE SEALED, 1½" DOWELS)

EXTENDED SEC K 15 QUANTITIES
STA 302+75 TO STA 303+95

1 STA	MACHINE GRADING - SPECIAL
400 SYD	DENSE GRADED AGG BASE (6" IN PLACE)
320 SYD	CONC PAV T - NONREINF 11" (GRADE 550 SHRP)
192 LFT	CONTRACTION JOINT C (SILICONE SEALED, 1½" DOWELS)

SHRP SEC NO K-23, TRANS E & C QUANTITIES
STA 303+95 TO STA 310+85

[illegible] CYD	EARTH EXCAV
1405 CYD	EMBANKMENT - SPECIAL (CIP)
2300 SYD	PERMEABLE ASPHALT TREATED BASE (4" IN PLACE)
2300 SYD	DENSE GRADED AGG BASE (4" IN PLACE)
1840 SYD	CONC PAV'T - NONREINF 11" (GRADE 550 SHRP)
660 LFT	OPEN GRADED UNDERDRAIN, 4" (SHRP)
1012 LFT	CONTRACTION JOINT C (SILICONE SEALED, 1½" DOWELS)

PLACE CULV GRATE AT
STA 311+00, RT OF NB

78 LBS	CULV END SECTION GRATE

SHRP SEC NO K-22, TRANS A QUANTITIES
STA 310+85 TO STA 318+65

2219 ~~1931~~ CYD	EARTH EXCAV
2602 ~~1914~~ CYD	EMBANKMENT - SPECIAL (CIP)
2600 SYD	PERMEABLE ASPHALT TREATED BASE (4" IN PLACE)
2600 SYD	DENSE GRADED AGG BASE (4" IN PLACE)
2080 SYD	CONC PAV'T - NONREINF 8 (GRADE 900 SHRP)
630 LFT	OPEN GRADED UNDERDRAIN, 4 (SHRP)
912 LFT	CONTRACTION JOINT C (SILICONE SEALED, 1¼" DOVELS)

NORMAL MDOT SECTION
STA 318+65 TO STA 327+65

9 STA	MACHINE GRADING SPECIAL
2400 SYD	CONC PAVT - REINF 10½"
1400 SYD	CONC SHOULDERS REINF
3000 SYD	OPEN GRADED DR CSE, STAB, (4" IN PLACE)
1800 LFT	OPEN GRADED UNDERDRAIN PIPE, 4"
3100 SYD	AGG BASE UNDER CONC (3 IN PLACE)

RECONSTRUCT BROKEN CULVERT END SECTION, AS DIRECTED BY THE ENGINEER, AT STA 297+00 LT OF NB

4 LFT	CLASS B CULV (CONC) 12
1 EACH	CULV END SECTION CONC, 12"
1 EACH	REM CULV END
5 SYD	CLASS B SODDING

LOCATE THE AUTOMATIC VEHICLE CLASSIFICATION (AVC) DEVICE WITHIN STA 302+75 TO STA 304+00 NB, AS DIRECTED BY THE ENGINEER. REFER ALSO TO SPECIAL PROVISION AND DETAIL SHEETS NUMBERS.

1 LSUM	AUTOMATIC VEHICLE CLASSIFIER

REPAIR DISJOINTED CULV END SEC
STA 311+00, LT OF NB

1 EACH	REM CULV END
1 EACH	CULV SLOPED END SECTION, FOR CONC PIPE (1 ON 6), 18"
8 LFT	CLASS B CULV (CONC), 18"
15 CYD	EMBANKMENT (CIP)
5 SYD	CLASS B SODDING

REPLACE GUARDRAIL AT (078), APPROX
STA 319+50 TO STA 324+00

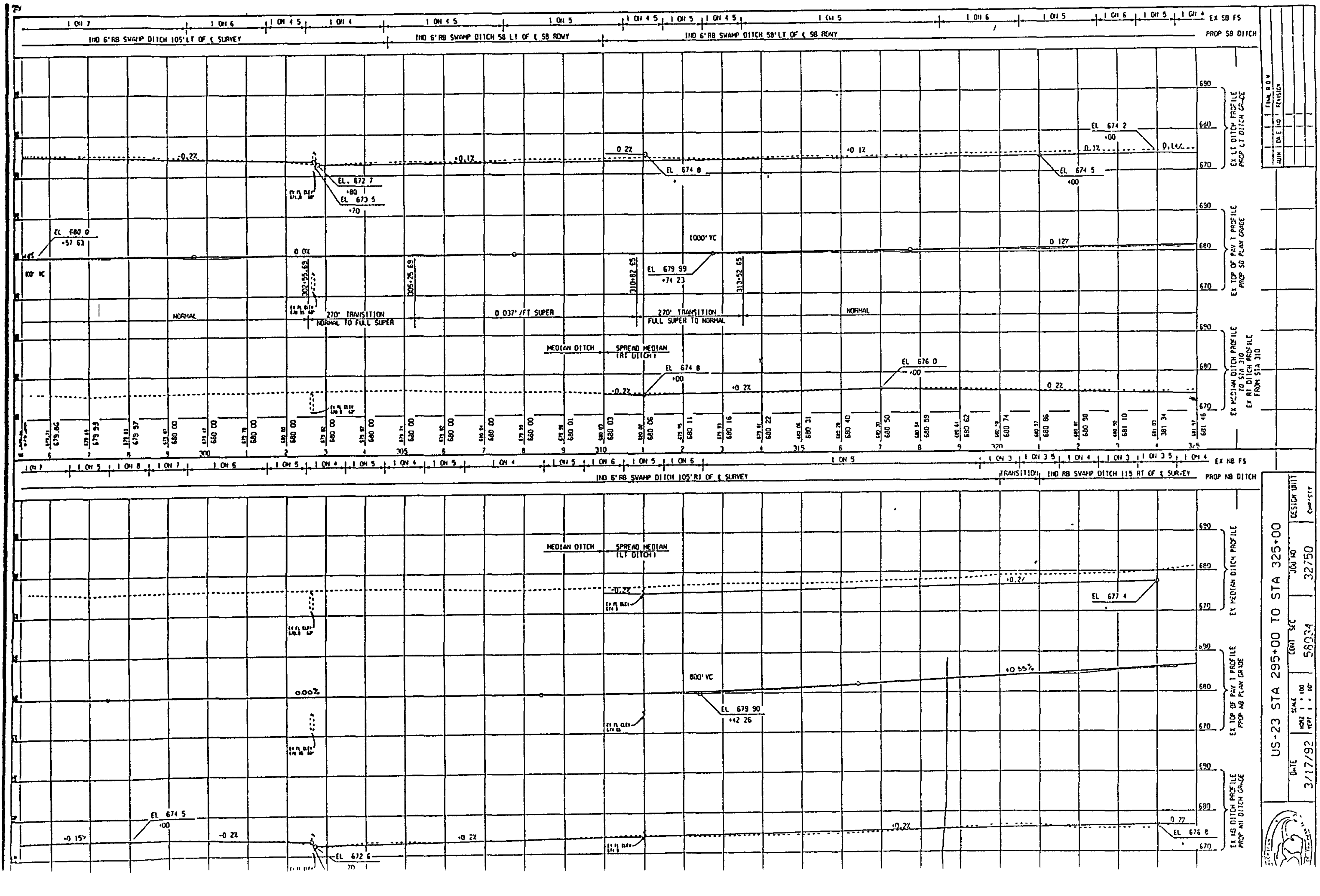
375 LFT	REM BEAM GUARDRAIL
* 350 LFT	GALV BEAM GUARDRAIL, TYPE T
1 EACH	GUARDRAIL ANCH, CABLE
1 EACH	THRIE BEAM ANCH, CABLE - DEPARTING END
9 EACH	REFLECTORIZED WASHER

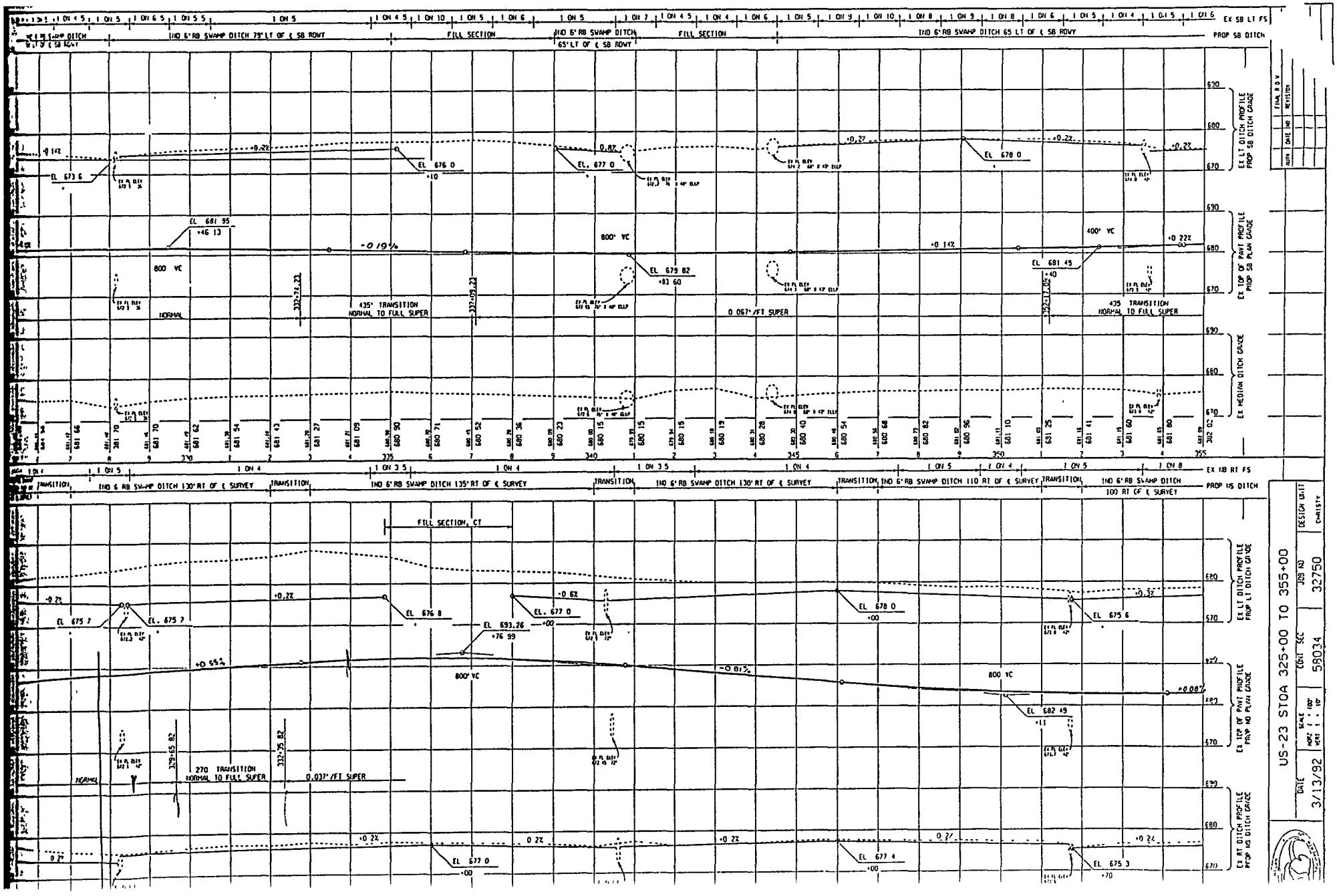
* 175 LFT AT 1:15 TAPER STARTING AT STA 321+50

NB MAINLINE QUANTITIES
STA 295 00 TO STA 325+00

309 TON	BIT MIXTURE - 38
1582 TON	BIT MIXTURE 11A
2334 SYD	CLASS A SHOULDER 6"
2637 CYD	EMBANKMENT MODIFIED (CIP)
27 STA	DITCH CLEANOUT
20334 SYD	REM PAVT
1611 CYD	EARTH EXCAV

CONSTRUCTION SHEET


IND 6'RB SWAMP DITCH 105' LT OF ℄ SURVEY
IND 6'RB SWAMP DITCH 58 LT OF ℄ SB RDWY
IND 6'RB SWAMP DITCH 58' LT OF ℄ SB RDWY
EX SB FS
PROP SB DITCH
EX LT DITCH PROFILE
PROP LT DITCH GRADE
EX TOP OF PAV T PROFILE
PROP SB PLAN GRADE
EX MEDIAN DITCH PROFILE TO STA 310
EX RT DITCH PROFILE FROM STA 310
1000' VC
270' TRANSITION
NORMAL TO FULL SUPER
0.037'/FT SUPER
FULL SUPER TO NORMAL
NORMAL
MEDIAN DITCH
SPREAD MEDIAN (RT DITCH)
SPREAD MEDIAN (LT DITCH)
IND 6'RB SWAMP DITCH 105' RT OF ℄ SURVEY
IND RB SWAMP DITCH 115 RT OF ℄ SURVEY
TRANSITION
EX NB FS
PROP NB DITCH
EX MEDIAN DITCH PROFILE
EX TOP OF PAV T PROFILE
PROP NB PLAN GRADE
EX RT DITCH PROFILE
PROP RT DITCH GRADE
800' VC
US-23 STA 295+00 TO STA 325+00
DATE 3/17/92
CONT SEC 58034
JOB NO 32750
DESIGN UNIT


EX SB LT FS
PROP SB DITCH
IND 6' RB SWAMP DITCH 79' LT OF ℄ SB RDWY
FILL SECTION
IND 6' RB SWAMP DITCH 65' LT OF ℄ SB RDWY
FILL SECTION
IND 6' RB SWAMP DITCH 65 LT OF ℄ SB RDWY
EL 673 6
EL 676 0
+10
EL. 677 0
EL 678 0
EL 681 95
+46 13
800' VC
-0 19%
800' VC
EL 679 82
+83 60
+0 14%
400' VC
+0 22%
EL 681 45
+40
435' TRANSITION
NORMAL TO FULL SUPER
0 067'/FT SUPER
435 TRANSITION
NORMAL TO FULL SUPER
EX LT DITCH PROFILE
PROP SB DITCH GRADE
EX TOP OF PVMT PROFILE
PROP SB PLAN GRADE
EX MEDIAN DITCH GRADE
EX RB RT FS
PROP RS DITCH
TRANSITION
IND 6 RB SWAMP DITCH 130' RT OF ℄ SURVEY
TRANSITION
IND 6' RB SWAMP DITCH 135' RT OF ℄ SURVEY
TRANSITION
IND 6' RB SWAMP DITCH 130' RT OF ℄ SURVEY
TRANSITION
IND 6' RB SWAMP DITCH 110 RT OF ℄ SURVEY
TRANSITION
IND 6' RB SWAMP DITCH
100 RT OF ℄ SURVEY
FILL SECTION, CT
EL 675 7
EL. 675 7
EL 676 8
EL 693.26
+76 99
EL. 677 0
+00
EL 678 0
+00
EL 675 6
+0 55%
800' VC
-0 81%
800' VC
+0 08%
EL 682 49
+11
270 TRANSITION
NORMAL TO FULL SUPER
0 037'/FT SUPER
EL 677 0
+00
EL 677 4
+00
EL 675 3
+70
EX LT DITCH PROFILE
PROP LT DITCH GRADE
EX TOP OF PVMT PROFILE
PROP RD PLAN GRADE
EX RT DITCH PROFILE
PROP RD DITCH GRADE
US-23 STOA 325+00 TO 355+00
DATE
3/13/92
SCALE
HORZ 1" = 100'
VERT 1" = 10'
CONT SEC
58034
JOB NO
32750
DESIGN UNIT
CHRISTY

NO	DATE	BY	REVISION

FINAL PLANS

SB MAINLINE QUANTITIES
STA 318+65 TO STA 356+00

2247 SYD
33 STA
1167 SYD
1120 SYD
6630 LFT
3800 SF
3133 SF
2247 S
3098 C
73 C

NB US-23
CURVE DATA
Δ=37°07' 45 00" RT
D=01°00 00 00"
R=5729 58'
T=1924 27'
L=3712 92'
E=
PC +331+64 30
PI +350+68 58
PT +368+27 22
SUPER = 0 037' /FT
TRANS LENGTH = 270'
FULL SUPER FROM
STA 332+35 82
TO STA 368+05 71
(EX SUPER = 0 02' /FT)

SB US 23
CURVE DATA
Δ=44°07' 45 00" RT
D=02°30' 00 00"
R=2291 83'
T=928 97'
L=1765 17'
E=
PC +335+80.58
PI +345+09 54
PT +353+45 74
SUPER = 0 067' /FT
TRANS LENGTH = 435'
FULL SUPER FROM
STA 337+09 23
TO STA 352+17.09
(EX SUPER = 0 056' /FT)

SECTION 15&10
T8S ,R6E
WHITEFORD TWP MONROE CO

PROP GUARDRAIL, LT OF SB STA 340+60 TO STA 346+10
(GAP OUT POST OVER CULVERT AT STA 344+40
DUE TO SHALLOW COVER SEE SPEC DET SH #52)

512 5 LFT GALV BEAM GUARDRAIL, TYPE T *
1 EACH GUARDRAIL ANCH, CABLE
1 EACH THRIE BEAM ANCH, CABLE - DEPARTING END
150 CYD EMBANKMENT - MODIFIED (CIP)
12 EACH REFLECTORIZED WASHER

* 200 LFT AT 1 ON 15 TAPER. PARALLEL PORTION TO 25 FT EITHER SIDE OF CULVERTS

RECONSTRUCT ERODED SLOPE AS DIRECTED BY THE ENGINEER, AT
STA 340+50 LT & RT OF NB

50 CYD EMBANKMENT (CIP)

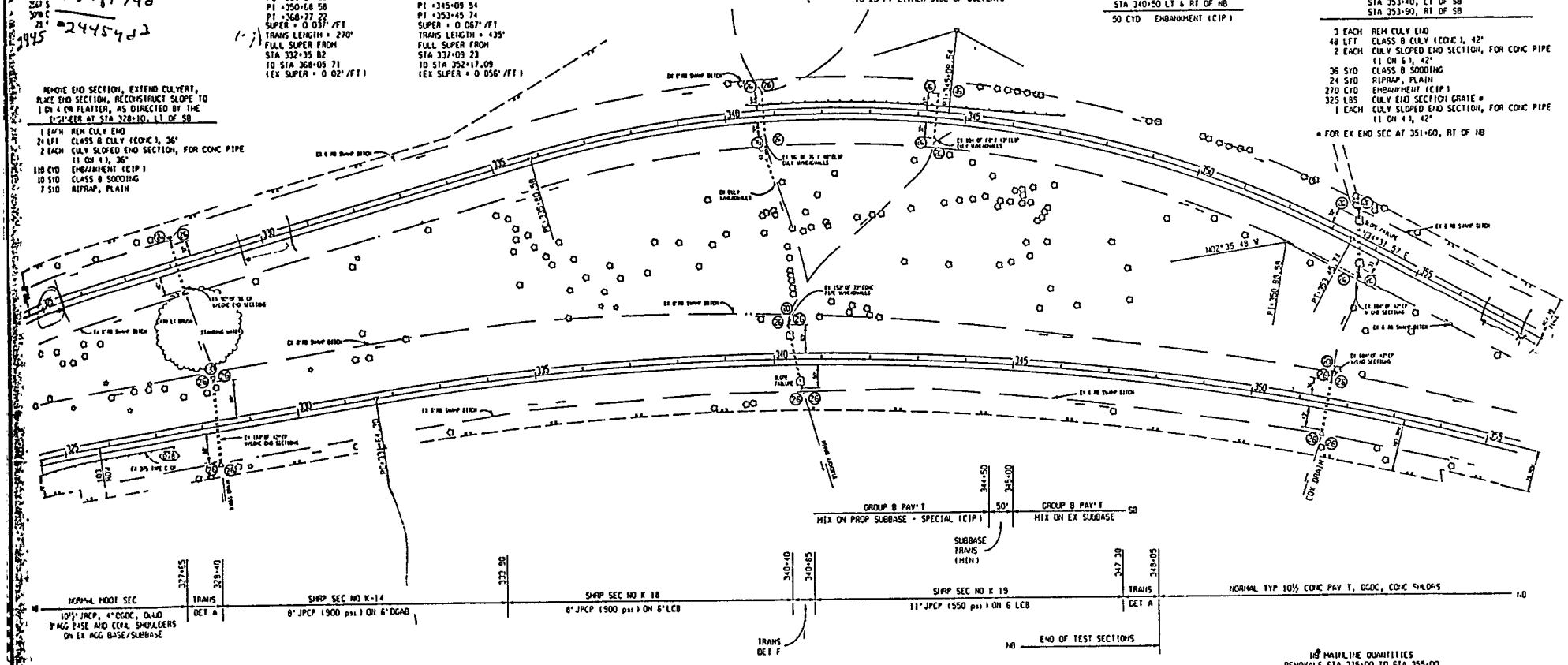
REMOVE END SECTION, EXTEND CULVERT
PLACE END SECTION, PLACE GRATE AND
RECONSTRUCT SLOPE TO 1 ON 6 OR FLATTER
ON INSIDE AND 1 ON 4 OR FLATTER ON
OUTSIDE, AS DIRECTED BY THE ENGINEER AT:
STA 351+60, LT & RT OF NB *
STA 353+40, LT OF SB
STA 353+90, RT OF SB

3 EACH REM CULV END
48 LFT CLASS B CULV (CONC), 42"
2 EACH CULV SLOPED END SECTION, FOR CONC PIPE
(1 ON 6), 42"
36 SYD CLASS B SODDING
24 SYD RIPRAP, PLAIN
270 CYD EMBANKMENT (CIP)
325 LBS CULV END SECTION GRATE *
1 EACH CULV SLOPED END SECTION, FOR CONC PIPE
(1 ON 4), 42"

* FOR EX END SEC AT 351+60, RT OF NB

REMOVE END SECTION, EXTEND CULVERT,
PLACE END SECTION, RECONSTRUCT SLOPE TO
1 ON 4 OR FLATTER, AS DIRECTED BY THE
ENGINEER AT STA 328+10, LT OF SB

1 EACH REM CULV END
24 LFT CLASS B CULV (CONC), 36"
2 EACH CULV SLOPED END SECTION, FOR CONC PIPE
(1 ON 4), 36"
110 CYD EMBANKMENT (CIP)
10 SYD CLASS B SODDING
7 SYD RIPRAP, PLAIN



QUANTITIES FOR MDOT SEC
STA 318+65 TO STA 327+65, NB

SEE PREVIOUS SHEET

SHRP SEC K-14 AND TRANS A QUANTITIES
STA 327+65 TO STA 334+40, NB

1675 CYD EARTH EXCAV
2098 CYD EMBANKMENT - SPECIAL (CIP)
2087 SYD DENSE GRADED AGG BASE (6" IN PLACE)
1667 SYD CONC PAV'T - NONREINF 8" (GRADE 900 SHRP)
1032 LFT CONTRACTION JOINT C (SILICONE SEALED, 1½" DOWELS)

SHRP SEC K 18 QUANTITIES
STA 334+40 TO STA 340+40, NB

1489 CYD EARTH EXCAV
1661 CYD EMBANKMENT - SPECIAL (CIP)
2000 SYD LEAN CONC BASE 16" IN PLACE)
1733 SYD CONC PAV'T - NONREINF 8" (GRADE 900 SHRP)
912 LFT CONTRACTION JOINT C (SILICONE SEALED, 1½" DOWELS)

QUANTITIES FOR
SHRP SECTION K-19 AND TRANS A & F
STA 340+40 TO STA 348+05, NB

1672 CYD EMBANKMENT - SPECIAL (CIP)
2090 SYD LEAN CONC BASE 16" IN PLACE)
2080 SYD CONC PAV'T - NONREINF 11" (GRADE 550-SHRP)
1067 CYD EARTH EXCAV
1176 LFT CONTRACTION JOINT C (SILICONE SEALED, 1½ DOWELS)

NB MAINLINE QUANTITIES
REMOVALS STA 325+00 TO STA 355+00
NORMAL TYP STA 348+05 TO STA 355+00

20334 SYD REM PAV'T
7 STA MACHINE GRADING - SPECIAL
2194 SYD AGG BASE UNDER CONC (3" IN PLACE)
2317 SYD OPEN GRADED DR. CSE, STAB, (4" IN PLACE)
1390 LFT OPEN GRADED UNDERDRAIN PIPE, 4"
1854 SYD CONC PAV'T - REINF 10½"
1081 SYD CONC SHOULDERS - REINF
2334 SYD CLASS A SHOULDER 6"
3579 CYD EMBANKMENT - MODIFIED (CIP)
7 STA DITCH CLEANOUT
1347 CYD EARTH EXCAV

PROP NB MAINLINE QUANTITIES
STA 327+65 TO STA 348+05

267 TON BIT MIXTURE - 3B
1278 TON BIT MIXTURE - 11A

CONSTRUCTION SHEET

APPENDIX B

SPS PROJECT DEVIATION REPORT

LTPP SPS Project Deviation Report Project Summary Sheet	State Code 26 Project Code 0200

Project Classification Information

SPS Experiment Number: 2	State or Province: MICHIGAN
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):	K
Construction Start Date: MAY, 1993	Construction End Date: NOV, 1993
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 Deviarions ☒ Minor Deviations ☐ Significant Deviations

Data Collection and Processing Status Summary

Inventory Data (SPS 5,6,7,9):	☐ Complete Submission ☐ Incomplete ☐ Data Not Available
Materials Data:	☒ All Scheduled Samples Obtained and Tested ☐ Incomplete/No Test Data
Construction Data:	☒ All Required Data Obtained ☐ Incomplete/Missing Data Elements
Historical Traffic Data:	☐ All Required Historical Estimates Submitted (SPS 5,6,7,9) ☐ Required Estimates Not Submitted
Traffic Monitoring Equipment:	☒ 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:	☐ 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)	☐ AWS Installed ☐ AWS Installation Report Submitted to FHWA

Page 1 of 1 Preparer Cary J. Keller, P.E. Date 12/7/95

APPENDIX C

PCC PAVEMENT EDGE THICKNESS AND ELEVATION MEASUREMENT RESULTS

February 1992

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [2] * TEST SECTION NO. [13]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]	[redacted]	[redacted]	[redacted]	[redacted]
2	[11]	[52]	[18.5]	---.3	---.-	---.-
3	[05]	[22 23]	[6.1]	5.1	6.5	0.3
4	[03]	[104]	[8.0]	7.7	8.34	0.2
5	[ ]	[ ]	[ ]	---.-	---.-	---.-
6	[ ]	[ ]	[ ]	---.-	---.-	---.-
7	[ ]	[ ]	[ ]	---.-	---.-	---.-
8	[ ]	[ ]	[ ]	---.-	---.-	---.-
9	[ ]	[ ]	[ ]	---.-	---.-	---.-
10	[ ]	[ ]	[ ]	---.-	---.-	---.-

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) (Rock, Stone, Dense Shale) [20.0]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

PREPARER Mike Green EMPLOYER MDOT DATE 3/94

February 1992

SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [1 3]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches) from centerline	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0	5.5			7.9
	36	5.8			8.2
225+15	72	5.3			8.4
	108	6.1			8.2
	168	5.9			8.6
1+00	0	5.9			8.2
	36	5.9			8.2
226+15	72	6.1			8.0
	108	6.1			8.0
	166	5.9			7.9
2+00	0	6.0			7.9
	36	5.9			8.0
227+15	72	6.0			8.0
	108	6.1			7.9
	166	6.4			7.7
3+00	0	6.5			7.7
	36	6.2			8.0
228+15	72	6.1			8.3
	108	6.6			7.9
	166	6.4			7.9
4+00	0	6.5			7.7
	36	6.2			7.9
229+15	72	6.5			8.0
	108	6.4			7.9
	166	6.1			8.0
5+00	0				8.2
	36				8.2
230+15	72				8.2
	108				8.3
	166				8.0
+__					
LAYER NUMBER[1]		03			04

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [__2] * TEST SECTION NO. [14]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]				
2	[11]	[52]	[~~10.5~~]	~~2~~	~~6.3~~	~~0.3~~
3	[05]	[23]	[~~5.8~~]	~~5.0~~	~~6.2~~	~~0.5~~
4	[03]	[04]	[~~8.1~~]	7.3	~~8.9~~	0.4
5	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
6	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
7	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
8	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
9	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
10	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) (Rock, Stone, Dense Shale) [35.0]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.
2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).
4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

PREPARER Mike Green EMPLOYER MDOT DATE 3/94

February 1992

SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [1 4]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches) from centerline	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0	5.2			8.5
	36	5.5			8.2
328+90	72	5.5			8.2
	108	5.3			8.3
	144	5.5			7.6
1+00	0	5.8			7.8
	36	5.5			7.9
329+90	72	5.6			7.9
	108	6.0			7.7
	144	5.8			7.8
2+00	0	5.8			7.8
	36	5.5			8.0
330+90	72	5.6			7.6
	108	6.0			7.3
	144	5.8			7.3
3+00	0	5.5			8.9
	36	5.6			8.5
331+90	72	5.6			8.3
	108	5.8			8.0
	144	5.8			7.8
4+00	0	6.0			8.6
	36	5.8			8.9
332+90	72	6.1			8.8
	108	6.0			8.3
	144	6.0			8.3
5+00	0	6.0			8.5
	36	5.9			8.5
333+90	72	6.1			8.0
	108	6.3			7.9
	144	6.2			7.8
+__					
LAYER NUMBER[1]		03			04

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [__2] * TEST SECTION NO. [15]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]	[redacted]	[redacted]	[redacted]	[redacted]
2	[11]	[52]	[15.5]	___._	___._	___._
3	[05]	[23]	[6.2]	5.9	7.1	0.3
4	[03]	[04]	[10.7]	10.4	11.5	0.3
5	[__ __]	[__ __]	[___._]	___._	___._	___._
6	[__ __]	[__ __]	[___._]	___._	___._	___._
7	[__ __]	[__ __]	[___._]	___._	___._	___._
8	[__ __]	[__ __]	[___._]	___._	___._	___._
9	[__ __]	[__ __]	[___._]	___._	___._	___._
10	[__ __]	[__ __]	[___._]	___._	___._	___._

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) (Rock, Stone, Dense Shale) [25.0]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

PREPARER Mike Green EMPLOYER MDOT DATE 3/94

February 1992

SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [1 5]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches) from centerline	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0	7.1			10.8
	36	6.6			11.2
296+50	72	6.7			10.7
	108	6.4			10.6
	144	6.5			10.3
1+00	0	6.1			10.8
	36	6.1			10.9
297+50	72	6.0			11.0
	108	6.1			10.7
	144	5.9			10.6
2+00	0	6.2			10.9
	36	6.4			10.9
298+50	72	6.2			11.0
	108	6.1			10.9
	144	6.4			10.6
3+00	0	6.4			11.0
	36	6.0			11.4
299+50	72	5.9			11.5
	108	6.1			10.8
	144	6.1			10.6
4+00	0	6.1			10.6
	36	5.9			10.6
300+50	72	6.2			10.4
	108	6.0			10.4
	144	5.6			10.4
5+00	0	6.2			10.3
	36	6.4			10.6
301+50	72	6.5			10.6
	108	6.7			10.2
	144	6.1			10.1
+__					
LAYER NUMBER[1]		03			04

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [__2] * TEST SECTION NO. [16]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]	[redacted]	[redacted]	[redacted]	[redacted]
2	[11]	[52]	[15.5]	—	—	—
3	[05]	[23]	[5.9]	5.0	6.5	0.4
4	[03]	[04]	[11.1]	10.6	11.8	0.3
5	[__]	[__]	[___.__]	___.__	___.__	___.__
6	[__]	[__]	[___.__]	___.__	___.__	___.__
7	[__]	[__]	[___.__]	___.__	___.__	___.__
8	[__]	[__]	[___.__]	___.__	___.__	___.__
9	[__]	[__]	[___.__]	___.__	___.__	___.__
10	[__]	[__]	[___.__]	___.__	___.__	___.__

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) (Rock, Stone, Dense Shale) [25.0]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

PREPARER Mike Green EMPLOYER MDOT DATE 3/94

February 1992

SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [1 6]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches) from conterline	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0	6.1			11.3
	36	6.1			11.4
244+85	72	6.1			11.4
	108	6.2			11.5
	168	6.5			10.9
1+00	0	5.9			11.2
	36	6.1			11.3
245+85	72	5.9			11.3
	108	5.8			10.9
	166	5.4			10.9
2+00	0	6.1			11.0
	36	6.0			11.2
246+85	72	5.9			11.4
	108	5.8			11.4
	166	6.5			10.8
3+00	0	6.4			10.8
	36	6.0			11.5
247+85	72	6.0			11.3
	108	6.0			11.3
	166	5.4			10.6
4+00	0	5.9			10.7
	36	5.5			11.3
248+85	72	5.8			11.2
	108	5.8			11.2
	166	5.4			10.6
5+00	0	5.6			11.3
	36	5.4			11.8
249+85	72	5.4			11.0
	108	5.0			11.2
	166	5.6			10.6
+__					
LAYER NUMBER[1]		03			04

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [02] * TEST SECTION NO. [17]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]				
2	[11]	[52]	[18.5]	—	—	—
3	[05]	[38]	[6.2]	5.4	6.7	0.4
4	[03]	[04]	[8.3]	7.6	9.0	0.4
5	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
6	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
7	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
8	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
9	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
10	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) (Rock, Stone, Dense Shale) [20.0]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

PREPARER Mike Green EMPLOYER MDOT DATE 3/94

February 1992

SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [1 7]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET ___ OF ___

STATION NUMBER	OFFSET (inches) from centerline	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0			6.4	8.8
	36			6.2	9.0
217+90	72			6.7	8.4
	108			6.7	7.9
	168			6.2	7.8
1+00	0			5.9	8.4
	36			5.6	8.8
218+90	72			5.9	8.4
	108			6.0	8.0
	166			5.8	7.7
2+00	0			6.1	8.4
	36			5.6	8.9
219+90	72			5.8	8.6
	108			5.9	8.3
	166			5.4	7.8
3+00	0			6.2	8.3
	36			6.0	8.6
220+90	72			6.2	8.4
	108			6.5	8.0
	166			6.4	7.9
4+00	0			6.7	7.9
	36			6.5	7.9
221+90	72			6.4	7.9
	108			6.5	7.9
	166			6.4	7.6
5+00	0			6.6	8.8
	36			6.6	8.8
222+90	72			6.5	8.8
	108			6.6	8.3
	166			6.6	7.9
___+___	___				
	___				
	___				
	___				
	___				
LAYER NUMBER[1]		___	___	03	04

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [2] * TEST SECTION NO. [28]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]				
2	[11]	[52]	[18.5]	—	—	—
3	[05]	[38]	[6.0]	5.0	6.6	0.4
4	[03]	[04]	[7.7]	6.7	8.8	0.5
5	[ ]	[ ]	[ ]			
6	[ ]	[ ]	[ ]			
7	[ ]	[ ]	[ ]			
8	[ ]	[ ]	[ ]			
9	[ ]	[ ]	[ ]			
10	[ ]	[ ]	[ ]			

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet)
(Rock, Stone, Dense Shale) [35.0]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

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SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [1 8]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches) from centerline	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0			5.9	7.6
	36			6.1	7.6
334+90	72			6.6	7.2
	108			6.5	7.1
	144			6.4	6.8
1+00	0			5.5	7.9
	36			6.1	7.9
335+90	72			6.2	7.4
	108			6.0	7.4
	144			5.8	7.4
2+00	0			5.0	8.8
	36			5.5	8.3
336+90	72			5.8	8.0
	108			6.0	7.9
	144			5.9	7.8
3+00	0			5.8	8.3
	36			5.9	8.4
337+90	72			6.0	7.8
	108			6.0	7.7
	144			5.9	7.8
4+00	0			5.4	8.3
	36			5.9	7.9
338+90	72			5.9	7.8
	108			6.1	7.6
	144			5.8	7.6
5+00	0			6.1	7.6
	36			6.2	7.6
339+90	72			6.2	7.0
	108			6.6	6.7
	144			6.6	6.7
+__					
LAYER NUMBER[1]				03	04

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

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SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [2] * TEST SECTION NO. [19]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]				
2	[11]	[52]	[15.5]	---.-	---.-	---.-
3	[05]	[38]	[5.0]	4.4	5.6	0.4
4	[03]	[04]	[12.1]	11.3	13.4	0.5
5	[__ __]	[__ __]	[---.-]	---.-	---.-	---.-
6	[__ __]	[__ __]	[---.-]	---.-	---.-	---.-
7	[__ __]	[__ __]	[---.-]	---.-	---.-	---.-
8	[__ __]	[__ __]	[---.-]	---.-	---.-	---.-
9	[__ __]	[__ __]	[---.-]	---.-	---.-	---.-
10	[__ __]	[__ __]	[---.-]	---.-	---.-	---.-

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) [35.0]
(Rock, Stone, Dense Shale)

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

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SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [1 9]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches) from centerline	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0			4.1	12.4
	36			5.2	12.2
341+65	72			5.0	12.1
	108			5.0	12.1
	144			4.9	12.1
1+00	0			4.8	12.6
	36			5.0	12.6
342+65	72			5.3	12.2
	108			4.9	12.2
	144			5.2	11.8
2+00	0			4.2	13.3
	36			4.6	13.4
343+65	72			4.7	13.0
	108			4.6	13.0
	144			4.7	12.6
3+00	0			5.2	12.0
	36			5.4	12.1
344+65	72			5.4	12.1
	108			5.6	11.9
	144			5.5	11.5
4+00	0			5.0	11.6
	36			5.2	11.6
345+65	72			5.3	11.5
	108			5.4	11.4
	144			5.4	11.3
5+00	0			4.4	12.2
	36			5.6	12.1
346+65	72			4.7	11.9
	108			4.8	11.6
	144			4.4	11.8
+___					
LAYER NUMBER[1]				03	04

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [__2] * TEST SECTION NO. [20]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]	[redacted]	[redacted]	[redacted]	[redacted]
2	[11]	[52]	[15.5]	—	—	—
3	[05]	[38]	[6.0]	5.4	7.3	0.5
4	[03]	[04]	[11.3]	10.7	12.3	0.4
5	[__]	[__]	[___]	___	___	___
6	[__]	[__]	[___]	___	___	___
7	[__]	[__]	[___]	___	___	___
8	[__]	[__]	[___]	___	___	___
9	[__]	[__]	[___]	___	___	___
10	[__]	[__]	[___]	___	___	___

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) (Rock, Stone, Dense Shale) [25.0]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

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SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [2 0]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches) from centerline	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0			6.5	11.4
	36			6.0	11.4
250+65	72			5.8	11.5
	108			6.6	11.2
	168			5.9	10.9
1+00	0			6.5	10.8
	36			5.9	11.2
251+65	72			5.8	11.0
	108			6.5	10.9
	166			5.4	11.0
2+00	0			6.1	11.2
	36			5.6	11.5
252+65	72			5.9	11.0
	108			6.5	10.9
	166			5.5	10.7
3+00	0			6.0	11.6
	36			5.9	11.4
253+65	72			5.9	11.4
	108			6.5	11.4
	166			5.6	12.3
4+00	0			5.2	11.9
	36			5.5	11.6
254+65	72			5.6	11.5
	108			6.6	11.4
	166			5.9	10.8
5+00	0			5.4	11.9
	36			6.1	11.5
255+65	72			6.1	11.4
	108			7.3	11.0
	166			6.4	10.7
+__					
LAYER NUMBER[1]				03	04

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [__2] * TEST SECTION NO. [2L]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]				
2	[LL]	[52]	[16.5]	---.-	---.-	---.-
3	[05]	[23]	[4.4]	3.6	5.9	0.6
4	[05]	[3L]	[4.2]	3.6	5.0	0.4
5	[03]	[04]	[8.0]	7.2	8.8	0.4
6	[__]	[__]	[---.-]	---.-	---.-	---.-
7	[__]	[__]	[---.-]	---.-	---.-	---.-
8	[__]	[__]	[---.-]	---.-	---.-	---.-
9	[__]	[__]	[---.-]	---.-	---.-	---.-
10	[__]	[__]	[---.-]	---.-	---.-	---.-

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) (Rock, Stone, Dense Shale) [20.0]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

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SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [2 1]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches) from centerline	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0	5.0	4.2		7.8
	36	5.4	3.8		7.8
231+80	72	4.8	4.6		7.8
	108	5.3	5.0		7.3
	168	5.9	4.7		7.2
1+00	0	4.2	4.6		8.2
	36	4.3	4.3		8.4
232+80	72	3.8	4.7		8.5
	108	3.6	4.2		8.8
	166	3.8	4.6		7.9
2+00	0	4.0	4.6		7.4
	36	4.2	4.0		7.9
233+80	72	4.3	3.8		8.0
	108	4.3	3.6		8.2
	166	4.1	3.7		8.0
3+00	0	3.6	4.6		8.3
	36	3.7	4.4		8.4
234+80	72	4.0	4.6		8.0
	108	4.0	4.1		8.4
	166	4.4	4.0		8.0
4+00	0	5.0	3.7		7.7
	36	5.3	4.2		7.6
235+80	72	5.0	4.4		7.7
	108	4.8	4.1		8.2
	166	4.1	4.1		7.9
5+00	0	4.3	3.7		8.0
	36	3.8	4.2		8.2
236+80	72	3.7	4.6		7.9
	108	3.7	4.0		8.5
	166	4.1	4.1		7.7
+__					
LAYER NUMBER[1]		03	04		05

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [__2] * TEST SECTION NO. [22]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]				
2	[11]	[52]	[16.5]	___.__	___.__	___.__
3	[05]	[23]	[4.2]	3.6	4.6	0.2
4	[05]	[31]	[4.2]	3.6	4.7	0.3
5	[03]	[04]	[7.9]	7.2	8.5	0.3
6	[__ __]	[__ __]	[___.__]	___.__	___.__	___.__
7	[__ __]	[__ __]	[___.__]	___.__	___.__	___.__
8	[__ __]	[__ __]	[___.__]	___.__	___.__	___.__
9	[__ __]	[__ __]	[___.__]	___.__	___.__	___.__
10	[__ __]	[__ __]	[___.__]	___.__	___.__	___.__

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) (Rock, Stone, Dense Shale) [30.__]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

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SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [2 2]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches) from Centerline	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0	4.6	3.6	.	8.3
	36	4.4	4.4	.	7.7
311+90	72	4.0	4.4	.	8.0
	108	4.1	4.7	.	7.6
	144	4.0	4.3	.	7.8
1+00	0	4.6	4.0	.	8.2
	36	4.4	4.3	.	7.7
312+90	72	4.1	4.1	.	7.8
	108	4.6	4.0	.	7.9
	144	4.3	4.1	.	7.6
2+00	0	4.3	4.1	.	8.5
	36	3.6	4.8	.	8.3
313+90	72	4.6	4.0	.	8.3
	108	4.2	4.2	.	7.9
	144	4.3	4.1	.	7.7
3+00	0	4.0	4.2	.	7.9
	36	4.1	3.7	.	8.4
314+90	72	4.2	4.2	.	7.7
	108	4.3	4.1	.	7.4
	144	4.3	4.2	.	7.2
4+00	0	4.0	4.0	.	8.0
	36	4.1	4.1	.	7.7
315+90	72	4.3	4.3	.	7.6
	108	4.4	4.0	.	7.7
	144	4.2	4.1	.	7.7
5+00	0	3.8	3.8	.	8.5
	36	4.2	3.6	.	8.4
316+90	72	4.4	4.4	.	7.7
	108	4.2	4.3	.	7.8
	144	4.0	4.6	.	7.7
+__		.	.	.	.
		.	.	.	.
		.	.	.	.
		.	.	.	.
		.	.	.	.
LAYER NUMBER[1]		03	04		05

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [2] * TEST SECTION NO. [23]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]	[redacted]	[redacted]	[redacted]	[redacted]
2	[11]	[52]	[13.5]	—	—	—
3	[05]	[23]	[4.3]	3.7	5.3	0.3
4	[05]	[31]	[4.1]	3.5	5.0	0.4
5	[03]	[04]	[11.0]	10.2	11.5	0.4
6	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
7	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
8	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
9	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
10	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) (Rock, Stone, Dense Shale) [25.0]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

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SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [2 3]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches)	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00 305+20	0 36 72 108 144	5.3 4.3 4.9 4.9 5.0	3.6 4.3 3.7 3.8 4.1	—.— —.— —.— —.— —.—	10.6 10.7 11.0 10.7 10.3
1+00 306+20	0 36 72 108 144	4.3 4.3 4.0 4.0 4.2	3.5 4.0 3.7 3.8 3.8	—.— —.— —.— —.— —.—	11.4 11.2 11.5 11.7 10.9
2+00 307+20	0 36 72 108 144	4.1 4.0 4.6 4.3 4.0	3.6 4.1 3.8 3.7 3.7	—.— —.— —.— —.— —.—	11.3 11.3 11.4 11.2 11.0
3+00 308+20	0 36 72 108 144	4.3 4.2 4.2 4.3 4.2	3.8 4.2 4.3 4.6 4.7	—.— —.— —.— —.— —.—	11.3 11.3 11.3 10.8 10.2
4+00 309+20	0 36 72 108 144	4.1 4.2 4.1 4.3 4.3	3.7 4.2 4.1 4.0 4.0	—.— —.— —.— —.— —.—	11.5 11.2 11.3 10.9 10.4
5+00 310+20	0 36 72 108 144	3.7 4.0 4.0 4.0 4.0	4.1 4.8 5.0 4.7 4.9	—.— —.— —.— —.— —.—	11.2 10.8 10.7 10.9 10.3
—+—	— — — — —	—.— —.— —.— —.— —.—	—.— —.— —.— —.— —.—	—.— —.— —.— —.— —.—	—.— —.— —.— —.— —.—
LAYER NUMBER[1]		03	04	— —	05

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

SPS-2 CONSTRUCTION DATA SHEET 4 LAYER DESCRIPTIONS	* STATE CODE [26] * SPS PROJECT CODE [2] * TEST SECTION NO. [24]

*1 LAYER NUMBER	*2 LAYER DESCRIPTION	*3 MATERIAL TYPE CLASS	*4 LAYER THICKNESSES (Inches)			
			AVERAGE	MINIMUM	MAXIMUM	STD. DEV.
1	SUBGRADE(7)	[52]				
2	[11]	[52]	[13.5]	___	___	___
3	[05]	[23]	[4.0]	3.4	4.6	0.3
4	[05]	[31]	[4.3]	3.4	5.2	0.4
5	[03]	[04]	[10.9]	9.8	12.1	0.5
6	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
7	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
8	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
9	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._
10	[__ __]	[__ __]	[_ _ _._]	_ _ _._	_ _ _._	_ _ _._

*5 DEPTH BELOW SURFACE TO "RIGID" LAYER (Feet) (Rock, Stone, Dense Shale) [25.0]

NOTES:

1. Layer 1 is the subgrade soil, the highest numbered layer is the pavement surface.

2. Layer description codes:

Overlay.....01	Base Layer.....05	Porous Friction Course..09
Seal/Tack Coat.....02	Subbase Layer.....06	Surface Treatment.....10
Original Surface.....03	Subgrade.....07	Embankment (Fill).....11
HMAC Layer (Subsurface).04	Interlayer.....08	

3. The material type classification codes are presented in Tables A.5, A.6, A.7 and A.8 of the Data Collection Guide for Long Term Pavement Performance Studies, dated January 17, 1990 (Appendix B of SPS-2 Data Collection Guide).

4. Enter the average thickness of each layer and the minimum, maximum and standard deviation of the thickness measurements, if known.

PREPARER Mike Green EMPLOYER MDOT DATE 3/94

February 1992

SPS-2 CONSTRUCTION DATA SHEET 5 LAYER THICKNESS MEASUREMENTS	* STATE CODE [2 6] * SPS PROJECT CODE [2] * TEST SECTION NO. [2 4]

LAYER THICKNESS MEASUREMENTS (Inches) SHEET 1 OF 1

STATION NUMBER	OFFSET (inches)	LAYER THICKNESS (Inches)			
		DENSE GRADED AGGREGATE BASE	PERMEABLE ASPHALT TREATED BASE	LEAN CONCRETE BASE	PCC SURFACE
0+00	0	4.0	4.2		11.2
	36	3.6	4.4		10.9
238+50	72	3.7	4.8		10.7
	108	3.8	4.8		10.1
	168	3.5	4.3		10.9
1+00	0	4.0	4.8		10.6
	36	3.8	4.9		10.6
239+50	72	3.8	5.0		10.6
	108	3.7	4.6		10.9
	166	3.4	4.4		10.8
2+00	0	3.8	4.1		11.0
	36	4.1	4.0		11.0
240+50	72	4.1	4.2		10.8
	108	4.0	4.1		11.0
	166	3.4	4.2		11.2
3+00	0	4.3	4.1		10.9
	36	4.2	4.3		10.7
241+50	72	3.8	5.2		10.3
	108	4.4	4.3		9.8
	166	4.4	4.4		10.6
4+00	0	4.0	4.0		11.4
	36	4.4	4.0		10.9
242+50	72	4.6	4.2		10.8
	108	4.3	4.2		10.8
	166	4.6	4.6		10.4
5+00	0	3.8	3.4		12.1
	36	4.0	3.4		12.0
243+50	72	3.8	4.0		11.8
	108	3.5	4.1		11.5
	166	4.1	4.6		10.9
+00					
LAYER NUMBER[1]		03	04		05

[1]From Construction Data Sheet 4.

PREPARER MIKE GREEN EMPLOYER MDOT DATE: 3/94

APPENDIX D

PROJECT SPECIAL PROVISIONS

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
INFORMATION TO CONTRACTORS
(SHRP TEST SECTIONS)

M&T:CDC 04-02-92
NH 58034/32750A

- Strategic Highway Research Program (SHRP) Test Sections
- Coordination for Materials Sampling
- Weigh-In-Motion (WIM)
- Automatic Vehicle Classification (AVC)

Bidders are hereby notified that this project requires the construction of twelve (12) experimental pavement test sections (designated SHRP SECTION K13 through K24 on plans) as part of the coordinated nationwide, SHRP long-term pavement performance evaluation program. Each test section is unique in design as described on the plans. Within each SHRP Section a 600 ft. long materials sampling and performance monitoring area will be designated by the Department.

This special materials sampling is necessary for documenting to SHRP the as-built characteristics and will be performed under a separate contract and will not be for acceptance purposes for this contract. Materials acceptance will be in accordance with usual Department sampling and test procedures.

Strict tolerance requirements on thickness and elevation within the SHRP test sections will be enforced.

The materials sampling for SHRP will take place on each layer of the pavement structure, i.e., subgrade, embankment, base and pavement surface. Table 1 gives the type and estimated number of samples. Note that not all of the samples are to be taken from pavement layers. There will be concrete and asphalt mixture sampling during placement. Following acceptance by the Engineer of each layer of SHRP test section construction, the Contractor is required to allow access and time for SHRP related materials sampling to be performed by others before proceeding with construction of overlaying pavement layers.

No claim shall be allowed for any delays to the Contractor's work schedule to allow for the above required materials sampling. The Contractor shall be responsible for the patching of the SHRP related material sampling core holes and backfilling bulk sampling excavations. Hence, the Contractor's progress schedule must allow for materials sampling of SHRP test sections. A minimum 24 hour notice will be given to the Engineer when the SHRP test sections are prepared for materials sampling.

The following Special Provisions describe the materials and construction requirements for the SHRP test sections:

- Embankment Special (CIP)
- Proof Rolling
- Dense-Graded Aggregate Base (DGAB)
- Lean Concrete Base (LCB)
- Permeable Asphalt Treated Base (PATB)
- Open Graded Underdrain, 4 inch
- Pavement Riding Quality
- Sealing Transverse Contraction Joints with Silicone Sealant
- Premium Coarse Aggregate for Portland Cement Concrete
- Portland Cement Concrete Pavement
- Sealing Longitudinal Pavement and Shoulder Joints with Silicone Sealant
- Weigh-In-Motion (WIM)
- Automatic Vehicle Classifier (AVC)

These Special Provisions are identified by including in the title, "SHRP TEST SECTIONS."

The portland cement concrete pavement for the SHRP test sections is 8 or 11 inches thick, 12 or 14 foot wide, doweled, jointed plain concrete with 15 foot uniform joint spacing. If necessary, joint location may be adjusted outside the limits of the 600 ft. test section to provide the required joint locations within the 600 ft. test section. A contraction joint shall start and end each 600 ft. SHRP test section. No construction or expansion joints are to be placed within the 600 ft. SHRP test section.

Bidders are hereby notified that this contract includes the requirement that a weigh-in-motion (WIM) system is to be purchased and installed. Requirements for the WIM system are provided by Special Provision and the location is indicated on the plans. Installation shall be in accordance with manufacturers requirements or as directed by the Engineer.

Bidders are also hereby notified that this contract includes the requirement that an automatic vehicle classification (AVC) system is to be purchased and installed. Requirements for the AVC system are provided by Special Provision and the location is indicated on the Plans. Installation shall be in accordance with manufacturer's requirements or as directed by the Engineer.

TABLE 1

MATERIAL AND SAMPLE DESCRIPTION (SHRP Test Sections)	ESTIMATED NUMBER OF SAMPLES (Total for all Sections)
Portland Cement Concrete Pavement	
Coring - 4" diam. cores	98
Bulk Sampling (molded into test specimens)	6
Unbound Base Layers	
In-place Density	24
Plate Bearing	4
Bulk Sampling	3
Moisture content samples	3
Lean Concrete Base	
Coring - 4" diam. cores (taken with PCC cores)	21
Bulk Sampling (molded into test specimens)	6
Permeable Asphalt-Treated Base	
Plate Bearing	2
Coring - 4" diam. cores (taken with PCC cores)	16
Bulk Sampling (100 lbs. per sample, uncompacted)	3
Subgrade & Embankment Layers	
Thin-Walled tube sampling	21
Splitspoon sampling (to replace any thin-walled tube samples that cannot be obtained)	
Bulk sampling (400 lbs. each sample)	6
Moisture content samples	6
In-Place Density	72
Plate Bearing Test	2
Shoulder Auger Probes (to 20 feet or refusal)	12

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
EMBANKMENT SPECIAL (CIP)
(SHRP TEST SECTIONS)

a. Description.-This work covers the compaction of embankments and subgrade soils as defined in Subsection 2.08 of the 1990 MDOT Standard Specifications for Construction with the exceptions as described below and within the designated limits as noted on the plans.

b. Placing and Compacting Embankment.-The soil used for embankment construction shall be only selected clay as approved by the Engineer. The soil shall be composed of sufficient clay and silt size material that a minimum 60 percent of the material by weight would pass a No. 200 sieve by washing and have a Plasticity Index (PI) of 10 or greater per ASTM D 4318.

The soil shall be deposited and spread in layers not more than 9 inches in depth, loose measure, and extending to the full width of the filled area.

At the time of compaction, the soil shall have a moisture content that ranges from no less than 85 percent of optimum moisture to no more than 120 percent of optimum moisture. If the soil contains an excess of moisture, it shall be aerated and thoroughly mixed for uniformity before being compacted. If the soil contains too little moisture, water shall be added and the soil thoroughly mixed for uniformity before being compacted.

AASHTO T-99 Method D shall be used to determine the Maximum Dry Density and Optimum Moisture of the soil being placed.

Each layer of the embankment shall meet moisture requirements and be compacted to not less than 95 percent of the Maximum Dry Density before the succeeding layer is placed.

In the event the specified percentage of maximum dry density and specified moisture content range have been attained but the compacted soil is not sufficiently stable to meet the finished subgrade requirements, aeration and mixing of the soil shall take place to lower the soil's moisture content (within the specified moisture content range) to gain the required stability. If this process does not achieve the required stability, the Engineer may direct that a modifier such as lime be mixed with the material to provide a stable subgrade. The Contractor shall be responsible for determining the proper proportions of lime and soil depending upon the characteristics of the soil to be approved by the Engineer.

Any variation of the surface of the finished subgrade shall not exceed 1/4 inch between two points longitudinally or transversely using a 10 foot straightedge.

Finished subgrade elevations shall not vary from design elevations by more than 0.04 foot based on a rod and level survey conducted by taking readings at a minimum of five locations (edge, outer wheel path, mid lane, inner wheel path, and inside edge of lane) at longitudinal intervals no greater than 50 feet.

c. Measurement and Payment.-The completed work as measured for EMBANKMENT SPECIAL (CIP) (SHRP TEST SECTIONS) will be measured by the same methods as used for EMBANKMENT (CIP) described in Subsection 2.08.17 of the 1990 Standard Specifications and will be paid for at the contract unit price for the following contract item (pay item).

Pay Item	Pay Unit
Embankment Special (CIP)	Cubic Yard

The Contractor shall plan his work to allow the time necessary for the above measurements to be obtained by the Department. No claim shall be allowed for any delays to the Contractor's work schedule to complete the above required measurements.

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
EMBANKMENT - MODIFIED (CIP)

D/PC/jm 1 of 1 4/22/92

Description

This work shall consist of constructing earth grades by placing embankments or fills.

Materials

The materials shall meet the requirements for Granular Material Class II as specified in Section 8.02 of the 1990 Standard Specifications for Construction.

Measurement and Payment

The completed work as measured for "Embankment - Modified (CIP)" will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Embankment - Modified (CIP)	Cubic Yard

Embankment - Modified (CIP) will be measured by volume in cubic yards, compacted in place, based on the grade and cross section shown on the plans or authorized, utilizing the staked section method. No allowance will be made for possible increase in quantity of fill material required due to normal consolidation of the natural ground under the embankment.

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
PROOF ROLLING
(SHRP TEST SECTIONS)

a. Description.-Proof rolling shall be performed to verify the uniformity of support and to identify unstable areas which might require remedial construction (undercutting and replacement). The use of a proof roller as described herein is for testing purposes only, and is not intended as a requirement for compaction of the subgrade.

b. Equipment.-The proof rolling shall be performed by a tractor drawn or self propelled pneumatic-tired proof roller. The proof roller shall consist of four pneumatic-tired wheels mounted on a rigid steel frame. The wheels shall be evenly spaced in one line across the width of the roller and shall be arranged in such a manner that all wheels will carry approximately equal loads when operated over an uneven surface. The maximum spacing between adjacent wheels shall not exceed the tire width. The tires shall be operated at an inflation pressure of 50 pounds per square inch ± 2 pounds per square inch.

The proof roller shall have a suitable body for ballast loading and operated at a gross load of 25 tons ± 1000 pounds. Ballast to obtain the required weight shall consist of ingots, concrete blocks, sandbags, or other approved material with a uniform known unit weight, so the total weight of the ballast used can be readily determined at all times. There shall be a sufficient amount of ballast available at the project site to load the proof roller to the required gross weight of 25 tons.

c. Construction Methods.-The proof roller shall be operated in a systematic manner so a record may be easily kept of the area tested and the working time required for the testing.

The proof roller shall be operated at a speed between 2-1/2 and 5 miles per hour while testing the subgrade.

One complete coverage by the proof roller is defined as the complete coverage by the tire tread of the roller over the entire surface area being tested. Unless otherwise specified or required by the Engineer, one complete coverage of the proof roller shall be made on a completed subgrade of embankments and cut sections with the following exceptions and additions:

For embankments more than 6 feet in depth below subgrade, the proof rolling shall also be conducted on the layer of fill 3 feet below the subgrade.

The proof roller shall not be operated within 15 feet of any bridge abutment or retaining wall.

Proof rolling will not be required on ramps, service or county roads or approaches to structures over the main roadway.

Where proof rolling shows the subgrade to be unstable or to have less than the specified density, such areas shall be corrected by the Contractor.

d. Measurement and Payment.-PROOF ROLLING will be measured in hours for the time the roller, including tractor, is operated for testing purposes. The time will be measured to the nearest 1/4 hour. No measurement will be made for the time required for servicing and repairing the equipment or when moving from one testing site to another. The Contractor will be paid half of the actual time required for moving the roller around a structure location if it is necessary to transport the roller on special equipment.

Unstable conditions encountered during Proof Rolling operations, which result from the failure of the Contractor to attain and maintain the specified density and moisture requirements shall be corrected by the Contractor at the Contractor's expense. Unstable conditions encountered when the specified density and moisture requirements have been attained, shall be corrected and will be paid for at the contract unit prices for the items involved or as extra work. There will be no adjustment in the contract unit price, regardless of the percentage of increase or decrease above or below the contract quantity, for the item of Proof Rolling.

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
DENSE-GRADED AGGREGATE BASE (DGAB)
(SHRP TEST SECTIONS)

a. Description.-This work shall be done in accordance with Section 3.01 of the 1990 Standard Specifications, where and as indicated on the plans for the designated SHRP pavement sections, except as modified herein.

b. Materials.

1. **Aggregate Requirements.**-The aggregate shall conform to the requirements of Section 8.02 for 21AA with the following exceptions:

   (a) The material shall be a crushed stone.

   (b) The percentage passing No. 4 sieve shall be 50 percent maximum.

   (c) The percentage passing No. 30 sieve shall be at least 1.7 times the actual loss by washing.

   (d) The material passing No. 40 sieve shall have a liquid limit of 25 maximum and a plasticity index (PI) of 4 maximum, when tested according to ASTM D 4318.

c. Construction Methods.-Dense-graded aggregate base shall be constructed in accordance with Section 3.01 of the 1990 Standard Specifications with the following exceptions:

1. The DGAB shall be compacted to a minimum of 95 percent of the maximum unit weight (dry density) as determined by AASHTO T-180 Method D for the full width of the travel lanes plus the width of the area receiving aggregate base.

2. Lift thickness shall be 4 inches or 6 inches, as called for in each respective section, after compaction.

3. Prior to placement of the portland cement concrete surface course, the DGAB shall be kept uniformly moist using a procedure that will avoid formation of mud or pools of water.

4. For sections incorporating a Permeable Asphalt Treated Base (PATB) layer, a DGAB base course will be constructed over the subgrade prior to placement of the PATB. In these sections the surface of the DGAB shall be primed with a coating of asphalt as described in the Special Provision for Permeable Asphalt Treated Base (PATB).

5. Surface irregularities within the limits designated for each SHRP section shall not exceed 1/4 inch between two points longitudinally or transversely using a 10-foot straightedge. The requirements of Section 3.01.07 will apply outside these limits. Finished DGAB elevations shall not vary from design more than 0.04

foot based on rod and level survey readings taken at a minimum of 5 locations across the outside travel lane (edge, outer wheel path, midlane, inner wheel path, and inside edge of lane) at longitudinal intervals no greater than 50 feet.

d. Measurement and Payment.-The completed work as measured for DENSE-GRADED AGGREGATE BASE will be paid for at the contract price for the following contract items (pay items):

Pay Item	Pay Unit
Dense-Graded Aggregate Base (4 Inch in Place)	Square Yard
Dense-Graded Aggregate Base (6 Inch in Place)	Square Yard

Dense-Graded Aggregate Base (4 inch or 6 inch in place) will be measured by area in square yards in place in accordance with methods specified for measuring Aggregate Base Under Concrete in Section 3.01.10 of the 1990 Standard Specifications. Payment for the item Dense-Graded Aggregate Base, ____ In. In Place, includes payment for furnishing the materials, placing, shaping, compacting, correcting any irregularities in surface or elevation, and maintaining the DGAB.

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
LEAN CONCRETE BASE (LCB)
(SHRP TEST SECTIONS)

M&T:RHV 1 of 2 04-02-92
NH 58034/32750A

a. Description.-This work shall be done in accordance with applicable provisions of the 1990 Standard Specifications, where and as indicated on the plans for the designated SHRP pavement sections, except as modified herein. The work requirements include the preparation of a concrete mix design by the Contractor.

b. Materials.

1. Cement.-Type I or IA only, conforming to AASHTO M 85.

2. Fine Aggregate.-2NS, except the fineness modulus shall not exceed 3.1.

3. Coarse Aggregate.-6AA coarse aggregate as described in the Special Provision for Premium Coarse Aggregate for Portland Cement Concrete.

4. Fly Ash.-Fly ash shall not be used in the Lean Concrete Base.

5. Curing Compound.-A wax-base curing compound conforming to ASTM C 309 Type 2 or AASHTO M 198 Type 2. (Resin-base compounds not acceptable for this use.)

c. Mixture.-The Contractor shall use the services of an independent laboratory to determine the proportions of the materials to produce a lean concrete with the following characteristics, using materials from the sources to be used by the Contractor:

Compressive Strength at 7 days	500-700 psi
Slump	1-3 in.
Air Content	6.5±2.0%
Coarse Aggregate as percent of total aggregate (by weight)	50-60%

The Contractor shall furnish to the Engineer (Materials and Technology Division, Attention: R. Till) a copy of all tests of the trial mixes and materials including:

Material sources, including specific gravity and absorption for aggregates.

Specific name and type of any admixtures used.

Properties of final trial batches: mix proportions, slump, air content, and yield.

Compressive strength (ASTM C 39) at 7 days, individual values and average of three specimens per batch, for minimum of two batches. Individual strength values shall not exceed 750 psi at 7 days.

The Contractor shall furnish his mix design to the Engineer (Materials and Technology Division) a minimum of ten working days prior to date of use. (Earlier submission is recommended in case the Engineer detects deficiencies in the submitted mix design.) The Engineer will approve the mix design provided no deficiencies are found in the information submitted.

d. Construction Methods.-

1. The Lean Concrete Base (LCB) shall be 6 inches thick and placed with a slipform paver.

2. The LCB layer shall be constructed for the full width of the travel lanes plus 3 feet outside the edges of the travel lanes. A sawed longitudinal joint shall be provided with an offset of not more than 3 feet from the centerline of the width being constructed, and shall not be within 1 foot of a planned longitudinal joint in the concrete pavement.

3. The LCB shall be finished to a smooth surface, not textured. Surface variations within the limits designated for each SHRP section shall not exceed 1/4 inch between any two points when using a 10 foot straightedge. Finished surface elevations shall not vary from design elevations by more than 0.04 feet based on rod and level survey readings taken at a minimum of 5 locations across the outside travel lane at longitudinal intervals no greater than 50 foot.

4. Wax-based curing compound shall be applied immediately after the LCB placement at a rate of one gallon per 100 square feet. A second coat of wax-based curing compound shall be applied within 24 hours prior to concrete pavement placement at a rate of one gallon per 150 square feet.

5. No traffic will be allowed on the LCB surface prior to the placement of the concrete pavement.

e. Measurement and Payment.-The completed work as measured for LEAN CONCRETE BASE will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Lean Concrete Base, 6 Inch In Place	Square Yard

Lean Concrete Base will be measured and paid for by area in square yards based on plan quantities and shall be payment in full for preparation of the mix design, furnishing all materials, all preparation, mixing, placing, and finishing the concrete mixture, and application of the two coats of curing compound.

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
PERMEABLE ASPHALT TREATED BASE (PATB)
(SHRP TEST SECTIONS)

M&T:RHV 04-02-92
NH 58034/32750A

a. Description.-This work shall be done in accordance with applicable provisions of the 1990 Standard Specifications, where and as indicated on the plans for the designated SHRP pavement sections, except as modified herein.

b. Materials.-The permeable asphalt treated base (PATB) shall be hot plant mixed and hot laid. The materials shall meet the following requirements.

1. **Aggregate.**-The aggregate shall be a 6A coarse aggregate, except it shall be crushed stone meeting the crushed material requirement for 9A coarse aggregate. No recycled crushed concrete pavement or asphalt pavement can be used as any aggregate in the mixture.

2. **Asphalt.**-The asphalt cement for the PATB mixture shall be 85-100 Penetration Grade, or AC-10 Viscosity Grade.

3. **Prime Coat.**-The asphalt for priming the DGAB shall be Grade MS-Op.

4. **PATB Mixture.**-The mixture shall contain 2 to 2.5 percent asphalt, as directed by the Engineer.

c. Construction Methods.

1. Prior to placing the PATB, the Dense-Graded Aggregate Base (DGAB) shall be primed with MS-Op asphalt at a rate of 0.25 to 0.40 gal/sq yd as described in 4.00.08 of the Standard Specifications.

2. The Permeable Asphalt Treated Base shall be placed in a single layer with a track mounted paver.

3. After placement, the mixture shall be thoroughly and uniformly compacted by a static steel wheel roller applying 0.5 to 1.0 tons of compactive force per foot of roller width. Two complete rollings are required immediately after the mixture is placed. A complete rolling is down and back in the same path.

4. No vehicular traffic or construction equipment shall be allowed to operate or park on the travel lanes or shoulders of the permeable base. Only the slip-form paving equipment to place the concrete pavement will be allowed on the Permeable Asphalt Treated Base surface. Any areas that become damaged or contaminated with fines from traffic or the Contractor's work operation shall be replaced or repaired to the Engineer's satisfaction, at no cost to the Department.

d. Testing and Acceptance.-The 6A aggregate will be sampled from the stockpile at the plant site, tested and approved for use prior to mixing. The asphalt content of the PATB mixture will be verified at the discretion of the Engineer by extraction testing. Any mixture that does not conform to the specifications shall be removed and replaced with acceptable material at the Contractor's expense.

e. Measurement and Payment.-The completed work as measured for PERMEABLE ASPHALT TREATED BASE will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Permeable Asphalt Treated Base, 4 Inch In Place	Square Yard

Permeable Asphalt Treated Base will be measured by area in square yards in place in accordance with the methods specified for measuring Aggregate Base Under Concrete in Section 3.01.10 of the 1990 Standard Specifications. Payment for the item Permeable Asphalt Treated Base includes payment for furnishing and applying the prime coat on the DGAB, furnishing the crushed aggregate, coating materials, mixing with asphalt cement, placing, spreading, shaping, and compacting the PATB.

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
OPEN-GRADED UNDERDRAIN, 4 INCH
(SHRP TEST SECTIONS)

M&T:DJT 1 of 2 04-02-92
NH 58034/32750A

a. Description.-This work shall consist of furnishing materials and constructing underdrains (both longitudinal and transverse) and outlets in accordance with the plans and the 1990 Standard Specifications; Sections 6.02, 8.02, and 8.10; except as modified herein or as directed by the Engineer.

b. Material.

1. Trench Backfill.-Trench backfill shall meet the requirements in Specification Section 8.02.05 for 6A aggregate, except the gradation shall have no more than 2 percent passing the number 200 sieve. Permeable Asphalt Treated Base material will not be permitted for use as trench backfill.

2. Geotextile Trench Lining.-The geotextile shall be a flexible, permeable fabric consisting of a fiber network such that the fibers or yarns retain their dimensional stability relative to each other. The geotextile fibers, and threads used in stitching fabric seams, shall consist of long chain synthetic fibers composed of at least 85% by weight polyolefin, polyester, or polyamide, and shall be resistant to chemical attack, mildew, and rot. The following are the physical requirements for the fabric:

Grab Tensile Strength (ASTM D 4632)	180 lbs minimum
Puncture Strength (ASTM D 4833)	80 lbs minimum
Mullen Burst Strength (ASTM D 3786 Modified*) . . .	290 psi minimum
Trapezoid Tear Strength (ASTM D 4533)	50 lbs minimum
Coefficient of Permeability (ASTM D 4491) . . .	0.02 cm/sec. minimum
Apparent Opening Size (ASTM D 4751)	0.125-0.212 mm

*The fluid displacement rate shall be 170 ±5 ml/min.

Seams, whether field or factory sewn or sealed, shall conform to the grab tensile strength requirement.

A certified copy of test (Type A Certification) on each lot of fabric shall be furnished with each shipment.

Geotextiles shall be packaged and delivered in ultraviolet resistant wrapping, and shall be stored and handled carefully and in accordance with the manufacturer's recommendations or as otherwise directed by the Engineer to provide protection from the elements. If any required physical property appears to be diminished, the Engineer may require testing before the geotextile can be used.

Each roll shall be labeled or tagged to provide product identification sufficient for field identification and correlation to certified test results, as well as inventory and quality control purposes.

d. Construction Methods.

1. Trench Lining.-The geotextile shall be unrolled as smoothly as possible in the prepared trench. Wrinkles and folds shall be removed by stretching and shaking as required. Geotextile trench lining shall be placed in accordance with manufacturer's specifications and as shown on the plans. Adjacent geotextile rolls shall be sewn or overlapped a minimum of 2 feet and shall have the upgrade section overlapping the downgrade section. The trench lining shall be firmly anchored while the drainage pipe and backfill are being placed.

   Exposure of the geotextile to the elements between lay-down and cover shall not exceed 14 days. Any damaged geotextile shall be replaced or repaired by placing a new layer of geotextile with a minimum of 3 foot laps beyond the perimeter of the damage. All repairs shall be subject to approval of the Engineer.

2. Outlets.-Discharge outlet pipes for underdrains shall be constructed in accordance with Specification Section 6.02. Outlet spacing shall be a maximum of 250 feet, including outlets which shall be installed at low points of all sag-vertical curves.

e. Measurement and Payment.-The completed work for OPEN-GRADED UNDERDRAIN, 4 INCH (SHRP) will be measured and paid for at the contract unit price for the following contract items (pay items):

Pay Item	Pay Unit
Open-Graded Underdrain, 4 Inch (SHRP)	Linear Foot

Payment for Open-Graded Underdrain, 4 Inch (SHRP), includes excavating the trench; furnishing and installing the geotextile trench lining, pipe, and fittings; placing and compacting the 6A aggregate backfill material; and disposing of material excavated from the trench.

Measurement and payment for Underdrain Outlet and Outlet Endings shall be in accordance with Section 6.02.10 of the 1990 Standard Specifications.

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
PAVEMENT RIDING QUALITY - CONCRETE
(SHRP TEST SECTIONS)

a. Description.-The intent of this specification is to provide incentive for the Contractor to construct the smoothest pavement possible. The Contractor, through judicious control of material, equipment, proportioning, and placement operations, will receive incentive payments for high levels of pavement ride quality within the applicable specification limits. The riding quality of the pavement, expressed in inches per mile will be determined from a profilogram (or trace) produced by a "California" type profilograph. Pavement lanes constructed with 0 to 5.99 inches per mile will result in payment of varying percentages for this pay item. Lanes with 6.00 to 10.00 inches per mile will not be eligible for any bonus payments for ride quality. Lanes with more than 10.00 inches per mile will not be considered acceptable and shall be diamond ground to achieve a value of 10.00 inches or less. All areas with bumps or high points exceeding 0.3 inches in 25 feet shall be diamond ground to remove the high point. Each SHRP test section, designated on the plans, will be evaluated individually under this specification.

b. Equipment.-The Contractor shall furnish a "California" type profilograph and trained operators who shall operate the profilograph. The profilograph shall print a profilogram with a true vertical scale and a one-inch to 25 feet horizontal scale. The profilogram shall have stations recorded on it.

c. Calibration.-Each profilograph shall be calibrated, at the project site, at the beginning and end of each day it is used to measure pavement riding quality for specification compliance. The calibration procedure shall consist of profiling two replicate runs on a designated roadway of 1,000 feet in length and observed by Department personnel. Horizontal calibration will be checked by running the profilograph over the 1,000 foot length and measuring the length of the resulting output on the profilogram. A 1,000 foot run must produce 40 inches (± 1/8 inch) of profilogram output. Vertical calibration will be checked by running the test wheel over a block of known thickness (usually 1 inch) and measuring the displacement it produces on the profilogram. There will be no tolerance allowed on the vertical calibration. If the horizontal or vertical checks do not meet specifications, they must be corrected. In addition to the calibration procedures, a visual inspection of the test instrument must be conducted. This would include the condition of the test tire and bogie wheels, tire pressure (25 psi ± 1 psi), tracking of the paper on the spool and paper drum, condition of chains and cables, tracking of the device down the road, and general condition of the test device.

d. Method of Testing.-The Contractor shall notify the Engineer a minimum of 24 hours prior to the profilograph run for pavement ride quality. All grinding to remove bumps or improve ride quality shall be completed prior to the determination of pavement riding quality. Profiles will be taken 3 feet from and parallel to each edge of each proposed lane. Bridge decks and existing pavements will be profiled with the adjacent new pavement until the measuring wheel is 20

feet onto the bridge deck or existing pavement. The profilograph shall be operated at a speed no greater than 3 miles per hour. All damage to the pavement surface caused by the profilograph shall be repaired at no increase in cost to the project.

e. **Method of Interpretation.**-The trace will be analyzed by the Engineer using a 0.2 inch blanking band measuring each deviation above and below the band to the nearest 0.05 inches according to MTM 204-88. Deviations will be summed for each 0.1 mile and proportional lengths as follows:

< 0.047 mile added to previous 0.1 mile
≥ 0.047 mile shall be a proportional unit extrapolated to 0.1 mile

Each run will be reported to the Contractor to the nearest 0.01 inches as the weighted average inches per mile for each lane.

f. **Method of Measurement.**-Quantities for the item PAVEMENT RIDE QUALITY MEASUREMENT will be determined by the length of each lane measured in miles. No deductions will be made for structures. Quantities for the item BUMP GRINDING will be determined in square yards for actual area ground for the area starting 25 feet from an existing pavement or bridge joint and ending 20 feet onto the existing pavement or bridge deck. Quantities for the item PAVEMENT RIDING QUALITY will be determined by the area in square yards based on plan quantities. Areas of ramps, tapers, bridge decks and the pavement for 25 feet on each end, and 25 feet of pavement adjacent to an existing pavement are not included under the item Pavement Riding Quality.

g. **Basis of Payment.**-Payment for the item PAVEMENT RIDE QUALITY MEASUREMENT will include all costs of furnishing and operating the profilograph one time only. No additional payment will be made for additional runs made on 0.1 mile segments which require diamond grinding due to exceeding 10.00 inches per mile or due to bump grinding. Payment for the item PAVEMENT RIDING QUALITY will be based on the inches per mile determined by the Engineer for the final weighted average for all values within each lane. Payment for the item BUMP GRINDING will include all costs for labor and equipment necessary to remove the bump. The criteria for making payments or no payments for this item will be:

1. **Bump Grinding.**-A bump which exceeds 0.3 inches in 25 feet within 25 feet of an existing pavement or joint at bridge decks shall be diamond ground and will be paid for as Bump Grinding. Any other bump or high point which exceeds 0.3 inches in 25 feet shall be diamond ground to remove the high point at no increase in cost to the project.

2. **Incentive Payments.**-A pavement lane having a range of 0 to 5.99 inches per mile will receive payments for Pavement Riding Quality based on the product of the number of square yards in the pavement lane times the contract unit price for Pavement Riding Quality, multiplied by 0.25 percent for each 0.01 inches per mile less than 6.00 inches per mile.

3. **No Payment.**-A pavement lane having a range of 6.00 to 10.00 will not qualify nor receive any payment for Pavement Riding Quality.

4. **Assessments.**-0.1 mile segments having over 10.00 inches per mile will require correction. Such work will be completed at the expense of the Contractor.

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
SEALING TRANSVERSE CONTRACTION
JOINTS WITH SILICONE SEALANT
(SHRP TEST SECTIONS)

a. Description.-This work shall consist of constructing transverse contraction joints across the pavement in accordance with Section 4.50 of the 1990 Standard Specifications except that the transverse contraction joints shall be sealed with a low modulus silicone sealant in place of the 1-1/4 inch preformed neoprene seal. Abutting longitudinal joints shall also be sealed with the silicone sealant for a minimum distance of one foot in each direction from the transverse contraction joint.

b. Silicone Sealant.-The silicone sealant shall be a low modulus sealant having a one part formulation which does not require a primer for proper bonding to portland cement concrete. The sealant shall meet the following requirements:

Property	Value	Test Method
Shelf Life, months	6 min (from date of shipment)	
Flow, inches	0.3 max	ASTM C 639
Extrusion Rate, grams/minute	90-300	MIL S 8802
Tack Free Time, minutes	35-75	MIL S 8802
Specific Gravity	1.010-1.515	ASTM D 792 (Method A)
Tests on Sealant Cured 7 Days at 75 F and 50% RH		
Durometer Hardness, Shore A	5-25	*ASTM D 2240
Tensile Stress at 150% Elongation, psi	45 max	*ASTM D 412 (Die C)
Elongation, %	700 min	*ASTM D 412 (Die C)
Bond test, -20 F, 100% Elongation, 3 cycles		
Non-Immersed	Pass	**Departmental
Water-Immersed, 96 hours	Pass	**Departmental

* The hardness, tensile stress, and elongation specimens shall be prepared from a sheet of material 1/8" to 3/16" thick which has been cast and cured on a sheet of polyethylene.

** Bond tests shall be run in triplicate on sealant sections 1/2"W x 3/8"D x 2"L, poured and tooled between sawed concrete blocks. A cycle shall consist of 100% extension at -20 F at a rate of 1/8 inch per hour. The specimens shall be allowed to recover at laboratory temperature for four hours, then conditioned for a minimum of four hours at -20 F before starting a cycle. Failure is determined by one or more of the three specimens exhibiting 10 percent or more adhesion or cohesion failure after three cycles.

The containers of the sealant shall be plainly marked with the manufacturer's name or trade name, color, lot number, and date of manufacture. The sealant will be sampled by a representative of the Department and tested by the Department. A minimum of three weeks will be required for testing from the time the sample is received.

c. **Joint Groove Sawing.**-The joint groove shall be sawed to the dimensions shown on the plans and as specified in Subsection 4.50.17 of the 1990 Standard Specifications. The joint groove for the transverse pavement contraction joint shall be extended down the vertical edges of the pavement by sawing or forming.

Immediately after the final sawing, the joint groove shall be cleaned with water having sufficient pressure to remove all slurry and debris from the joint faces and reservoir.

d. **Joint Repair.**-Prior to sealing, all spalls or voids in the joint area shall be repaired as specified in Subsection 4.50.19 of the 1990 Standard Specifications. Prior to sealing the joint, the repaired areas shall be sandblasted to clean and texture the surface.

e. **Joint Preparation.**-Immediately prior to sealing, the joint shall be cleaned to remove all dust and contamination from the joint faces and reservoir. In addition to cleaning the transverse contraction joints, all abutting longitudinal joints shall be cleaned for a minimum distance of one foot in both directions from the transverse joints.

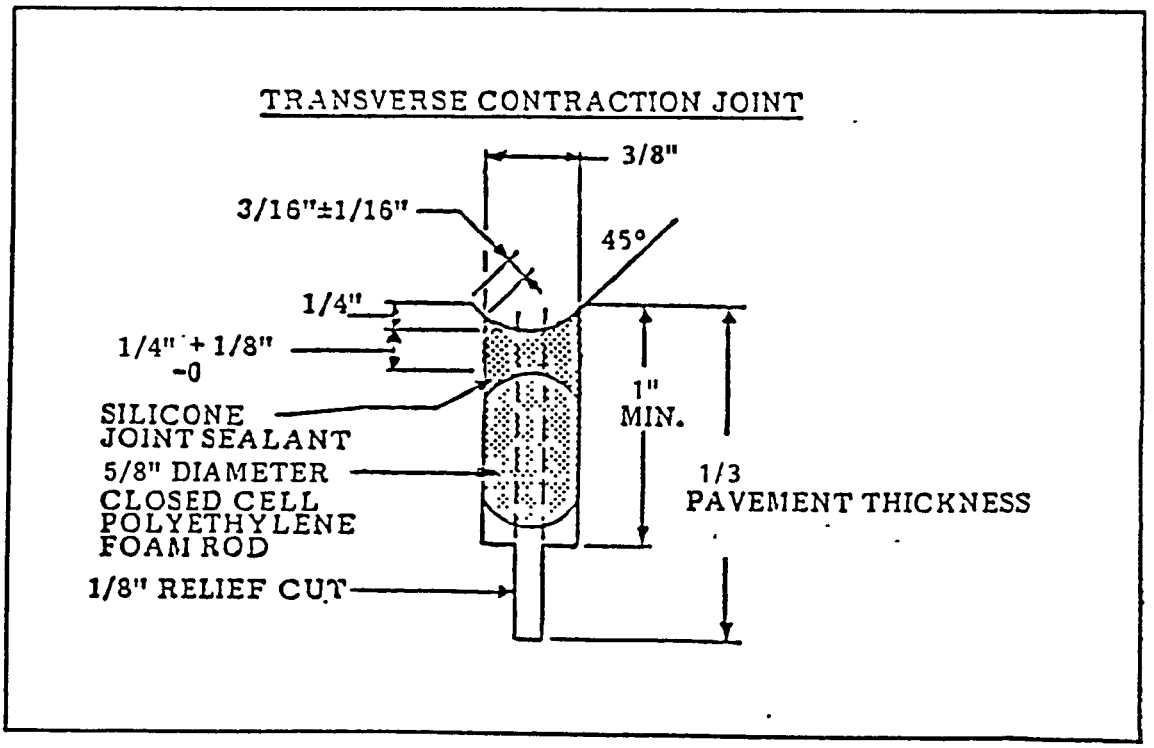
Cleaning shall consist of sandblasting followed by a final cleaning with compressed air, free of oil and water and having a minimum pressure of 90 psi. After the final cleaning, the closed cell polyethylene backer rod shall be inserted into the transverse joint groove to the depth shown on the Special Detail Sheet.

f. **Joint Sealing.**-The joint groove shall be sealed after the insertion of the backer rod and prior to becoming contaminated. At the time of sealing, the joint groove faces shall be dry and dust free. The silicone shall be pumped into the joint groove (including the vertical groove) in a continuous operation to properly fill and seal the joint groove. A list of recommended pumps for this procedure can be obtained from the supplier of the sealant. In conjunction with or immediately after placement, the sealant shall be tooled to force it against the joint faces and to obtain the correct depth. The sealant shall be tooled 1/4 inch below the pavement surface. The silicone sealant shall be placed in the longitudinal joint prior to sealing the remainder of the longitudinal joint with a hot-poured sealant.

The joints shall not be sealed when the air or pavement temperature is below 40 F or when the pavement is wet.

Traffic shall not be allowed on the sealed joints for a minimum of 3 hours after tooling.

g. **Measurement and Payment.**-The work of constructing transverse contraction joints will be paid for by length in linear feet, based on plan quantities listed for Contraction Joint C (SHRP). Payment for the contraction joint includes the furnishing of all joint materials required, such as load transfer assemblies and joint sealants; sawing, forming, and cleaning the joints; repairing spalls or voids; furnishing and applying bond breaker where required; and furnishing and placing the silicone joint sealant.


TRANSVERSE CONTRACTION JOINT
3/8"
3/16"±1/16"
45°
1/4"
1/4" + 1/8"
-0
SILICONE
JOINT SEALANT
5/8" DIAMETER
CLOSED CELL
POLYETHYLENE
FOAM ROD
1/8" RELIEF CUT
1"
MIN.
1/3
PAVEMENT THICKNESS

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
PREMIUM COARSE AGGREGATE FOR
PORTLAND CEMENT CONCRETE
(SHRP TEST SECTIONS)

M&T:GHG | 1 of 1 | 04-02-92
NH 58034/32750A

a. Description.-The coarse aggregate for use in concrete pavement and shoulders and lean concrete base shall meet the requirements specified in Section 8.02 of the 1990 Standard Specifications except as modified herein. The premium coarse aggregate shall be used for the entire length of the northbound portion of the project including the SHRP pavement sections, the MDOT pavement sections and any transition sections.

b. Materials.-Premium coarse aggregate for portland cement concrete shall be a crushed stone aggregate meeting both the 6AA grading requirements of Table 8.02-1 and the physical requirements of Table 8.02-2 and shall be from a source having a maximum freeze-thaw dilation of 0.010 percent per 100 cycles based on testing the aggregate in accordance with Michigan Test Method (MTM) 115.
(The crushed stone/mine rock 6AA coarse aggregate specified for Group A concrete pavement and shoulder sections on the southbound US-23 roadway meets these requirements. The special requirements for uniformity of that aggregate will not apply to aggregate used in the northbound roadway.)

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
PORTLAND CEMENT CONCRETE PAVEMENT
(SHRP TEST SECTIONS)

a. Description.-This work shall be done in accordance with the applicable provisions of Sections 4.50 and 7.01 of the 1990 Standard Specifications, except as described herein. Included are requirements for preparation of concrete mix designs by the Contractor. This pavement is to be used as indicated in the SHRP project sections.

b. Materials.-Except as provided herein, the materials shall be as listed in 7.01.02 of the Standard Specifications.

Portland Cement - Type I or IA only, conforming to AASHTO M 85.

Fine Aggregate - 2NS, except the fineness modulus shall not exceed 3.1.

Coarse Aggregate - 6AA coarse aggregate as described in Special Provision for Premium Coarse Aggregate for Portland Cement Concrete.

Admixtures - Air entraining admixtures shall be used as necessary. Non-chloride water-reducing admixtures may be used if required by the mix design. No accelerating admixtures shall be used. No silica fume shall be used.

c. Mix Proportioning.-The Contractor shall use the services of an independent laboratory to determine the proportions of the materials to produce concrete with the required characteristics, using materials from sources proposed to be used by the Contractor.

Two grades of concrete are required, designated as Grade 550 and Grade 900. The mixes shall be designed to conform to the following requirements:

Flexural strength at 14 days, third-point loading (ASTM C 78), psi	
Grade 550	550
Grade 900	900
Slump, in.	1-1/2
Air Content, percent	6.5
Coarse aggregate content, bulk volume (dry loose) per unit volume of concrete, percent minimum	72 *

Fly ash is permitted up to 15 percent by weight of the cementitious materials used.

The Contractor shall furnish to the Engineer (Materials and Technology Division, Attention: R. Till) a copy of all tests of the trial mixes and materials including:

Material sources, including specific gravity and absorption for aggregates (and specific gravity of fly ash, if used).

Specific name and type of any admixtures used.

Properties of trial batches: materials quantities, slump, air content, and yield.

Flexural strength (ASTM C 78) at 14 days, individual value and average of three specimens per batch.

The Contractor shall submit a single mix design for each grade with data from at least three test batches of laboratory produced concrete. At least three flexure test specimens shall be tested for each batch. The test results shall conform to the following requirements:

	Grade 550	Grade 900
Flexural Strength, psi, average of the batch averages	525-575	860-940
Flexural Strength, psi, range of the batch averages		
for 3 batches tested	165	250
for 4 batches tested	180	270
for 5 batches tested	195	290
for 6 batches tested	200	300

The Contractor shall furnish his mix designs to the Engineer (Materials and Technology Division) a minimum of ten working days prior to production of field trial batches. (Earlier submission is recommended in case the Engineer detects deficiencies in the submitted mix designs.) The Engineer will give preliminary approval to the mix designs, provided no deficiencies are found in the information submitted. Following preliminary approval, the Contractor will mix one or more field trial production batches of concrete conforming to each of the grades, for sampling and testing to determine that the strength of production concrete conforms adequately to the strength of the laboratory concrete. (Additional batches may be necessary if air content or slump of the first batch is not within specification limits.) Adjustments to the preliminary mix designs may be necessary so that the production concrete has strengths as close as practical to the intended strengths. The concrete from the trial field batches may be placed in ramps, or in shoulders on the northbound lanes, subject to the Engineer's approval. The production trial batches shall be made at least 28 calendar days prior to use in the SHRP sections.

d. Concrete Requirements.-The concrete as furnished for constructing the concrete pavement shall conform to the approved mix design (except for adjustments in the water and air-entraining admixture to maintain the slump and air content, respectively).

The concrete as placed shall have a slump of 1 to 2-1/2 inches and an air content of 6.5 ±1.5 percent.

e. **Construction Procedure.**-The concrete pavement shall be constructed in accordance with Section 4.50 of the Standard Specifications, using the slipform procedure and paving the full width (24 or 26 feet) in one operation. Concrete placement for each test section should be done in a single continuous operation. The Contractor shall make every effort to construct the pavement to the 8-inch or 11-inch thickness as close as possible.

Transverse contraction joints shall contain 1-1/4-inch epoxy-coated dowels in 8-inch pavement and 1-1/2-inch epoxy-coated dowels in 11-inch pavement, placed at mid-depth in basket assemblies. Note that special dowel basket assemblies are required for the 14-foot lanes. The longitudinal joint shall be tied using 30-inch long, No. 5 epoxy-coated deformed bars of Grade 40 steel, placed at 30 inches center-to-center at mid-depth of the concrete.

The initial saw cut for both transverse and longitudinal joints shall be one-third of the pavement thickness, that is, 2.7 inches in 8-inch pavement and 3.7 inches in 11-inch pavement. Sawing shall begin as soon as the concrete can support the sawing equipment and prevent excessive ravelling of the concrete surface. Longitudinal sawing shall be initiated at the same time as the transverse sawing. All first stage sawing shall be completed within 24 hours of concrete placement.

The first coat of white membrane curing compound shall be applied to the concrete surface within 15 minutes after the surface texturing operation and no later than 45 minutes after concrete placement. The second coat shall be applied within two hours of application of the first coat.

The transverse and longitudinal joints shall be sealed with silicone sealant in accordance with the special provisions included elsewhere in the proposal.

f. **Opening to Traffic.**-The pavement in the test sections shall not be opened to construction or general traffic until all of the following criteria are met:

(1) Seven days elapsed since placement,

(2) Flexural strength of 550 psi minimum by ASTM C 78 (600 psi minimum if flexural strength for open-to-traffic is determined as described in 7.-01.04-e (ASTM C 293 modified), and

(3) Joint sealing is completed.

g. **Measurement and Payment.**-Measurement and payment shall be according to Section 4.50.25 of the Standard Specifications, and the following additional provisions.

The following pay items are added:

Concrete Pavement-Nonreinforced, 8-inch, Grade 550 (SHRP)	Square Yard
Concrete Pavement-Nonreinforced, 11-inch, Grade 550 (SHRP)	Square Yard
Concrete Pavement-Nonreinforced, 8-inch, Grade 900 (SHRP)	Square Yard
Concrete Pavement-Nonreinforced, 11-inch, Grade 900 (SHRP)	Square Yard
Contraction Joint C (Silicone Sealed) (1-1/4-inch Dowels)	Linear Foot
Contraction Joint C (Silicone Sealed) (1-1/2-inch Dowels)	Linear Foot

The item of Concrete Pavement-Nonreinforced, _____-inch, Grade _____ (SHRP) shall include all materials in the quantities required by the mix design and all costs of developing the mix design, (including additional costs for the trial production batches) in addition to the items enumerated in Section 4.50.25 to be included with concrete pavement.

Price Adjustment for Pavement Thickness - The intent is that pavements be constructed as close to 8 inches or 11 inches in thickness as is possible. Pavement thickness will be determined by rod and level survey procedures on the underlying course prior to placing the concrete, and on the surface of the hardened concrete. Measurements will be made at five points transversely in the outside (traffic) lane and at 50-foot intervals longitudinally. The five transverse measurements will be averaged and will represent the thickness of a 50-foot length of pavement.

Any 50-foot length of pavement in the lane that deviates from the specified thickness will be paid for as follows:

Deviation from Specified Thickness, plus or minus, inches	Amount of Contract Price Paid, percent
0.2 or less	100
0.3	90
0.4	70
0.5 and over	0*

*No payment, or remove and replace as directed by the Engineer.

Pavement in the adjacent lane (passing lane) may be cored at the Engineer's discretion, and the tolerances and price adjustments of Section 4.50.25 will apply.

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
SEALING LONGITUDINAL PAVEMENT AND SHOULDER
JOINTS WITH SILICONE SEALANT
(SHRP TEST SECTIONS)

a. Description.-This work consists of sealing longitudinal joints (Symbols B or D) in accordance with Section 4.50 of the 1990 Standard Specifications and Standard Plan II-41 Series, with the exception that the joints shall be cleaned by abrasive blasting and sealed with a low modulus silicone sealant in place of the hot-poured rubber asphalt. The joints to be sealed include the pavement centerline and pavement/shoulder interface.

b. Silicone Sealant.-The silicone sealant shall be a low modulus sealant having a one part formulation which does not require a primer for proper bonding to portland cement concrete. The sealant shall meet the following requirements:

Property	Value	Test Method
Shelf Life, months	6 min (from date of shipment)	
Flow, inches	0.3 max	ASTM C 639
Extrusion Rate, grams/minute	90-300	MIL S 8802
Tack Free Time, minutes	35-75	MIL S 8802
Specific Gravity	1.010-1.515	ASTM D 792 (Method A)
Tests on Sealant Cured 7 Days at 75 F and 50% RH		
Durometer Hardness, Shore A	5-25	*ASTM D 2240
Tensile Stress at 150% Elongation, psi	45 max	*ASTM D 412 (Die C)
Elongation, %	700 min	*ASTM D 412 (Die C)
Bond test, -20 F, 100% Elongation, 3 cycles		
Non-Immersed	Pass	**Departmental
Water-Immersed, 96 hours	Pass	**Departmental

* The hardness, tensile stress, and elongation specimens shall be prepared from a sheet of material 1/8" to 3/16" thick which has been cast and cured on a sheet of polyethylene.

** Bond tests shall be run in triplicate on sealant sections 1/2"W x 3/8"D x 2"L, poured and tooled between sawed concrete blocks. A cycle shall consist of 100% extension at -20 F at a rate of 1/8 inch per hour. The specimens shall be allowed to recover at laboratory temperature for four hours, then conditioned for a minimum of four hours at -20 F before starting a cycle. Failure is determined by one or more of the three specimens exhibiting 10 percent or more adhesion or cohesion failure after three cycles.

c. Construction.-The longitudinal joints (Symbols B or D) shall be sawed to the dimensions shown on Standard Plan II-41 Series, except that the width shall be 3/8 inch instead of 1/4 inch as shown.

d. Joint Preparation.-Immediately prior to sealing, the joint shall be cleaned to remove all dust and contamination from the joint faces and reservoir.
Cleaning shall consist of abrasive blasting followed by a final cleaning with compressed air, free of oil and water and having a minimum pressure of 90 psi.

e. Joint Sealing.-At the time of sealing, the joint groove faces shall be dry and dust free. A closed cell polyethylene backer rod shall be inserted into the longitudinal joint groove to the depth shown on the Special Detail Sheet of this Special Provision. The silicone shall be pumped into the joint groove in a continuous operation to properly fill and seal the joint groove. A list of recommended pumps for this procedure can be obtained from the supplier of the sealant. In conjunction with or immediately after placement, the sealant shall be tooled to force it against the joint faces and to produce a finished sealant surface 1/8" to 1/4" below the surface of the pavement.
The joints shall not be sealed when the air or pavement temperature is below 40 F or when the pavement is wet.
Traffic shall not be allowed on the sealed joints for a minimum of three hours after tooling.

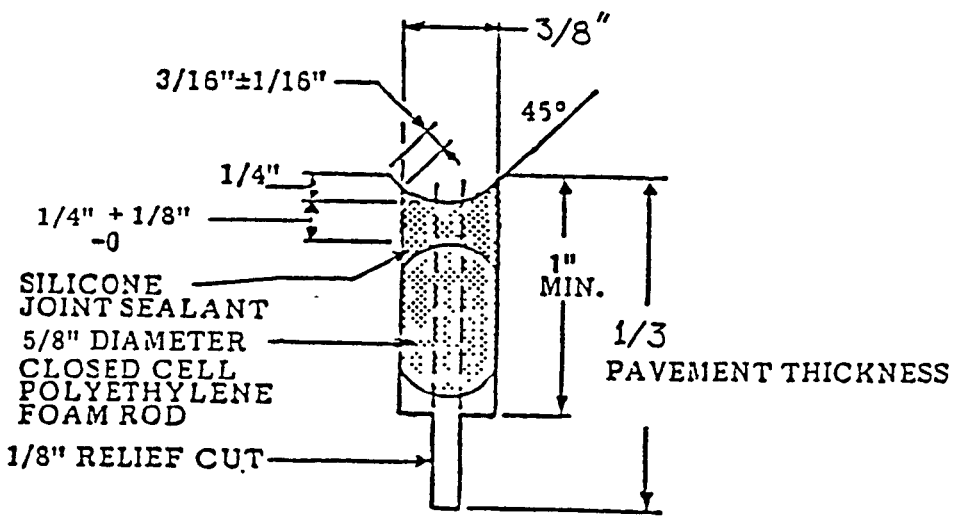
f. Measurement and Payment.-The completed work as measured for SEALING LONGITUDINAL PAVEMENT AND SHOULDER JOINTS WITH SILICONE SEALANT will be paid for at the contract unit price for the following contract item (pay item).

Pay Item	Pay Unit
Sealing Longitudinal Shoulder Joint (SHRP)	Linear Foot

The work of sawing and sealing Longitudinal Pavement and Shoulder Joints will be determined by length in linear feet based on plan quantities.
Longitudinal joints, other than those specified above will not be paid for separately but shall be included in the contract unit price for Lean Concrete Base or Concrete Pavement.
Payment for Sealing Longitudinal Shoulder Joint (SHRP) and Longitudinal Joints paid for under the pay item Lean Concrete Base or Concrete Pavement includes sawing, forming and cleaning the joints; repairing spalls or voids; furnishing and applying backer rod and furnishing and placing the silicone joint sealant.

Special Detail Sheet

Detail for Sealing Longitudinal
Pavement or Shoulder Joints



MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
AUTOMATIC VEHICLE CLASSIFIER (AVC)
(SHRP TEST SECTIONS)

NOTE: Whenever this Special Provision conflicts with the plans or Standard Specifications, this Special Provision shall govern.

TERMS: Shall is a mandatory requirement. Failure to comply will result in disqualification.

VEHICLE CLASSIFICATION EQUIPMENT

1.0 DESCRIPTION: This item of work consists of the Contractor furnishing and installing permanent Automatic Vehicle Classifier (AVC) devices at the two locations (Northbound and Southbound), designated on the Plans (not within SHRP Test Sections but SHRP required). The AVC shall be installed in accordance with the manufacturer's recommendations and this Special Provision.

1.2 The Contractor/Vendor shall provide all equipment necessary to detect Classify and record, by lane, all vehicles from four lanes of traffic.

1.3 One Diamond Tally 2001 Vehicle Classifier configured to operate with the axle sensors selected in section 1.4 for each location. The Diamond Tally 2001 is the only multi-lane classifier in use and supported by the Department.

1.4 Two, half lane width, axle sensors per lane. Vehicle signals from these sensors shall be useable by the Diamond Tally.

1.4.1 Acceptable axle sensors are:
Class 2 piezoelectric axle sensor.
"Dynax" Resistive axle sensor.

1.5 Communication devices necessary to access the Diamond Tally 2001 permanent classifier.

1.6 All necessary connectors and cables to construct a complete operational system - this includes electrical power and telephone connections.

2.0 MATERIALS: All electronic components shall be new and unused, and of solid state design with high noise immunity and low power consumption. Logic and data components shall be mounted on replaceable plug-in circuit boards. Circuit boards shall be firmly mounted and housed so that they will not be damaged by jolts, shocks and vibrations encountered in transportation and use. Electronic components shall be fully protected against overloads, power surges, static electrical discharge and transients.

2.2 Materials shall be free from all defects and imperfections that might affect the serviceability of the finished product. The equipment shall be standard manufactured products, so that prompt and continuing service and delivery of spare parts may be assured.

2.3 All equipment housed in the controller cabinet shall operate within a temperature of at least 0° to 140° F with a humidity range to 95% noncondensing relative humidity. The systems shall additionally be capable of withstanding temperatures in the range -40° to +160° F without suffering permanent damage.

2.3.1 Acceptable controller cabinet shall be a Hennessy Type M, base mounted cabinet or equivalent, mounted on a suitable concrete pad.

3.0 **POWER:** The system shall operate from 120V, 60 Hz AC mains power with surge lightning and RF protection as required by the manufacturer.

3.1 The controller cabinet shall also provide a switched light and a spare duplex outlet for the use of repair personnel and shall contain a circuit breaker for the incoming AC lines. A housing locking device and two keys shall be provided.

3.2 It shall be the responsibility of the contractor to provide AC power connection and a telephone connection to this housing. It shall be the Contractor's responsibility to obtain all necessary permits for hookups of these utilities.

4.0 **PERFORMANCE SPECIFICATIONS:** The equipment shall be capable of gathering classification and speed data on all vehicles operating at normal highway speeds.

4.1 Vehicle type classification shall use FHWA 2-digit (13-type) scheme, shown in Attachment #1, page 8. The accuracy shall be as follows:

Less than 10% of all vehicles erroneously classified.

Less than 10% of Class 9 vehicles erroneously classified.

4.2 Classification accuracy will be determined by MDOT personnel.

During the fifteen (15) day operational acceptance test period (Section 11.0) five (5) 400 vehicle samples will be collected and compared to visual observations.

Three (3) additional 400 vehicle samples will be taken to determine Class-9 accuracy.

4.3 The AVC system's operation shall not be affected by CB radio communications, two-way radio, etc.

5.0 SOFTWARE User programmable factors shall include initial setup parameters required for initialization the system including site identification, time and date etc.

5.2 Modes of operation and parameters for data processing and storage shall be user-programmable. These options must include : classify all vehicles, classify selected vehicle classes and vehicle speeds.

5.3 Diagnostic checks of system operation and performance shall include, as a minimum, checks for axle sensor failure, telemetry errors, condition of stored data, and battery voltage, if used.

5.6 Provision shall be made for input of all the system operating parameters on-site using a portable laptop microcomputer or via the telemetry connection. Both on-site and telemetry connections shall permit the same operations to be requested. The telemetry communications parameters need only be accessible on-site.

6.0 DATA FILES: Each data file shall have a file name which uniquely identifies the file. The file must uniquely identify the recording unit and site.

6.1 The AVC equipment shall be capable of storing requested data in 24 hour periods. The system shall be capable of closing the existing file and open a new data file at midnight.

6.2 Data for each vehicle shall be filed within one hour of the vehicle's passing through the site, and the current files shall be available for downloading at any time during the day.

7.0 DATA TRANSFER/COMMUNICATION/OUTPUT: All procedures contained within the on-site classifier which control data recording, storage, display and data transmittal shall be designed to prevent any inadvertent actions such as destruction of data contained in memory. All operator commands which would have this result shall provide a warning and require that the instruction be confirmed through a password before it is executed. Failure to confirm shall return the program to normal operation with all stored data intact. All associated cables and/or equipment necessary to perform data transfer shall be supplied by the Contractor/Vendor. Cables provided for communication with an IBM AT compatible computer shall connect via an RS-232-C.

7.1 The AVC equipment shall include a telemetry sub-system able to receive and transmit data via commercial dial-up telephone connections. Provision shall be made for error trapping and re-transmission of data by a defined and approved protocol. The telemetry connection shall be transparent to the computer's primary data collection.

7.2 Provision shall be made for on-site portable data retrieval from the classifier by means of downloading to a portable laptop microcomputer.

7.3 The classifier shall be capable of transmitting data in a full ASCII or compressed binary format as determined by the user.

7.4 All on-site communications shall be RS232-C compatible. Telephone data transmission rates will include 1200 baud. Protocols and handshaking shall be provided for communication to Hayes-compatible modems.

7.5 Take Away Memory modules, portable memory modules, if used, shall be transparent to the on-site computers normal operation. Any additional equipment or software necessary to access or process data from these devices shall be provided at no extra cost.

8.0 **SYSTEM COMPATIBILITY:** The AVC equipment provided for these specifications shall be configured so that all vehicle data gathered can be directly transferred to the portable laptop microcomputer for analysis and further processing.

8.1 It shall be the responsibility of the Contractor/Vendor to identify all restrictions and constraints on the use of the software and programs such as copyrights, etc.

9.0 **MANUALS:** The Contractor shall provide the Department with two (2) complete sets of vendor-supplied manuals. These shall include: operation of the AVC equipment; maintenance and troubleshooting, including schematics, voltage points, and waveforms; and software manuals and source code. The set shall be contained in individual binders suitable for field and office use and storage.

9.1 Manuals shall be bound separately for equipment operations (field work) and data operations (office work).

9.2 Maintenance manuals shall include schematics, circuit diagrams, photographic parts location diagram, parts lists, parts price list, parts lists with cross-reference of all components by manufacturers, and instructions suitable for MDOT technicians to perform services and repairs.

10.0 **TRAINING:** Training shall be provided for up to 10 MDOT personnel by the Contractor/Vendor. Training will include: Maintenance of all Contractor/Vendor supplied equipment, operation of the equipment in the field, and software options for data summary and storage. Manuals for each segment of training will be made available to MDOT at least 5 days before the training session.

10.1 The Contractor/Vendor shall provide a training program during the equipment installation period. Such training program shall provide a designated technical staff of MDOT personnel with (1) an understanding of all components in the system and their function; (2) knowledge of the system hardware and software and training in system operation and maintenance; and (3) training in trouble-shooting, checking, and repair of system for satisfactory operation. It shall be the responsibility of the Contractor/Vendor to define the level and degree of training in a plan, and submit this plan for MDOT approval. The training period shall be at a time mutually agreed upon.

11.0 **ACCEPTANCE:** Final Acceptance will be based upon the following:

11.1 Satisfactory completion of 15 days of continuous operation.

11.2 Delivery of all required documents, manuals and drawings.

11.3 Completion of staff training.

12.0 **MAINTENANCE AND TECHNICAL SUPPORT:** For continued support from AVC vendor beyond initial 1 year warranty period, the following information shall be provided:

12.1 Name, location and telephone number of individual to contact in the event of equipment failure.

12.2 A preventive maintenance plan on system components including duration and frequency.

12.3 A recommended list of spare parts and their cost.

13.0 **WARRANTY AND SERVICE:** The Contractor shall deliver to MDOT a binding warranty from the Vendor/Manufacturer which meets the following requirements:

13.1 All products delivered shall be guaranteed against faulty material and workmanship for warranty periods as specified below. If during these warranty periods such faults develop, the units or parts affected are to be replaced (including shipping) and installed at no cost to the Michigan Department of Transportation. Where accessories are to be supplied, they must be compatible with the rest of the furnished equipment. Any trips and/or expenses incurred by the Vendor/Manufacturer or his agents necessary to repair the equipment under this warranty shall be at no expense to the Department.

13.2 The AVC and all other equipment furnished under this contract shall be warranted against failure in normal use for a period of one year after formal acceptance of the system. Upon notification of a problem, this AVC system shall be restored to normal operation within thirty days or as soon as weather conditions permit during winter months.

13.3 All software revisions and upgrades shall be made available to the Department at no cost during the warranty period.

14.0 **AVC SYSTEM AVAILABILITY:** Known acceptable Diamond AVC equipment is available from the following Vendor/Manufacturer:

1. Traffic Engineering Services, Inc.
   13000 W. Bluemound Rd. #205
   Elm Grove WI 53122
   414-797-9097

2. Diamond Scale Constructions Co.
   Diamond Traffic Products
   P.O. Box 1455
   Oakridge OR 97463
   503-782-2053

Axle Sensors may be obtained from the following vendors:

1. IRD, Inc. - Joe Madek
   28 Lord Road, Suite 267
   Marlboro, Massachusetts 01752
   508-481-9066
   Dynax Axle Sensors and Piezoelectric Class 2 Axle Sensors

2. Phillips Electronic Instruments
   Industrial Automation Div.
   2975 Courtyard Drive
   Norcross GA 30071
   Piezoelectric Class 2 Axle Sensors

15.0 **OTHER SYSTEMS:** Other systems meeting the requirements of this Special Provision will be evaluated and considered.

15.1 Any system offered for use under this Special Provision shall be evaluated based on the following information submitted by the Contractor/Vendor:

15.1.1 The output data's format shall be identical to the Diamond Tally 2001 Traffic Classifier.

15.1.2 The proposed equipment shall respond to all Diamond Tally 2001 Setup, command and integration commands.

15.1.3 Detailed equipment specifications, circulars, drawings and all necessary data which describes in detail the equipment proposed for use under this Special Provision.

15.1.4 A listing of any discrepancies between the proposed equipment capabilities and the capabilities specified.

15.1.5 Location(s) where identical system(s) installed and operating for at least one year.

15.1.6 Normal life expectancy of sensor arrays, recorders and associated equipment.

15.1.7 A list of parts needing periodic replacement, including their normal life expectancy and their itemized costs.

15.1.8 The address where the proposed equipment will be produced and serviced.

15.1.9 The manufacturer shall have been in operation for a period of at least 3 years and have a facility adequate for and devoted, at least in part, to the manufacturing of AVC traffic data collection systems.

16.0 **BASIS OF PAYMENT:** The Automatic Vehicle Classification payments shall be measured by the lump sum complete in place.

16.1 The amount of completed and accepted work, measured as provided above shall be paid for at the contract lump sum price for "Automatic Vehicle Classifier," which price shall be full compensation for furnishing all materials, all utility hook-ups, for all labor, equipment, warranties, training, tools and incidentals necessary to complete the work.

ATTACHMENT 1

VEHICLE TYPE CLASSIFICATION
CLASSIFICATION CRITERIA

(FHWA SCHEME F)

CLASS	Description	AXLE A - B	AXLE B - C	AXLE C - D	AXLE D - E	AXLE E - F	AXLE F - G
1	Motorcycle	0.0 - 6.7					
2	Car - Car w/ trlr	6.7 - 10.0	6.7 - 13.3	0.0 - 6.7			
3	Pickup - Van	10.0 - 13.3					
4	Bus	20.0 - 40.0	0.0 - 6.7	0.0 - 6.7			
5	2-Axle/6 tire	13.3 - 20.0					
6	3-Axle S. U.	6.7 - 20.0	0.0 - 6.7				
7	4-Axle S. U.	6.7 - 20.0	0.0 - 6.7	0.0 - 6.7			
8	2S1	6.7 - 16.7	16.7 - 40.0				
8	3S1	6.7 - 20.0	0.0 - 6.7	10.0 - 40.0			
8	2S2	6.7 - 16.7	13.3 - 40.0	0.0 - 6.7			
9	3S2	6.7 - 20.0	0.0 - 6.7	10.0 - 40.0	0.0 - 13.3		
9	3-AXLE W/TRLR	6.7 - 20.0	0.0 - 6.7	6.7 - 26.7	10.0 - 26.7		
10	6-OR MORE AX. SGL TR	6.7 - 16.7	0.0 - 6.7	10.0 - 40.0	0.0 - 13.3	0.0 - 13.3	0.0 - 13.3
11	5-AXLE MULTI-TRLR	6.7 - 16.7	13.0 - 26.7	6.7 - 16.7	10.0 - 26.7		
12	5-AXLE MULTI-TRLR	6.7 - 16.7	0.0 - 6.7	10.0 - 26.7	6.7 - 13.3	0.0 - 26.7	
13	7-AXLE MULTI-TRLR	6.7 - 16.7	0.0 - 6.7	10.0 - 26.7	6.7 - 13.3	0.0 - 40.0	0.0 - 6.7
14	TOTAL ALL VEHICLES NOT MATCHING ONE OF THE ABOVE						

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
WEIGH-IN-MOTION (WIM)
(SHRP TEST SECTIONS)

NOTE: Whenever this Special Provision conflicts with the plans or Standard Specifications, this Special Provision shall govern.

TERMS: Shall is a mandatory requirement. Failure to comply will result in disqualification.

WEIGH-IN-MOTION EQUIPMENT

1.0 DESCRIPTION: This item of work consists of the Contractor furnishing and installing a Weigh-In-Motion (WIM) device at the location designated on the Plans. The WIM shall be installed in accordance with the manufacturer's recommendations and this Special Provision.

1.1 The Contractor/Vendor shall provide an experienced field services technical representative to plan, supervise and guide the above activities

1.2 The Contractor/Vendor shall provide all equipment necessary to weigh and record on a minimum of two lanes of traffic. The on-site computer shall be capable of monitoring and reporting vehicle weight and classification data from four (4) lanes of traffic. The WIM system shall also have one spare operational weigh pad assembly with weigh sensors.

1.3 Weigh pads to weigh two adjacent 12' lanes.

1.4 Communication devices necessary to access the on-site computer as specified in Section 8.0 of this Special Provision.

1.5 All necessary connectors and cables to construct a complete operational system - this includes electrical power and telephone connections.

2.0 MATERIALS: The proposed system must meet the requirements of ASTM Standard E1318-90 for a Type I WIM system. Vendor shall also show that systems identical to that proposed have been installed in the U.S. and successfully operated for at least one year.

2.1 All electronic components shall be new and unused, and of solid state design with high noise immunity and low power consumption. Logic and data components shall be mounted on replaceable plug-in circuit boards. Circuit boards shall be firmly mounted and housed so that they will not be damaged by jolts, shocks and vibrations encountered in transportation and use. Electronic components shall be fully protected against overloads, power surges, static electrical discharge and transients.

2.2 Materials shall be free from all defects and imperfections that might affect the serviceability of the finished product. The equipment shall be standard manufactured products, so that prompt and continuing service and delivery of spare parts may be assured.

2.3 All equipment housed in the controller cabinet shall operate within a temperature of at least 0° to 140° F with a humidity range to 95% noncondensing relative humidity. The systems shall additionally be capable of withstanding temperatures in the range -40° to +160° F without suffering permanent damage.

2.4 All steel, including nuts and bolts, used in the weigh pad and mounting frame shall be stainless steel or hot dipped galvanized steel. The weigh pad shall withstand shock loads normally encountered under a loaded truck traveling at 80 mph. The sensor shall also be capable of supporting a static load of 80,000 lb. without suffering permanent damage. Weight sensor replacement shall not require modification of the roadbed installation; neither by cutting and patching the concrete, nor by replacement of the support frame.

2.5 The contractor shall submit the weigh pad foundation drawings to the engineer for approval. Provisions for drainage of platform pit shall also be shown.

2.6 The weigh pad output should be an electrical output which is independent of vehicle speed. If the weigh pad is speed dependent, the manufacturer shall provide speed-weight relationship data and demonstrate how the software algorithm compensates for vehicle speed variations.

3.0 POWER SUPPLY: The system shall operate from 120V, 60 Hz Ac mains power with surge, lightning and RF protection as required by the manufacturer.

3.1 The controller cabinet shall be water tight with a gasketed door. The cabinet shall have a switched light and a spare duplex outlet for use by repair personnel and shall contain a circuit breaker for the incoming AC lines. A housing locking device and two keys shall be provided.

3.2 It shall be the responsibility of the contractor to provide AC power connection and a telephone connection to this housing. It shall be the Contractor's responsibility to obtain all necessary permits for hookups of these utilities.

4.0 PERFORMANCE SPECIFICATIONS: The system shall be capable of gathering weight, length, classification and speed data on vehicles operating at normal highway speeds. Accuracy for weight, length, and speed shall be as stated in the ASTM Standard.

4.1 Vehicle type classification shall use FHWA 2-digit (13-type) scheme, shown in Attachment #1, page 9. The accuracy shall be as follows:

Less than 10% of all vehicles erroneously classified.

Less than 10% of Class 9 vehicles erroneously classified.

4.2 Classification accuracy will be determined by MDOT personnel.

During the fifteen (15) day operational acceptance test period (Section 13.0) five (5) 400 vehicle samples will be collected and compared to visual observations.

Three (3) additional 400 vehicle samples will be taken to determine Class-9 accuracy.

4.3 The WIM system's operation shall not be affected by CB radio communications, two-way radio, etc.

4.4 The central processing computer shall have sufficient memory capacity to store a minimum of 200,000 truck records.

5.0 SOFTWARE: User programmable factors shall include an initial calibration factor and other parameters required for setting-up the system such as identification, time and date, sensor configuration, etc.

5.1 Mode of operation and parameters for data processing and storage shall be user-programmable. Must include options to: weigh all vehicles, weigh only heavy vehicles while classifying all light vehicles, classify all vehicles without recording weight.

5.2 Diagnostic checks of system operation and performance shall include, as a minimum, checks for axle sensor failure, data consistency between sensors, telemetry errors, condition of stored data, and battery voltage, if used.

5.3 The on-site computer status items shall include, but need not be limited to:

	Item	Minimum Positions
1.	Station Identification Number	10
2.	Date (Calendar)	6
3.	Current Time	6
4.	Recording Configuration	As necessary
5.	Recording Interval	As necessary
6.	Start and Stop Dates	As necessary
7.	Start and Stop Times	As necessary
8.	Battery Condition (Voltage)	If used
9.	Detector Operation	As Necessary
10.	Data from the most recent vehicle	As Specified Below

5.4 The self-calibration algorithm shall be by lane and capable of being disabled by the operator. The automatic self-calibration factor shall be based on a sample of not less than 150 Class-9 vehicles. Each adjustment may be no more than one percentage point toward the new factor.

In binned data modes, self-calibration adjustments shall only be permitted at the end of each recording period, if sufficient vehicles have been accumulated since the previous adjustment. In all modes, however each adjustment shall be logged in the data record, including time, date, lane number, calculated factor and actually-implemented factor.

5.5 Provision shall be made for input of all system operating parameters on-site using a terminal or keyboard, and via the telemetry connection. Both on-site and telemetry connections shall permit the same operations to be requested. The telemetry communications parameters need only be accessible on-site.

6.0 REPORTS: Individual vehicle reports from the on-site computer shall have the capability of storing or displaying and reporting individual vehicle records in the FHWA Truck Weight Record format (7-card) in an ASCII file. (Attachment 2a-2b, pages 10-11)

6.1 The individual vehicle weight data reports shall include, but need not be limited to:

	Item	Minimum Positions
1.	Station Identification Numbers	10
2.	Lane	2
3.	Direction	1
4.	Date (Calendar)	6
5.	Time	6
6.	Individual wheel loads	4 ea
7.	Individual axle spacings	3 ea
8.	Vehicle speed	3

6.2 Summary reports shall include include, but need not be limited to:

1. Total vehicles by hour and by day.

2. FHWA 13-classes by hour and by day. Shall also include unclassified vehicles.

3. Summary of vehicles by speed group and hour.

4. Gross vehicle weights by FHWA 13-classes, including overweights.

5. 18-kip Equivalent Single Axle Load (ESAL) by each of the FHWA 13-classifications.

6. Weight Violations by hour and by day.

7.0 DATA FILES: Each data file shall have a file name which uniquely identifies the file. The file must uniquely identify the recording unit and site.

7.1 The on-site computer shall be capable of storing requested data in 24 hour periods. The system shall close the existing file and open a new data file at midnight.

7.2 Data for each vehicle shall be filed within one hour of the vehicle's passing through the site, and the current files shall be available for downloading at any time during the day.

8.0 DATA TRANSFER/COMMUNICATION/OUTPUT: All procedures contained within the on-site computer which control data recording, storage, display and dat transmittal shall be designed to prevent any inadvertent actions such a destruction of data contained in memory. All operator commands whic would have this result shall provide a warning and require that t instruction be confirmed through a password before it is execute Failure to confirm shall return the program to normal operation with a stored data intact. All associated cables and/or equipment necessary perform data transfer shall be supplied by the Contractor/Vendor. Cab provided for communication with an IBM AT compatible computer sh connect via an RS-232-C.

8.1 The on-site computer program shall include a telemetry sub-system abl receive and transmit data via commercial dial-up telephone connect Provision shall be made for error trapping and re-transmission of da a defined and approved protocol. The telemetry connection sha transparent to the computer's primary data collection.

8.2 Provision shall be made for on-site portable data retrieval from t site computer by means of downloading to a portable laptop microco

8.3 The on-site computer shall be capable of transmitting data in a fu or compressed binary format as determined by the user.

8.4 All on-site communications shall be RS-232-C compatible. Telepl transmission rates will include 1200 baud. Protocols and ha shall be provided for communication to Hayes-compatible modems.

8.5 Take Away Memory modules, portable memory modules, if used, transparent to the on-site computers normal operation. Any equipment or software necessary to access or process data devices shall be provided at no extra cost.

9.0 PORTABLE LAPTOP MICROCOMPUTER FUNCTIONS: One (1) laptop computer shall be provided for on-site data retrieval of at least 200,000 truck records.

386 - 20MHZ
2 - Meg RAM
40 - Meg Hard Drive or as necessary to store 200,000 truck records.
3.5 - 1.4 Meg Floppy Drive
2400 Baud - Hayes compatible internal modem
2 serial
1 parallel
VGA compatible

9.1 One (1) AC/DC powered portable printer shall be provided for on-site monitoring and report generating.

10.0 SYSTEM COMPATIBILITY: The WIM system provided for these specifications shall be configured so that all vehicle data gathered can be directly transferred to the portable laptop microcomputer for analysis and further processing. In addition, software shall be supplied for the permanent on-site computer, which will perform data management and create summary tables and a truck weight file (Attachments 2a-2b, pages 10-11) using an IBM AT compatible microcomputer.

10.1 It shall be the responsibility of the Contractor/Vendor to identify all restrictions and constraints on the use of the software and programs such as copyrights, etc.

11.0 MANUALS: The Contractor shall provide the Department with four (4) complete sets of vendor-supplied manuals. These shall include: operation of the WIM equipment; maintenance and troubleshooting, including schematics, voltage points, and waveforms; and software manuals and source code. The set shall be contained in individual binders suitable for field and office use and storage.

11.1 Maintenance manuals shall include schematics, circuit diagrams, photographic parts location diagram, parts lists and instructions suitable for MDOT technicians to perform services and repairs.

12.0 TRAINING: Training shall be provided for 10 MDOT personnel by the Contractor/Vendor. Training will include: Maintenance of all Contractor/Vendor supplied equipment, operation of the equipment in the field, and software options for data summary and storage. Manuals for each segment of training will be made available to MDOT at least 5 days before the training session. The training period shall be at a time mutually agreed upon.

13.0 ACCEPTANCE: Final Acceptance will be based upon the following:

13.1 Satisfactory completion of 15 days of continuous operation.

13.2 Delivery of all required documents, manuals and drawings.

13.3 Completion of staff training.

14.0 **MAINTENANCE AND TECHNICAL SUPPORT:** For continued support from WIM vendor beyond initial 5 year warranty period, the following information shall be provided:

14.1 Name, location and telephone number of individual to contact in the event of system failure.

14.2 A preventive maintenance plan on system components including duration and frequency.

14.3 A recommended list of spare parts and their cost.

15.0 **WARRANTY AND SERVICE:** The Contractor shall deliver to MDOT a binding warranty from the Vendor/Manufacturer which meets the following requirements:

15.1 All products delivered shall be guaranteed against faulty material and workmanship for warranty periods as specified below. If during these warranty periods such faults develop, the units or parts affected are to be replaced (including shipping) and installed at no cost to the Michigan Department of Transportation. Where accessories are to be supplied, they must be compatible with the rest of the furnished equipment. Any trips and/or expenses incurred by the Vendor/Manufacturer or his agents necessary to repair the equipment under this warranty shall be at no expense to the Department.

15.2 The on-site computer and all other equipment furnished under this contract shall be warranted against failure in normal use for a period of five years after formal acceptance of the system. Upon notification of a problem, this WIM system shall be restored to normal operation within thirty days or as soon as weather conditions permit during winter months.

15.3 All software revisions and upgrades shall be made available to the Department at no cost during the warranty period.

16.0 **WIM SYSTEM AVAILABILITY:** Known acceptable WIM systems are available from the following Vendor/Manufacturer:

1. Toledo Scale - Harry Owens
   60 Collegeview Road
   Westerville, Ohio 43081
   614-841-5030

2. PAT Equipment Corp.
   1665 Orchard Park (South)
   Chambersburg, Pennsylvania 17201
   717-263-7655

3. IRD, Inc. - Joe Madek
   28 Lord Road, Suite 267
   Marlboro, Massachusetts 01752
   508-481-9066

17.0 OTHER SYSTEMS: Other systems meeting the requirements of this Special Provision will be evaluated and considered.

17.1 Any system offered for use under this Special Provision shall be evaluated based on the following information submitted by the Contractor/Vendor:

* Detailed equipment specifications, circulars, drawings and all necessary data which describes in detail the equipment proposed for use under this Special Provision.

* A listing of any discrepancies between the proposed equipment capabilities and these specifications.

* Location(s) where identical system(s) installed and operating for at least one year.

* Normal life expectancy of sensor arrays, recorders and associated equipment.

* A list of parts needing periodic replacement, including their normal life expectancy and their itemized costs.

* The address where the proposed equipment will be produced and serviced.

* The manufacturer shall have been in operation for a period of at least 3 years and have a facility adequate for and devoted, at least in part, to the manufacturing of weigh-in-motion traffic data collection systems.

18.0 BASIS OF PAYMENT: The "WIM EQUIPMENT FURNISHED" will be measured and paid for at the LUMP SUM unit price which shall be payment in full for furnishing the weigh-in-motion scales (two lanes), factory made hardware, detecting and monitoring equipment complete and delivered to the site.

The "WIM EQUIPMENT PLACED" will be measured and paid for at the LUMP SUM unit price which shall be payment in full for furnishing and placing all site installed equipment, wiring, cabinet, telephone connection, loop detectors, handholes, fit up C.P. Co. pole and setting the scales to make a complete and operating weigh-in-motion system as specified and shown on the plans.

18.1 The amount of completed and accepted work, measured as provided above shall be paid for at the contract lump sum price for "Weigh-In-Motion Device", which price shall be full compensation for furnishing all materials, all utility hook-ups, for all labor, equipment, warranties, training, tools and incidentals necessary to complete the work.

ATTACHMENT 1

VEHICLE TYPE CLASSIFICATION
CLASSIFICATION CRITERIA

(FHWA SCHEME F)

CLASS	Description	AXLE A - B	AXLE B - C	AXLE C - D	AXLE D - E	AXLE E - F	AXLE F - G
1	Motorcycle	0.0 - 6.7					
2	Car - Car w/ trlr	6.7 - 10.0	6.7 - 13.3	0.0 - 6.7			
3	Pickup - Van	10.0 - 13.3					
4	Bus	20.0 - 40.0	0.0 - 6.7	0.0 - 6.7			
5	2-Axle/6 tire	13.3 - 20.0					
6	3-Axle S. U.	6.7 - 20.0	0.0 - 6.7				
7	4-Axle S. U.	6.7 - 20.0	0.0 - 6.7	0.0 - 6.7			
8	2S1	6.7 - 16.7	16.7 - 40.0				
8	3S1	6.7 - 20.0	0.0 - 6.7	10.0 - 40.0			
8	2S2	6.7 - 16.7	13.3 - 40.0	0.0 - 6.7			
9	3S2	6.7 - 20.0	0.0 - 6.7	10.0 - 40.0	0.0 - 13.3		
9	3-AXLE W/TRLR	6.7 - 20.0	0.0 - 6.7	6.7 - 26.7	10.0 - 26.7		
10	6-OR MORE AX. SGL TR	6.7 - 16.7	0.0 - 6.7	10.0 - 40.0	0.0 - 13.3	0.0 - 13.3	0.0 - 13.3
11	5-AXLE MULTI-TRLR	6.7 - 16.7	13.0 - 26.7	6.7 - 16.7	10.0 - 26.7		
12	5-AXLE MULTI-TRLR	6.7 - 16.7	0.0 - 6.7	10.0 - 26.7	6.7 - 13.3	0.0 - 26.7	
13	7-AXLE MULTI-TRLR	6.7 - 16.7	0.0 - 6.7	10.0 - 26.7	6.7 - 13.3	0.0 - 40.0	0.0 - 6.7
14	TOTAL ALL VEHICLES NOT MATCHING ONE OF THE ABOVE						

FHWA
TRUCK WEIGHT RECORD

FACE RECORD Attachment 2-a

Columns	No. of Columns	Description	TMG Ref. Page
1	1	Truck weight record code (7)	
2-3	2	State code (20)	5-6-2
4-5	2	Functional classification	5-6-3
6-8	3	Station identification number	5-6-3
9	1	Direction of travel	5-6-3
10-11	2	Year of data	5-6-4
12-13	2	Month of data	5-6-19
14-15	2	Date of month	5-6-19
16-17	2	Hour of day	5-6-19
18-23	6	Vehicle type code	5-6-19
24-25	2	(99) Body type (optional)*	5-6-22
26	1	(9) Engine type (optional)*	5-6-25
27-28	2	(open)	5-6-26
29-31	3	(000) Registered weight (thousands of pounds)	5-6-26
		(9) Basis of registration	5-6-26
		Optional, if one is coded, both must be coded*	
33-35	3	(open)	5-6-26
36-40	5	(99999) Commodity code (optional)*	5-6-27
41	1	(9) Load status code (optional)*	5-6-32
42-45	4	Total weight of truck or combination	5-6-32
46-48	3	A-axle weight (hundreds of pounds)	5-6-32
49-51	3	B-axle weight (hundreds of pounds)	5-6-32
52-54	3	C-axle weight (hundreds of pounds)	5-6-32
55-57	3	D-axle weight (hundreds of pounds)	5-6-32
58-60	3	E-axle weight (hundreds of pounds)	5-6-32
61-63	3	(A-B) axle spacing (feet and tenths)	5-6-32
64-66	3	(B-C) axle spacing (feet and tenths)	5-6-32
67-69	3	(C-D) axle spacing (feet and tenths)	5-6-32
70-72	3	(D-E) axle spacing (feet and tenths)	5-6-32
73-76	4	Total wheelbase (feet and tenths)	5-6-32
77-79	3	Record serial number (same for continuation record)	5-6-32
80	1	Continuation indicator (0 = no continuation record 1 = has a continuation record)	5-6-32

*Each interview data item has a default value which must be entered when the data item is not collected. Defaults are given in parentheses.

CONTINUATION RECORD* Attachment 2-b

Columns	No. of Columns	Description	TMG Ref. Page
1-28	28	Same as columns 1-28 of the face record	
29-31	3	F-axle weight (hundreds of pounds)	5-6-32
32-34	3	G-axle weight (hundreds of pounds)	5-6-32
35-37	3	H-axle weight (hundreds of pounds)	5-6-32
38-40	3	I-axle weight (hundreds of pounds)	5-6-32
41-43	3	J-axle weight (hundreds of pounds)	5-6-32
44-46	3	K-axle weight (hundreds of pounds)	5-6-32
47-49	3	L-axle weight (hundreds of pounds)	5-6-32
50-52	3	M-axle weight (hundreds of pounds)	5-6-32
53-55	3	(E-F) axle spacing (feet and tenths)	5-6-32
56-58	3	(F-G) axle spacing (feet and tenths)	5-6-32
59-61	3	(G-H) axle spacing (feet and tenths)	5-6-32
62-64	3	(H-I) axle spacing (feet and tenths)	5-6-32
65-67	3	(I-J) axle spacing (feet and tenths)	5-6-32
68-70	3	(J-K) axle spacing (feet and tenths)	5-6-32
71-73	3	(K-L) axle spacing (feet and tenths)	5-6-32
74-76	3	(L-M) axle spacing (feet and tenths)	5-6-32
77-79	3	Record serial number (same as face record)	5-6-32
80	1	Continuation indicator (2 = first continuation record for a vehicle with more than 13 axles 9 = last continuation record)	5-6-32

* Used only for truck combinations having six or more axles and immediately follows the face record.

APPENDIX E

PCC AND LCB MIX DESIGNS

soil and materials engineers, inc.

43980 Plymouth Oaks Blvd Plymouth, MI 48170-2584 (313) 454-9900 FAX (313) 454-0629

Kenneth W Kramer, PE
Richard O Anderson PE
Garrett H Evans PE
Frank A Henderson PG
Starr D Kohn, PhD PE
Edward S Lindow PE
Robert C Rabeler PE
Robert E Zayko PE

Larry P Jedele PE
Paul C Larsen PE
Gerard P Madej, PE
Francis F Widrig PE
Timothy H Bedenis PE
J William Coberly CET
Cheryl Kehres-Dietrich CGWP
Jerry B Givens, PE
Truman F Maxwell CPA
Timothy J Mitchell, PE
John C Zarzecki CWI
Christine R Rollinson
Donald C Templin PE

July 1, 1993

Mr. Richard C. Ingberg
Regional Engineer
Strategic Highway Research Program
1983 Sloan Place, Suite 10
St. Paul, MN 55117

RE: Concrete Mix Designs
SPS-2 Site
US-23, Michigan

Dear Mr. Ingberg:

Attached, please find copies of the proposed mix designs for the lean concrete base, Grade 550, and Grade 900 concrete material proposed for use at the referenced site. Also enclosed, please find MDOT's specifications for concrete material.

The mix designs submitted for the lean concrete base and the Grade 550 are within the specified strength limits of 500 to 700 psi (compressive) and 525 to 575 psi (flexural), respectively. The average of the Grade 900 mix is 890 psi which is slightly below 900 psi but within the range of 860 to 940 psi which we consider acceptable.

The 900 mix was obtained after a significant effort by the contractor. A total of 23 mix designs were performed prior to reaching the desired strength. We feel that the contractor have done the best effort possible to meet the SHRP requirements.

The project specifications require the contractor to perform a minimum of 3 batches for the mix design to be accepted. If the average of the three batches is within the acceptable range, we recommend that the mix be accepted even if it results in a flexural strength that is less than the desired 900 psi. However, prior to proceeding with the three batches, we would like to inform the contractor if the present mix design is acceptable. Please review the enclosed information and provide us with an answer as soon as possible. We also recommend that the lean concrete base and the Grade 550 mix be accepted.

If you have any questions regarding this information, please do not hesitate to contact us.

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC.

Chuck Gemayel

Chuck A. Gemayel, P.E.
Project Engineer

cc: Gene Skok, BIP
Monte Symons, FHWA/LTPP
Shiraz Tayabji, PCS/LAW
David Church, MDOT
Roger Till, MDOT

Division VI - SHRP Grade 550

Materials	Materials Producer
Cement - Type I	Medusa
Fine Aggregate - 2NS	Bundy Hill Sand & Gravel
Coarse Aggregate - 6AA	France Stone, Silica
Air Entraining Admixture	Masterbuilders MB-VR Concentrate
Water Reducing Admixture	Masterbuilders Pozzolith 220N

Mix Design Weights per cubic yard:

Cement - 376 lbs.
Fine Aggregate - 1485 lbs. (SSD)
Coarse Aggregate - 1827 lbs. (SSD)
Net Water - 211 lbs.
Air Entraining Admixture - 1 oz. cwt.
Water Reducing Admixture - 3 oz. cwt.

BOWSER MORNER

BOWSER-MORNER INC.

REPORT OF CONCRETE MIX DESIGN

Project:	MDOT Project NH 58034/32750A. U.S. Rtw. 23, Monroe Cty., Michigan	Job No.:	74809
		Date Designed:	1/27/93
Client:	Interstate Highway Construction, Inc. P. O. Box 1450 East Lansing, MI	Mix Number:	8
		Mix Identification:	SHRP Grade 550
Supplier:	-		

Material Analysis and Sources

	Fine Aggregate	Coarse Aggregate
Source	Bundy Hill Sand & Gravel	France Stone Silica
Size Range	2NS	6AA

Fine Aggregate Sieve	Percent Passing	Coarse Aggregate Sieve	Percent Passing
3/8"	100	1 1/2"	100
#4	99	1"	100
#8	87	3/4"	96
#16	68	1/2"	48
#30	46	#4	5
#50	20	#8	3
#100	4	(Loss by wash) #200	1.8
(Loss by wash) #200	1.7		

	Fine Aggregate	Coarse Aggregate
Specific Gravity	2.645	2.658
Absorption, %	1.5	3.6
Organic Impurities	-	-
Decantation Loss, %	-	-
Fineness Modulus	2.8	Dry Loose Unit Wt.pcf 87.0

Cement - Brand: Medusa Type: I

Concrete Mix Design Data

Strength - P.S.I.: 525-575 @ 14 days Water-Cement Ratio: 0.56

Cement Factor: 3.76 Slump (ins.): 1-2 1/2" AirContent(%): 6.5±1.5

	Cement	Net Water	Fine Aggregate	Coarse Aggregate	Air Content	Chemical Admixtures
Mix Design volume cu.ft.:	1.91	3.40	9.00	11.02	1.89	Master Bldrs. MBVR-
Mix Design lbs./cu.yd.:	376	212	1485	1827		Concentrate 1 oz. cwt. Master Bldrs. Pozzolith 220N 2 oz.cwt.

	Unit Wt. (lbs.)	Slump (in.)	Air Content (%)	Yield (cu.ft/cu.yd).
Laboratory test results:	144.7	1 1/2	7.0	27.0

Flexural Strength Results-P.S.I.

Specimen Number	Date Tested	7 Day	14 Day	28 Day
ZZ-57-A	2/3/93	540		
ZZ-57-B	2/10/93		580	
ZZ-57-C	2/10/93		580	
ZZ-57-D	2/10/93		560	
Avg. Strength			570	

Remarks: Aggregate weights are based on SSD moisture condition and must be adjusted for free moisture at the time of batching.

Approved by: Robert B. Bell

Grade 900 (SHRP)

Materials	Materials Producer
Cement - Type I	Medusa
Fine Aggregate - 2NS	Bundy Hill Sand & Gravel (Pit No. 30-35)
Coarse Aggregate - 6AA	France Stone, Waterville (Pit No. 93-4)
Air Entraining Admixture	Masterbuilders MB-VR Concentrate
Water Reducing Admixture	Masterbuilders Pozzolith 220N

Mix Design Weights per cubic yard:

Cement - 750 lbs.
Fine Aggregate - 1370 lbs. (SSD)
Coarse Aggregate - 1605 lbs. (SSD); Dry Loose Unit Weight pcf 90.4 lbs.
Net Water - 285 lbs.
Air Entraining Admixture ~~- 5.9 oz. cwt.~~ 3 oz/cwt
Water Reducing Admixture - 5.0 oz. cwt.

BOWSER MORNER

REPORT OF CONCRETE MIX DESIGN

Project:	MDOT Project NH 58034/32750A, U.S. Rte. 23, Monroe Cty., Michigan	Job No.:	74809
		Date Designed:	7/8/93
Client:	Interstate Highway Construction, Inc.	Mix Number:	24
	P. O. Box 1450 East Lansing, MI	Mix Identification:	Grade 900 SHRP
Supplier:	-		

Material Analysis and Sources

	Fine Aggregate	Coarse Aggregate
Source	Bundy Hill Sand & Gravel	France Stone, Waterville
Size Range	2NS	6AA

Fine Aggregate Sieve	Percent Passing	Coarse Aggregate Sieve	Percent Passing
3/8"	100	1 1/2"	100
#4	99	1"	100
#8	87	3/4"	94
#16	68	1/2"	52
#30	46	#4	4
#50	20	#8	2
#100	4	(Loss by wash) #200	0.7
(Loss by wash) #200	1.7		

	Fine Aggregate		Coarse Aggregate
Bulk SSD Specific Gravity	2.645		2.77
Absorption, %	1.5		1.07
Organic Impurities	-		-
Decantation Loss, %	-		-
Fineness Modulus	2.8	Dry Loose Unit Wt.pcf	90.4

Cement - Brand: Medusa Type: I

Concrete Mix Design Data

Strength - P.S.I.: 860-940 @ 14 days Water-Cement Ratio: 0.38

Cement Factor: 7.5 Slump (ins.): 1-2 1/2 AirContent(%): 6.5±1.5

	Cement	Net Water	Fine Aggregate	Coarse Aggregate	Air Content	Chemical Admixtures
Mix Design volume cu.ft.:	3.82	4.60	8.30	9.29	1.43	Master Bldrs. MBVR
Mix Design lbs./cu.yd.:	750	287	1370	1605		Concentrate ~~5.0 oz./cwt.~~ 3.0 oz/cwt Master Bldrs. Pozzolith 220N 5.0 oz. cwt.

	Unit Wt. (lbs.)	Slump (in.)	Air Content (%)	Yield (cu.ft/cu.yd)
Laboratory test results:	147.3	1 1/2	5.3	27.1

Flexural Strength Results-P.S.I.

Specimen Number	Date Tested	3 Day	14 Day	28 Day
ZZ-104-A	7/22/93		810	
ZZ-104-B	7/22/93		805	
ZZ-104-C	7/22/93		730	
ZZ-104-D	7/22/93		875	
Average			805	

Coarse aggregate weight should be decreased by absorption value in calculating yield.

Division V - Lean Concrete Base (LCB)

Materials	Materials Producer
Cement - Type I	Medusa
Fine Aggregate - 2NS	Bundy Hill Sand & Gravel
Coarse Aggregate - 6AA	France Stone, Silica
Air Entraining Admixture	Masterbuilders MB-VR Concentrate

Mix Design Weights per cubic yard:

Cement - 165 lbs.
Fine Aggregate - 1580 lbs. 1685 165 > REVISED
Coarse Aggregate - 1875 lbs. 1800 161 >
Net Water - 258 lbs.
Air Entraining Admixture - 1 oz. cwt.

BOWSER MORNER

BOWSER-MORNER INC.

REPORT OF CONCRETE MIX DESIGN

Project:	MDOT Project NH 58034/32750A U.S. Rte. 23, Monroe County, Michigan	Job No.:	74809
		Date Designed:	
Client:	Interstate Highway Construction, Inc. P. O. Box 1450, East Lansing, Michigan	Mix Number:	5
		Mix Identification:	LeanConcreteBase(LCB) SHRP
Supplier:			

Material Analysis and Sources

	Fine Aggregate	Coarse Aggregate
Source	Bundy Hill Sand & Gravel	France Stone, Silica
Size Range	2NS	6AA

Fine Aggregate Sieve	Percent Passing	Coarse Aggregate Sieve	Percent Passing
3/8"	100	1 1/2"	100
#4	99	1"	100
#8	87	3/4"	96
#16	68	1/2"	48
#30	46	3/8"	17
#50	20	#4	5
#100	4	(Loss by wash) #200	1.8
(Loss by wash) #200	1.7		

	Fine Aggregate	Coarse Aggregate
Specific Gravity	2.645	2.658
Absorption, %	1.5	3.6
Organic Impurities	-	-
Decantation Loss, %	-	-
Fineness Modulus	2.8	
Dry Loose Unit Wt.pcf		87.0

Cement - Brand: Medusa Type: I

Concrete Mix Design Data

Strength - P.S.I.: 500-700@7 days Water-Cement Ratio: 1.56

Cement Factor: 1.65 Slump (in.): 1-3 AirContent(%): 6.5±2.0

	Cement	Net Water	Fine Aggregate	Coarse Aggregate	Air Content	Chemical Admixtures
Mix Design volume cu.ft.:	.839	4.13	9.57	11.3	1.54	Master Bldrs. MBVR
Mix Design lbs./cu.yd.:	165	258	1580	1875		Concentrate 1 oz. cwt.

	Unit Wt. (lbs.)	Slump (in.)	Air Content (%)	Yield (cu.ft/cu.yd)
Laboratory test results:	145.0	1	5.7	26.7

Compressive Strength Results-P.S.I.

Specimen Number	Date Tested	Cyl. Wt. (lbs.)	7 Day	14 Day	28 Day
ZZ-37-A	12/30/92	8.4	620		
ZZ-37-B	12/30/92	8.4	600		
ZZ-37-C	12/30/92	8.4	640		
ZZ-37-D	12/30/92	8.4	610		
ZZ-37-E	12/30/92	8.4	670		
Avg. Strength			630		

Remarks: Aggregate weights are based on SSD moisture condition and must be adjusted for free moisture at the time of batching.

Approved by: Robert B. Bol

Alternate Concrete Mix Design - Project Quantities

Contractor: Interstate Highway Construction

Project: NH 58034/32750A

Date: 6/11/93

Materials to be used (NO SUBSTITUTIONS):

	Specific Gravity	Absorption %
Cement: Medusa Type I	3.12	
Fly Ash: U. S. Ash, Avon Lake (Class F)	2.50	
Fine Agg, 2NS (dry): Bundy Hill (30-35)	2.59	1.71
Coarse Agg, (6AA)(dry): Michigan Stone #1 (58-3)	2.62	2.40
Water-Reducing admixture: Pozzolith 220N		

Unit wt of Coarse Agg: , 92 lb/ft^3
b/b$_o$ 35P = 0.75 30P = 0.77
Specified Air Content: 6.5 ± 1.5%

	Materials Proportions per cubic yard of concrete	
	Grade 35P	Grade 30P
Mix Design No.	93-545	93-546
Portland Cement, lb	451	414
Fly Ash, lb	113	103
Fine Agg 2NS, (dry) lb	1157	1144
Coarse Agg, (6AA) (dry) lb	1870	1922
Water Reducer, fl oz	3 cwt	3 cwt
Water, lb		
Net Mixing	225	226
Absorbed	65	67
Total	290	293

30 C.Y.

Under yield 1 ft^3 per Barrett 8-24-93 Told Barrett to [illegible]

Table 7.01-1 Concrete Mixtures

1990

Grade of Concrete	Section Number Reference (k)	Class of Coarse Aggregate and Relative Quantity (i)	Cement Type (b)(c) Note (1) = IA (2) = IS-A, I(SM)-A (3) = IP-A, I(PM)-A	Cement Content		Fly Ash, Lbs / Cu Yd	Water-Reducing or Water-Reducing Retarding Admixtures Optional Except Where Required(d)	Consistency (Slump) inches			Anticipated Minimum Strength of Concrete(g)				
				Lbs per Cu Yd	Sacks (94 lb.) per Cu Yd			Without Admixtures or With Type A or D Admixtures(e)	With Type F or G Admixtures		Flexural, psi				Compressive, psi
									Prior to Addition of Admixture	After Addition of All Admixtures(f)	At 3 Days	At 7 Days	At 14 Days	At 28 Days	At 28 Days
45D	5 03, 5 08, 5 09	6AA	(1), (2), (3)	658	7 0	0	Req'd	0-3½	0-3	0-7		625	700	725	4500
40S	5 02	6A, 17A	(1), (2), (3)	611	6 5	0	Opt	3-5	0-3	3-7		600	650	700	4000
			(1)	545	5 8	92	Req'd								
35HE	4 50, 4 52, 6 08	6A	(1), (2)	658	7 0	0	Opt	0 3	0-3	0-7	550	600		650	3500
			(3)	790	8 4	0	Opt								
35T	5 03	6A	(1), (2) (3)	611	6 5	0	Opt	3-7	0-4	3-8		550	600	650	3500
			(1)	545	5 8	92	Req'd								
35P 35S	4 50(h), 4 52 5 03, 5 09, 5 10, 5 11, 6 08 6 09, 6 11, 6 17, 6 26	6AA(a), 6A,17A(j)	(1), (2), (3)	564	6 0	0	Opt	0-3	0-3	0-7		550	600	650	3500
			(1), (2), (3)	526	5 6	0	Req'd								
			(1)	517	5 5	78	Opt								
			(1)	480	5 1	72	Req'd								
30P 30S	4 50, 6 10, 6 11, 6 12	6A, 17A(j)	(1), (2), (3)	517	5 5	0	Opt	0-3	0-3	0-7		500	550	600	3000
			(1), (2) (3)	489	5 2	0	Req'd								
			(1)	470	5 0	71	Opt								
			(1)	451	4 8	68	Req'd								
30M	5 14, 6 01, 6 03, 6 13, 6 18 6 21 [illegible]	Commercial grade concrete containing 517 pounds (5 5 sacks) of cement per cubic yard Portland cement may be reduced up to 20 percent by weight when 1 4 pounds of fly ash are substituted for each 1 0 pound of cement removed													
X		Unless otherwise specified on the plans or in the proposal, Grade X concrete shall have not less than 282 pounds (3 0 sacks) of cement per cubic yard Portand cement may be reduced up to 20 percent by weight when 1.4 pounds of fly ash are substituted for each 1 0 pound of cement removed													

(a) Unless otherwise specified, Coarse Aggregate 6AA shall be used for exposed structural concrete used in bridges, retaining walls, and pumphouses

(b) Concrete mixtures containing Type IS-A, I(SM)-A, IP-A, or I(PM)-A cement, or containing ground blast-furnace slag or fly ash, shall not be used on projects in the Lower Peninsula between October 15 and April 1 nor in the Upper Peninsula between October 1 and April 15, except this restriction does not apply to Grade 40S concrete used in foundation piling below ground level, and Grade 35T concrete used in tremie construction

(c) Non-air-entraining cement corresponding to the types of air-entraining cement listed may be used with an approved air-entraining admixture to produce the specified air content

(d) The quantity of admixture shall be as recommended by the manufacturer, or as directed by the Engineer, to provide reduction in mixing water The admixture used in Grade 45D concrete shall be a water-reducing or a water-reducing retarding admxture and shall be used in such amounts as necssary to provide the necessary retardation of setting

(e) Occasional batches having a consistency outside the specified range may be used if the slump does not exceed the limits of the specified range by more than ½ inch

(f) Occasional batches having a consistency outside the specified limits may be used if the slump does not exceed the maximum limits specified by more than 1 inch This increase in slump shall be due entirely to the addition of the Type F or G admixture

(g) The flexural and compressive strengths are not part of the specifications but are listed for informational purposes only and are the minimum strengths anticipated for the mix proportions specified for the various grades of concrete when cured under standard conditions

(h) Grade 35S concrete may be used for Miscellaneous Concrete Pavement

(i) The mix design basis for bulk volume (dry, loose) of coarse aggregate per unit volume of concrete is 68% for Grade 40S, 70% for Grades 45D, 35S, 35T, and 30S, 72% for Grades 35HE and 35P, and 74% for Grade 30P

(j) Coarse aggregate 17A shall not be used in Grade 35P or 30P concrete unless otherwise specified

(k) Section Number Reference·

4 50 Concrete Pavements
4 52 Concrete Pavement Repair
5 02 Foundation Piling
5 03 Structural Concrete Construction
5 08 Bridge Railings
5 09 Bridge Rehabilitation—Concrete
5.10 Bridge Rehabilitation—Steel
5 11 Culverts
5 14 Drainage Structures
6 01 Slope Protection
6 03 Paved Ditches
6 08 Concrete Driveways
6.09 Concrete Curb and Gutter
6 10 Bicycle Paths
6 11 Concrete Sidewalk, Sidewalk Ramps, and Steps
6 12 Concrete Barriers and Glare Screens
6 13 Guardrail, Guardrail Anchorages, and Miscellaneous Posts
6 17 Miscellaneous Precast Concrete Items
6 18 Rustic Construction
6 21 Fencing
6 26 Traffic Signs

APPENDIX F

MATERIALS SAMPLING AND TESTING PLAN

TABLE 3. MATERIAL SAMPLING REQUIREMENTS

Layer	Quantity	Units
PORTLAND CEMENT CONCRETE		
Cores (4 in. diameter)	108	Number
Bulk Samples – Molded into test specimens. From each location mold 6 cylinders (6"X12") and 3 beams (6"X6"X20") giving a total of 42 cylinders (6"X12") and 21 beams (6"X6"X20")	7	Locations
UNBOUND AGGREGATE BASE (SHPR AND CONTROL SECTIONS)		
Bulk and Moisture Samples	4	Locations
LEAN CONCRETE BASE		
Cores (4 in. diameter)	21	Number
Bulk Samples – Molded into test specimens. From each sample mold 9 cylinders (6"X12") for a total of 18 cylinders (6"X12")	3	Locations
PERMEABLE ASPHALT TREATED BASE		
Cores (4 in. diameter)	0	Number
Bulk Samples	3	Locations
OPEN GRADED DRAINAGE COURSE		
Cores (4 in. diameter)	0	Number
Bulk Samples	1	Location
EMBANKMENT		
Bulk and Moisture Samples	7	Locations
Split–spoon Sampling (see Note 1)	21	Number
EXISTING SUBBASE (CONTROL SECTION)		
Bulk and Moisture Samples – Obtain samples from both base and subbase	1	Location
Split–spoon Sampling (see Note 1)	3	Number
SUBGRADE		
Bulk and Moisture Samples	8	Locations

NOTE 1: Split–spoon samples through the embankment at 21 locations and through the existing base/subbase in the control section at 3 locations were obtained for a total of 24 locations. Could not retrieve test quality thinwalls. Samples were obtained to a minimum depth of 4 feet below the existing surface.

TABLE 4. SUMMARY OF FIELD TESTS

Test	Tests per Section	Number of Sections	Total Tests
ELEVATION MEASUREMENTS			
Subgrade	55	12	660
Embankment	55	12	660
Existing Subbase (Control Section)	55	1	55
Aggregate Base (SHRP Sections)	55	8	440
Aggregate Base (Control Section)	55	1	55
Permeable Asphalt Treated Base	55	4	220
Open Graded Drainage Course	55	1	55
Lean Concrete Base	55	4	220
Portland Cement Concrete	55	13	715
DENSITY AND MOISTURE TESTS			
Subgrade	–	–	44
Embankment	–	–	43
Existing Subbase (Control Section)	–	–	4
Aggregate Base (SHRP Sections)	–	–	24
Aggregate Base (Control Section)	–	–	3
FALLING WEIGHT DEFLECTOMETER TESTS			
Embankment	42	12	504
Existing Subbase (Control Section)	42	1	42
Aggregate Base (SHRP Sections)	42	8	336
Aggregate Base (Control Section)	42	1	42
Permeable Asphalt Treated Base	42	4	168
Open Graded Drainage Course	42	1	42
Lean Concrete Base	42	4	168
DRILLING			
Embankment auger probes	–	–	7
Split–spoon sampling	–	–	24
PLATE BEARING TEST			
Embankment	–	–	6
Dense Graded Aggregate Base	–	–	3
LEAN CONCRETE BASE (Perform tests on bulk samples)			
Air Content (ASTM C231)	–	–	3
Slump (ASTM C143)	–	–	3
Temperature (ASTM C1064)	–	–	3
PORTLAND CEMENT CONCRETE (Perform tests on bulk samples)			
Air Content (ASTM C231)	–	–	7
Slump (ASTM C143)	–	–	7
Temperature (ASTM C1064)	–	–	7

TABLE 5. LABORATORY TESTS ON SUBGRADE, EMBANKMENT, AGGREGATE BASE, EXISTING BASE/SUBBASE (CONTROL SECTION), PATB AND OGDC

Test	SHRP Test Designation	SHRP Protocol	No. of Tests
SUBGRADE			
Sieve Analysis	SS01	P51	8
Hydrometer to 0.01mm	SS02	P42	8
Atterberg Limits	SS03	P43	8
Classification and Type of Subgrade	SS04	P52	32
Moisture–Density Relations	SS05	P55	8
Resilient Modulus – NOTE 1	SS07	P46	8
Unit Weight	SS08	P56	0
Natural Moisture Content	SS09	P49	8
Unconfined Comp. Strength	SS10	P54	0
Permeability	SS11	P57	3
EMBANKMENT			
Sieve Analysis	SS01	P51	7
Hydrometer to 0.01mm	SS02	P42	7
Atterberg Limits	SS03	P43	7
Classification and Type of Subgrade	SS04	P52	28
Moisture–Density Relations	SS05	P55	7
Resilient Modulus – NOTE 1	SS07	P46	7
Unit Weight	SS08	P56	0
Natural Moisture Content	SS09	P49	7
Unconfined Comp. Strength	SS10	P54	0
Permeability	SS11	P57	3
AGGREGATE BASE (INCLUDING CONTROL SECTION)			
Particle Particle Size Analysis	UG01,UG02	P41	4
Atterberg Limits	UG04	P43	4
Moisture–Density Relations	UG05	P44	4
Resilient Modulus – NOTE 1	UG07	P46	4
Classification	UG08	P47	4
Permeability	UG09	P48	4
Natural Moisture Content	UG10	P49	4

TABLE 5 CONTINUED

TABLE 5. LABORATORY TESTS ON SUBGRADE, EMBANKMENT, AGGREGATE BASE, EXISTING BASE/SUBBASE (CONTROL SECTION), PATB AND OGDC (CONTINUED)

Test	SHRP Test Designation	SHRP Protocol	No. of Tests
EXISTING SUBBASE (CONTROL SECTION)			
Particle Size Analysis	UG01,UG02	P41	1
Atterberg Limits	UG04	P43	1
Moisture–Density Relations	UG05	P44	1
Resilient Modulus – NOTE 1	UG07	P46	1
Classification	UG08	P47	1
Permeability	UG09	P48	1
Natural Moisture Content	UG10	P49	1
PERMEABLE ASPHALT TREATED BASE			
Asphalt Content (Extraction)	AC04	P04	3
Gradation of Aggregate (Extracted)	AG04	P14	3
OPEN GRADED DRAINAGE COURSE (CONTROL SECTION)			
Asphalt Content (Extraction)	AC04	P04	1
Gradation of Aggregate (Extracted)	AG04	P14	1
NOTE 1: Tests to be Performed by FHWA Contractor on remolded bulk samples.			

TABLE 6. LABORATORY TESTS ON SAMPLES MOLDED IN THE FIELD

Material and Test	SHRP Test Designation	SHRP Protocol	No. of Tests
LEAN CONCRETE BASE			
Compressive Strength – Cylinders	PC01	P61	
7 Day			9
28 Day			9
1 Year			9
PORTLAND CEMENT CONCRETE			
Compressive Strength – Cylinders	PC01	P61	
14 Day			7
28 Day			7
1 Year			7
Splitting Tensile Strength – Cylinders	PC02	P62	
14 Day			7
28 Day			7
1 Year			7
Flexural Strength – Beams	PC09	P69	
14 Day			7
28 Day			7
1 Year			7

TABLE 7. LABORATORY TESTS ON CORES FROM LEAN CONCRETE BASE AND PORTLAND CEMENT CONCRETE

Material And Test	SHRP Test Designation	SHRP Protocol	Number of Tests
LEAN CONCRETE BASE – CORES			
Thickness of Cores	PC06	P66	21
Compressive Strength	PC01	P61	
14 Day			7
28 Day			7
1 Year			7
PORTLAND CEMENT CONCRETE – CORES			
Thickness of Cores	PC06	P66	108
PCC Unit Weight	PC05	P65	39
Compressive Strength	PC01	P61	
14 Day			13
28 Day			13
1 Year			13
Splitting Tensile Strength	PC02	P62	
14 Day			13
28 Day			13
1 Year			13
Static Modulus of Elasticity	PC04	P64	
28 Day			13
1 Year			13
Air Content at 28 days	PC08	P68	2
PCC Coefficient of Thermal Expansion – NOTE 1	PC03	P63	2
NOTE 1: Test to be Performed by FHWA			

FIGURE 2 - Legend for Figures 3 - 21

T1 - T96, MT1 - MT6	In-place Density and Moisture Tests (Also conduct test at locations B1 - B14, MB1)
P1 - P9	Plate Bearing Tests
S1 - S6, MS1	Shoulder Probes
A1 - A21, MA1 - MA21	Split-spoon Sampling
B1 - B7	Bulk Samples and Moisture Samples from Subgrade
B8 - B14	Bulk Samples and Moisture Samples from Embankment
BA1 - BA3	Bulk Samples and Moisture Samples from Aggregate Base
BP1 - BP3	Bulk Samples of LCB
BT1 - BT3,	Bulk Samples of PATB
FC1 - FC7	Bulk Samples of PCC
MB1	Bulk Samples of Subgrade and Existing Subbase in control section
MB2	Bulk Samples of Aggregate Base from control section
MBT1	Bulk Sample of Open Graded Drainage Course from control section
C1 - C101	4 inch diameter cores of PCC and/or LCB

FIGURE 2 - Legend for Figures 3 - 21

T1 - T96, MT1 - MT6	In-place Density and Moisture Tests (Also conduct test at locations B1 - B14, MB1)
P1 - P9	Plate Bearing Tests
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A1 - A21, MA1 - MA21	Split-spoon Sampling
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B8 - B14	Bulk Samples and Moisture Samples from Embankment
BA1 - BA3	Bulk Samples and Moisture Samples from Aggregate Base
BP1 - BP3	Bulk Samples of LCB
BT1 - BT3,	Bulk Samples of PATB
FC1 - FC7	Bulk Samples of PCC
MB1	Bulk Samples of Subgrade and Existing Subbase in control section
MB2	Bulk Samples of Aggregate Base from control section
MBT1	Bulk Sample of Open Graded Drainage Course from control section
C1 - C101	4 inch diameter cores of PCC and/or LCB

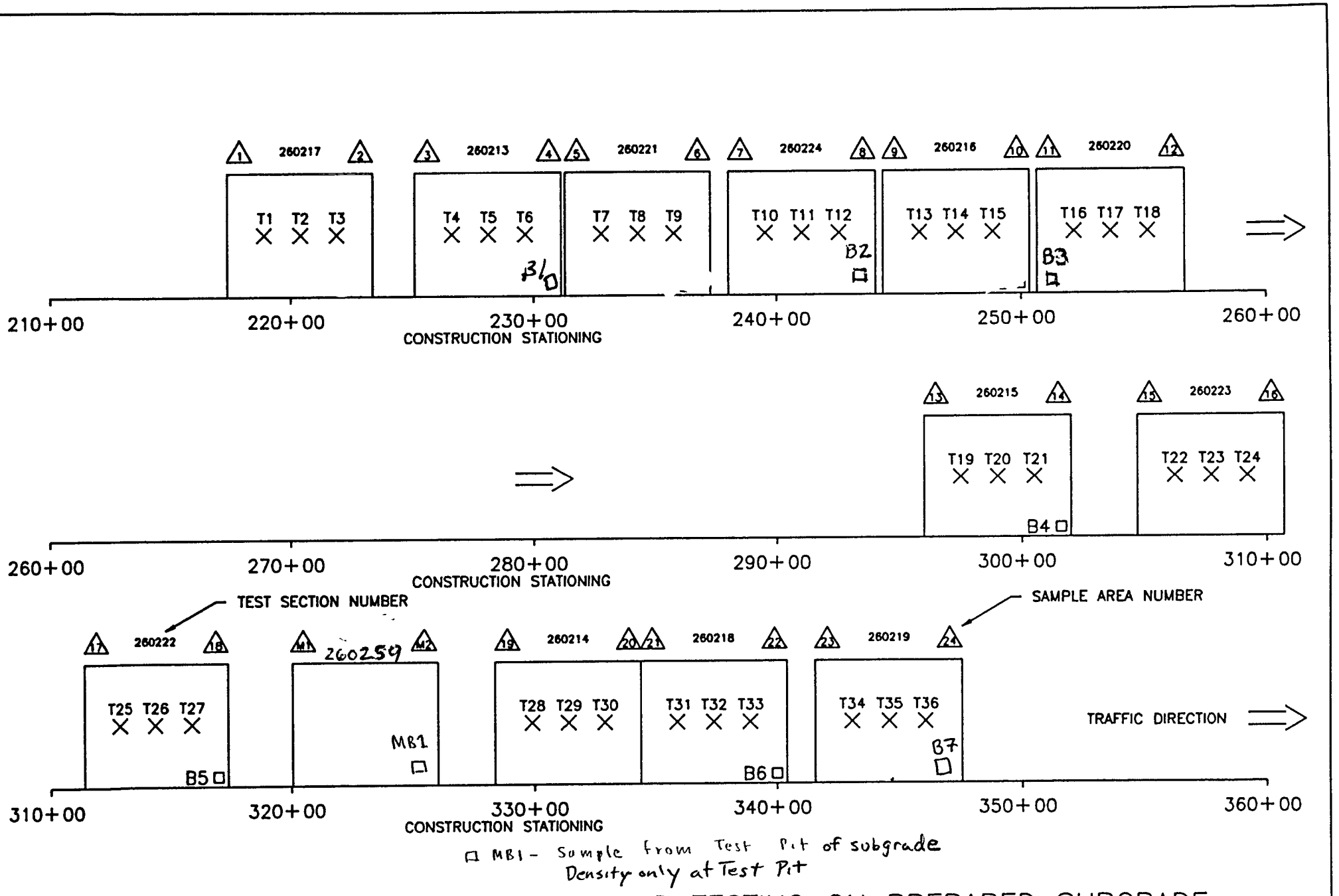
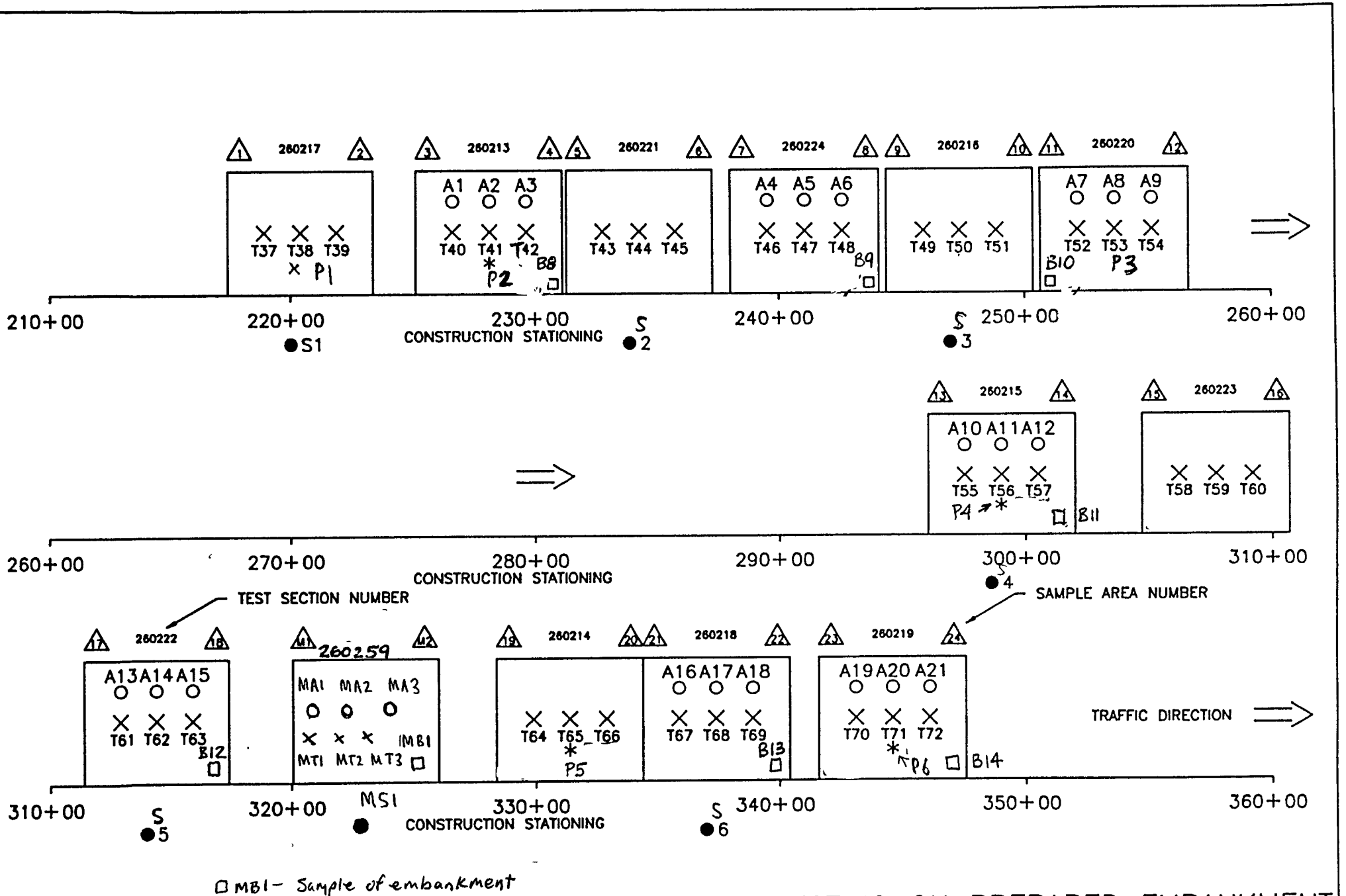


FIG.16 – OVERVIEW OF SAMPLING AND TESTING ON PREPARED SUBGRADE



□ MB1 – Sample of embankment

FIG. 17 – OVERVIEW OF MATERIAL SAMPLING AND TESTING ON PREPARED EMBANKMENT

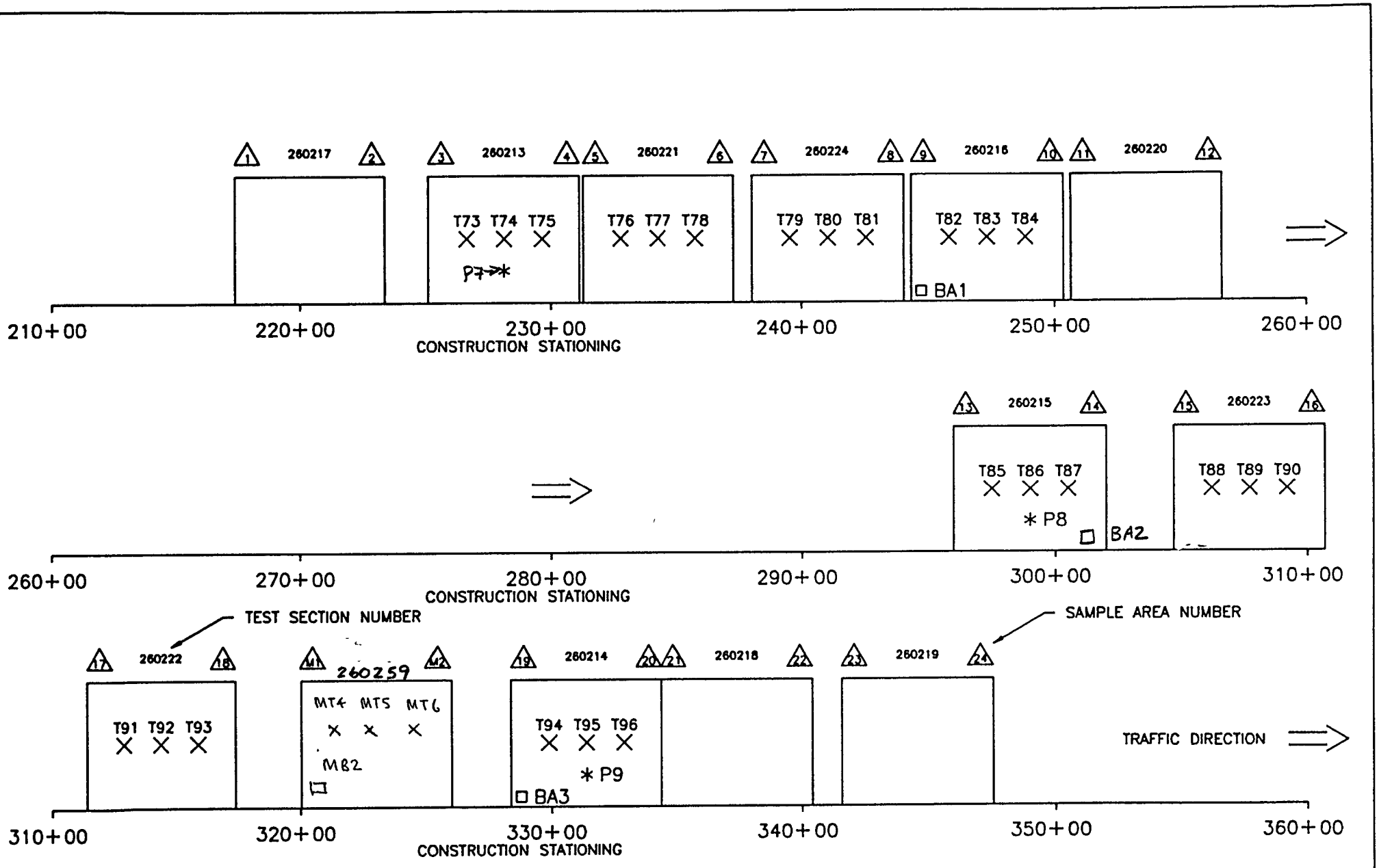


FIG 18 – OVERVIEW OF MATERIAL SAMPLING AND TESTING ON DGAB

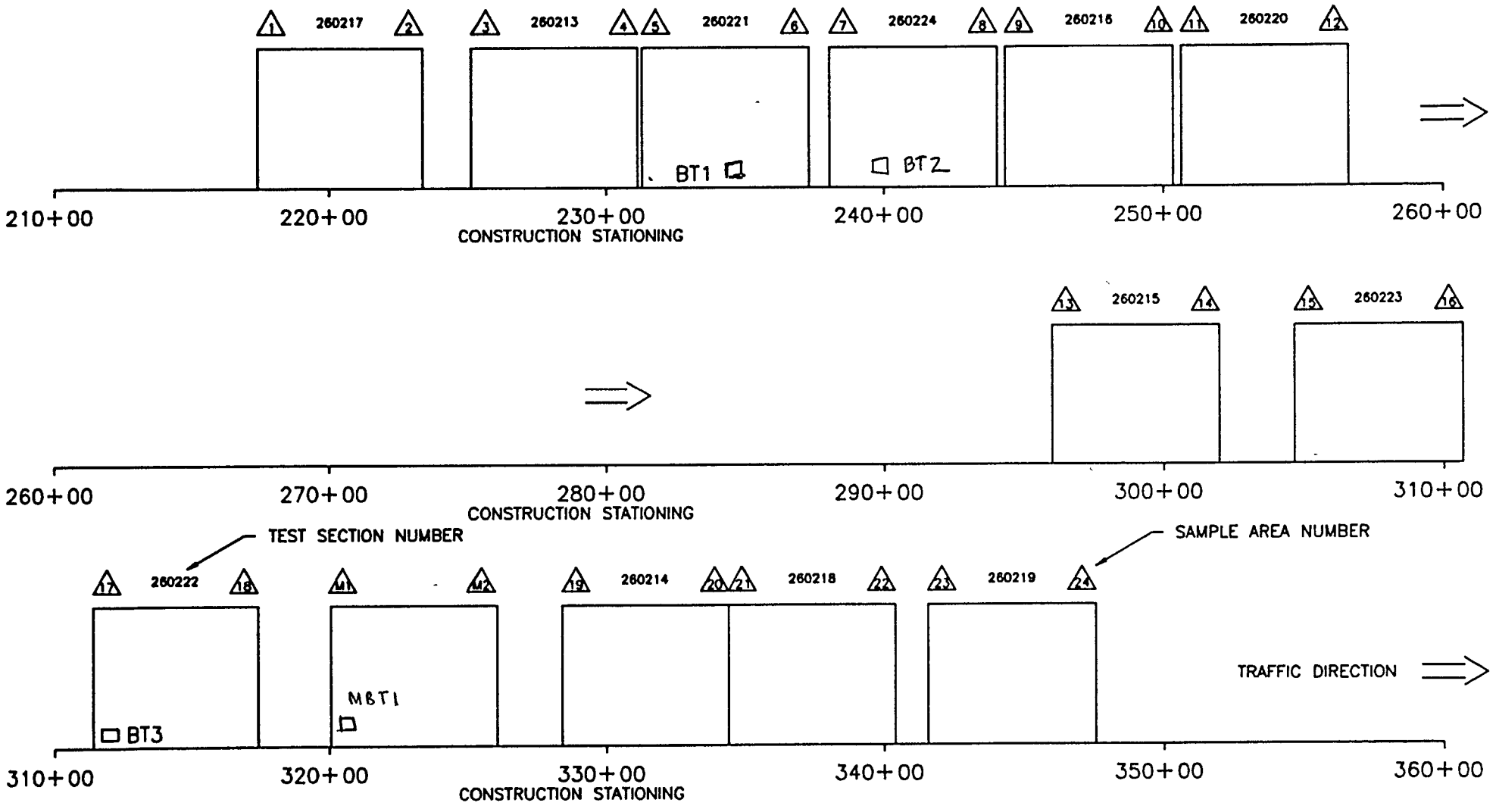


FIG 19 – OVERVIEW OF MATERIAL SAMPLING AND TESTING ON PATB

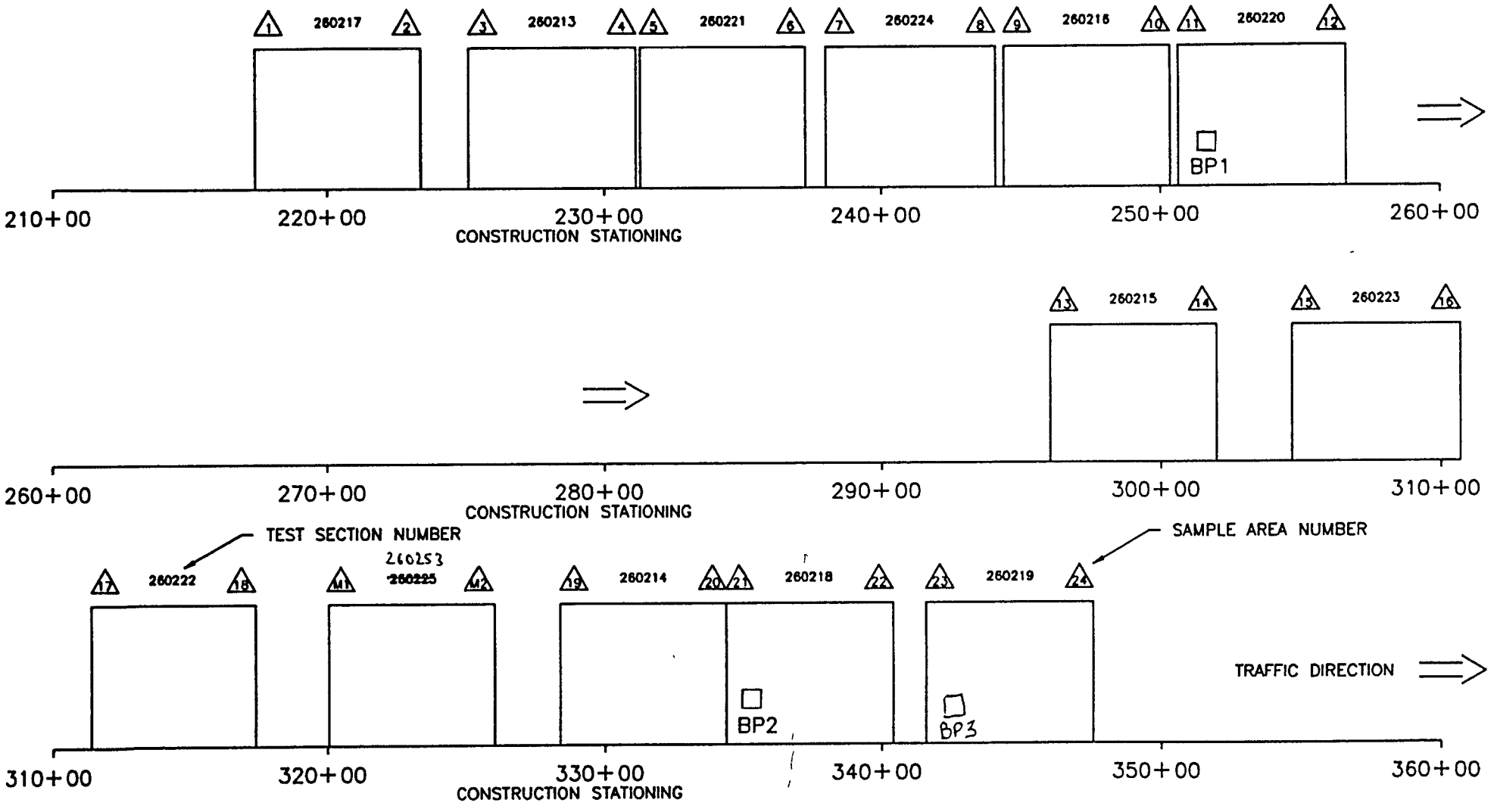
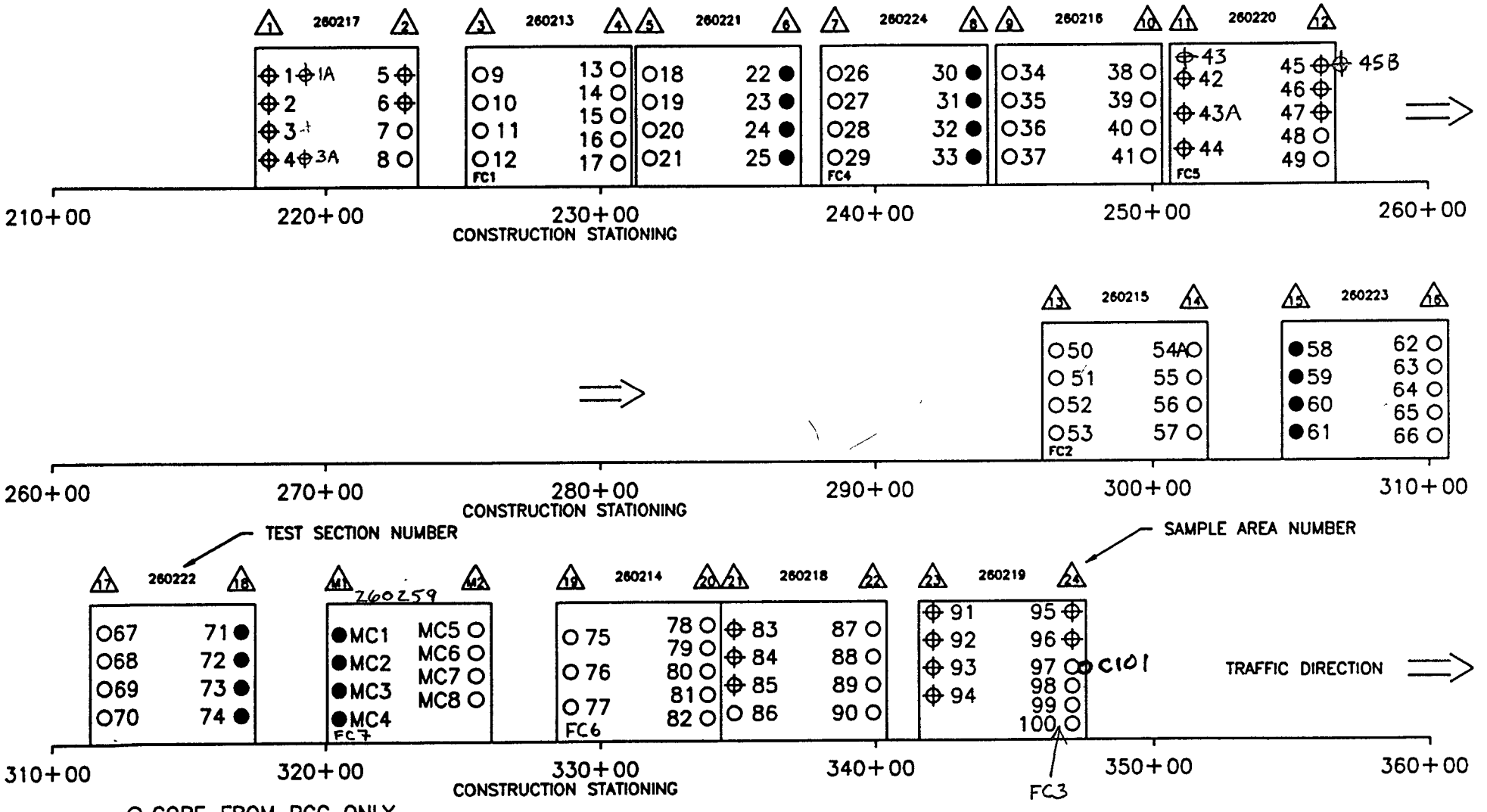


FIG 20 – OVERVIEW OF MATERIAL SAMPLING PLAN FOR LCB



O CORE FROM PCC ONLY

⊕ CORE FROM PCC AND LCB OR CORE FROM LCB ONLY

● CORE FROM PCC AND PATB OR OGDC – NOTE: NO CORES OF PATB/OGDC WERE RETRIEVED
CORE OF PCC ONLY

FIG 21 – OVERVIEW OF MATERIAL SAMPLING PLAN FOR PCC

APPENDIX G

1994, 1995 CONDITION SURVEY SUMMARY LETTERS

soil and materials engineers, inc.
43980 Plymouth Oaks Blvd Plymouth, MI 48170-2584 (313) 454-9900 FAX (313) 454-0629

Kenneth W Kramer, PE
Frank A Henderson, PG
Garrett H. Evans, PE
Starr D Kohn, PhD, PE
Edward S Lindow, PE
Robert C Rabeler, PE
Gerald M Belian, PE
Robert E Zayko, PE

Cheryl Kehres-Dietrich, CGWP
Larry P Jedele, PE
Gerard P Madej, PE
Timothy H Bedenis PE
J William Coberly, CET
Chuck A Gemayel, PE
Truman F Maxwell, CPA
Timothy J Mitchell, PE
John C Zarzecki, CWI

January 24, 1995

Mr. Richard Ingberg
N.C. Regional Engineer
FHWA-LTPP
6875 Washington Avenue South
P.O. Box 39108
Minneapolis, MN 55439-0108

Re: 1994 Distress Survey
Michigan SPS-2
Monroe County, Michigan
SME Project No. PP18400

Dear Mr. Ingberg:

In early December 1994, SME performed a manual distress survey of the Michigan SPS-2 project which was opened to traffic in the Fall of 1993. The following is a brief summary of our observations.

1. Longitudinal joint seal damage extended the entire length of each section along the lane/shoulder joint, with the exception of sections 260221, 260213 and 260224 which had isolated damage. No sealant damage was observed in section 260259 (control section). The joint damage consisted of raveling (asphalt concrete spalling) and cracking near the asphalt concrete shoulder face of the joint. The sealant was well adhered to both the PCC and AC joint faces and there was no evidence of cohesive failure. Pumping of underlying pavement fines were observed along this joint in sections 260213, 260215, 260216, 260217, 260218, 260220 and 260224.

2. Lane shoulder drop-off increased an average of 4mm to 10mm on all sections, except the control section, which has a portland cement concrete shoulder.

3. Transverse joint seal damage characterized by loss of sealant was evident at each joint located in section 260214. The severity of the joint seal damage varied between low and moderate (lengths ranging from 0.5 to 1.5 meters), with the exception of a few high severity joints (lengths greater than 2 meters).

4. In addition to the previous distresses, several mid-panel longitudinal and transverse cracks were observed throughout section 260218. The severity of these cracks varied between low and moderate. Evidence of pumping and faulting (ranging between -1mm and 3mm) were observed at several of these cracks. Light longitudinal reflective cracks, apparently correlated to the transverse joint dowel bar placement, were observed at several transverse joints. The reflective cracks occasionally coincided with slabs which were

cracked. These reflective cracks were located primarily in the outside edge (shoulder side) of the test lane.

A copy of the 1994 manual distress surveys for this Michigan SPS-2 project have been forwarded to Mr. Ben Worel for input into the database.

If you should have any questions regarding the contents of this letter, please do not hesitate to contact our office.

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC.

Eric D. Huff
Staff Engineer

Cary T. Keller, P.E.
Senior Engineer

cc: Eugene Skok - Braun Engineering (w/o encl.)
Ben Worel - Braun Engineering (w/encl.)
John Miller - PCS Law Engineering (w/encl.)
Jon Reincke - Michigan Department of Transportation
Mike Green - Michigan Department of Transportation

EDH/jn/18400ltr doc

soil and materials engineers, inc.
43980 Plymouth Oaks Blvd. Plymouth, MI 48170-2584 (313) 454-9900 FAX (313) 454-0629

Kenneth W Kramer, PE
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Chuck A Gemayel, PE
Larry P Jedele, PE
Cheryl Kehres-Dietrich, CGWP
Gerard P Madej, PE
J William Coberly, CET
David J Hurlburt, PE
Truman F Maxwell, CPA
Timothy J Mitchell, PE
John C Zarzecki, CWI

December 4, 1995

Mr. Richard E. Ingberg, Regional Engineer
North Central FHWA - LTPP
6875 Washington Avenue South
P.O. Box 39108
Minneapolis, MN 55439-0108

Re: Michigan SPS-2 1995 Condition Survey
FHWA - LTPP
SME Project No. PP18400

Dear Mr. Ingberg:

In late May and early June, 1995, we performed condition surveys of the Michigan SPS-2 experiment. Copies of the condition surveys are enclosed with this letter in Appendix A. The project has been open to traffic since November, 1993. There are several items of concern which were voiced in our previous letter of January 24, 1995 (Appendix B) summarizing the results of the 1994 survey, and which are jeopardizing the integrity of the experiment. The following is a brief summary of the areas of main concern and our observations, conclusions, and recommendations. The pavement sections, materials, and lane widths are provided in the attached table for background information.

OBSERVATIONS

Longitudinal joint seal damage of the lane/shoulder joint has occurred in all of the test sections with the exception of 260259, the state control test section. This section has a tied concrete shoulder which is sealed with hot-poured rubberized asphalt. All of the SHRP test sections had the joint reservoir sawed at the shoulder and were sealed with silicone sealant. The following table provides the length of damaged sealant in each section:

DESIGN FEATURES OF TEST SECTIONS

Test Section	Lane Width (ft)	PCC Flexural Strength (psi)	Layer Types and Thicknesses		
			Layer 1	Layer 2	Layer 3
260217	14	550	PCC 8"	LCB 6"	–
260213	14	550	PCC 8"	DGAB 6"	–
260221	14	550	PCC 8"	PATB 4"	DGAB 4"
260224	14	900	PCC 11"	PATB 4"	DGAB 4"
260216	14	900	PCC 11"	DGAB 6"	–
260220	14	900	PCC 11"	LCB 6"	–
260215	12	550	PCC 11"	DGAB 6"	–
260223	12	550	PCC 11"	PATB 4"	DGAB 4"
260222	12	900	PCC 8"	PATB 4"	DGAB 4"
260253*	12	550	PCC 10.5"	OGDC 4"	AGG 3"
260214	12	900	PCC 8"	DGAB 6"	–
260218	12	900	PCC 8"	LCB 6"	–
260219	12	550	PCC 11"	LCB 6"	–

NOTE:
* – Control Section

PCC – Portland Cement Concrete
LCB – Lean Concrete Base
DGAB – Dense Graded Aggregate Base
PATB – Permeable Asphalt Treated Base
AGG – Aggregate Base
OGDC – Open Graded Drainage Course

LONGITUDINAL JOINT SEAL DAMAGE (SHOULDER JOINT)

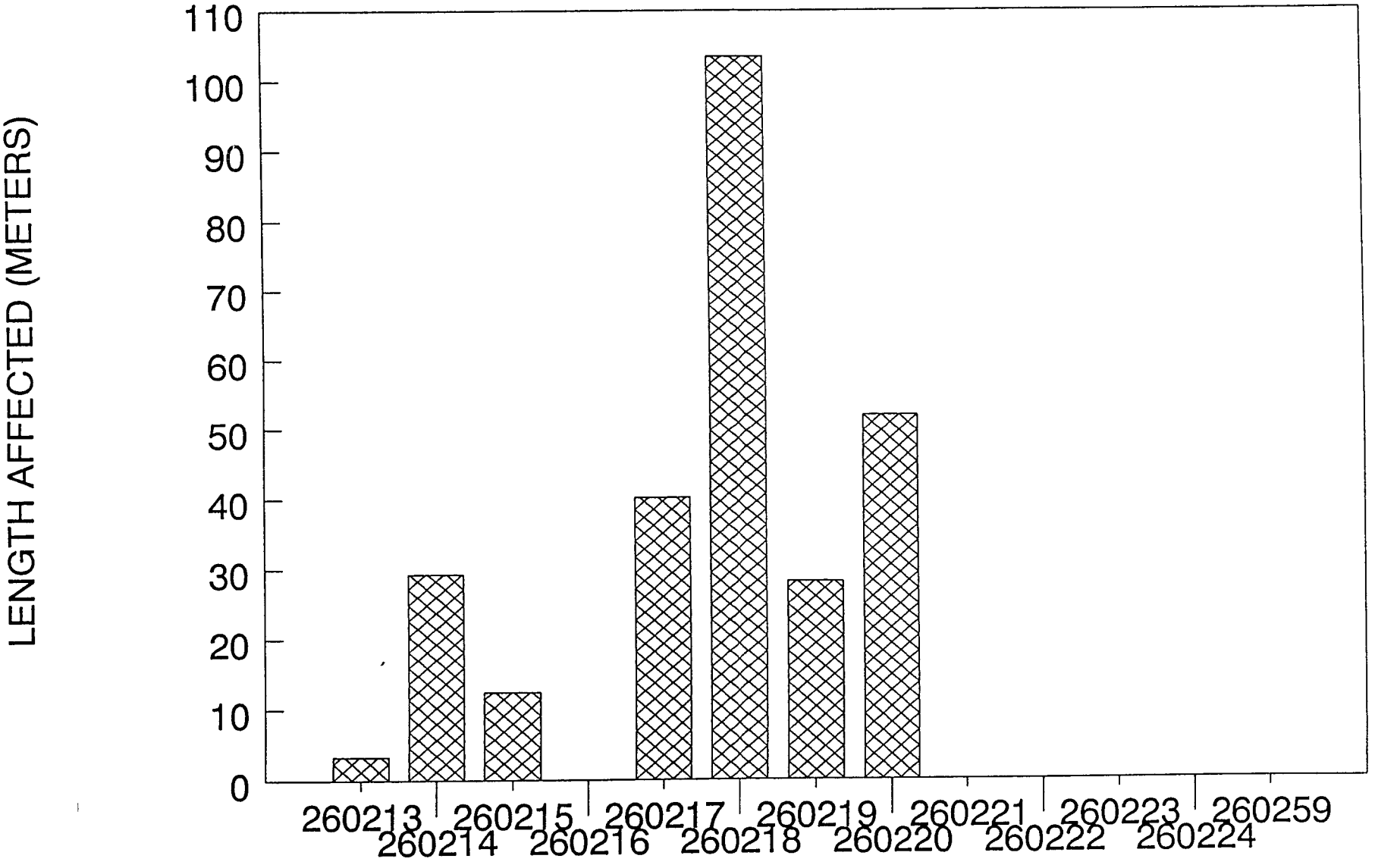
TEST SECTION	LENGTH OF DAMAGED SEALANT (meters)
260213	152.5
260214	147.0
260215	144.1
260216	129.9
260217	152.5
260218	151.8
260219	152.5
260220	152.5
260221	83.8
260222	144.0
260223	152.3
260224	6.4
260259	0.0

The amount of joint seal damage was lowest in section 260224 and there was none observed in section 260259. Based on a drive-through of the site, the joint seal damage is occurring in roughly the same amount on the inside shoulder joint. The damage consists of a tensile failure of the asphalt concrete adjacent to the silicone sealant. Typical photos are included in Appendix C. The sealant was still well adhered, in most cases, to the concrete side of the sawed joint. Backer rod has been exposed in several areas with a loss of the sealant in these areas. We observed in the areas where the sealant was absent that the joint reservoir, which was about 3/4 inch wide, had been sawed in both the concrete and in the asphalt concrete shoulder.

Pumping of the longitudinal joint along the outside shoulder is occurring in most of the sections constructed on the Dense Graded Aggregate Base (DGAB) and on all of the sections constructed with the Lean Concrete Base (LCB). A typical photo of the joint pumping in a LCB section is included in Appendix C. There was no pumping observed at the time of our surveys on section 260216 (11" PCC on DGAB) and on sections 260221 - 260224 which were constructed with a Permeable Asphalt Treated Base (PATB). However, there was some pumping noted in our December, 1994, survey on sections 260216, 260220, and 260224. The attached bar chart displays the length of affected pavement in each test section. There was some transverse joint pumping and some of the observed longitudinal joint pumping may

MICHIGAN SPS – 2

LONGITUDINAL JOINT PUMPING



be due to transverse joint pumping and subsequent washing of the fines along the grade. There was little difference in the performance of the 14 ft. wide lanes versus the 12 ft. wide lanes or in the performance of the higher strength concrete versus the lower strength concrete.

Some transverse joint seal damage characterized by loss of sealant has occurred on a majority of the test sections and ranges from a low of 0% of the total length of transverse joints sealed in a test section (30% of the test sections) to a high of 8.4% on section 260214.

Test section 260218 is experiencing some structural distress. The pavement structure consists of 8 inches of 900 psi concrete on 6 inches of LCB. The following is a summary of the distress types and quantities:

MAJOR DISTRESS QUANTITIES ON SECTION 260218

SEVERITY	TRANSVERSE CRACKING (NO. OF CRACKS)	LONGITUDINAL CRACKING (LENGTH (METERS)	CORNER BREAKS (NO. OF BREAKS)
LOW	4	16.5	2
MEDIUM	7	3.3	1
HIGH	1	0	0

The quantities provided above are in addition to the large amount of pumping observed at the longitudinal shoulder joint. Evidence of pumping was observed at several of the transverse cracks and faulting of 2 to 5 mm was recorded. Some of the low severity longitudinal cracking observed was related to cracks occurring over the dowel bars and were most pronounced in the slabs which also had the transverse cracking and corner breaks. In addition, based on our observation of cracking in the LCB prior to placement of the concrete, some of the transverse cracking in the concrete is located over cracks in the LCB. Again, typical photos are included in Appendix C.

CONCLUSIONS

The longitudinal joint seal failure described above occurred soon after construction and began as a small crack with some light spalling in the asphalt concrete adjacent to the sealant. It has since deteriorated from two winters of freeze/thaw action to its present condition.

The amount and severity of pumping at the site has increased since it was first observed in 1994. The drained base sections performed better than the undrained sections, although there was some evidence of pumping within the drained base sections in the 1994 survey. The most severe pumping occurred on the thinner (8 in.) test sections constructed on LCB and it was reduced in the thicker pavements due to the reduced stresses. The effect of water on the pumping is accentuated on test sections 260218 and 260219 which are located on a superelevated section which drains toward the outside shoulder and thus has twice the amount of water entering the pavement structure. Fines from the LCB were observed at the longitudinal joint and it appears that the LCB may be deteriorating.

The distresses occurring in section 260218 could be due to a number of factors. Based on cores taken from the test section, the concrete is only about 7 inches thick. The cracking and corner breaks which were observed tended to be concentrated in slabs which had dowel bar cracks, which combined with the "thin" pavement suggests that the cracks may be forming due to slab curling and warping. The severe pumping of the base and subgrade is contributing to reduced support conditions and faulting. The possibility of a few of the transverse cracks being related to cracks in the underlying LCB cannot be ruled out.

RECOMMENDATIONS

We recommend that a condition survey be performed in the spring of 1996 to determine the progression of the distress. We also recommend that a site meeting be held between LTPP staff and MDOT research and district personnel to determine the type and location of required repairs or if additional investigations are required.

Should you have any questions concerning the contents of this letter or if you have any comments, please contact our office.

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC.

Cary T. Keller, P.E.
Senior Engineer

Chuck A. Gemayel, P.E.
Senior Associate

Enclosures: Appendix A
Appendix B
Appendix C

pc: Erland Lukanen, Braun Intertec w/o enclosures
Monte Symons, FHWA LTPP Division w/o enclosures
Henry Quiroga, Mich. Dept. of Transportation w/ enclosures
Dave Smiley, Mich. Dept. of Transportation w/o enclosures
John Miller, PCS Law w/ enclosures