INVESTIGATION OF VIDEO CRACK & PATCH SURVEYING FOR PAVEMENT MANAGEMENT

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8. ABSTRACT

The Iowa DOT has been using the AASHTO Present Serviceability Index (PSI) rating procedure since 1968 to rate the condition of pavement sections. A ride factor and a cracking and patching factor make up the PSI value. Crack and patch surveys have been done by sending crews out to measure and record the distress.

Advances in video equipment and computers make it practical to videotape roads and do the crack and patch measurements in the office. The objective of the study was to determine the feasibility of converting the crack and patch survey operation to a video recording system with manual post processing.

The summary and conclusions are as follows:

Video crack and patch surveying is a feasible alternative to the current crack and patch procedure. The cost per mile should be about 25 percent less than the current procedure. More importantly, the risk of accidents is reduced by getting the people and vehicles off the roadway and shoulder. Another benefit is the elimination of the negative public perceptions of the survey crew on the shoulder.

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DISCLAIMER

INTRODUCTION

The Iowa DOT has been using the AASHTO Present Serviceability Index (PSI) rating procedure since 1968 to rate the condition of pavement sections. A ride factor and a cracking and patching factor make up the PSI value. Crack and patch surveys are done by sending crews out to measure and record the distress. Sending crews out has been the most economical, most reliable procedure for obtaining the information.

Recent advances in video technology and computer technology have made videotaping roads an attractive alternative to sending crews to do the surveys. Improved picture resolution, better picture storage, faster, more portable computers make video survey competitive with survey crews.

The Office of Transportation Research conducted a research project to bring together "state-of-the-art" video equipment and test it in a mobile unit filming at highway speeds. The research was to demonstrate the capability of filming the highway system R.O.W. line to R.O.W. line. This same equipment would work equally well for filming only the pavement surface.

OBJECTIVE

The objective of the study was to determine the feasibility of converting the crack and patch survey operation to a video recording system with manual post processing.

EQUIPMENT

The Transportation Inventory "videolog van" was borrowed for the testing. The van has a Sony DXC-750 broadcast quality camera and a Panasonic 12" laser disk recorder. A central processing unit ties a distance measuring device to the camera and recorder. The computer was set to capture a picture every 10.56 feet of travel. The camera is mounted inside in the center of the van from the roof. A camera angle and zoom setting was used that cleared the dashboard and hood and covered the 12 ft. lane in the foreground of the picture. The equipment is described in detail in FHWA Report No. FHWA-DP-90-085-004.

TESTING

The videolog van was used to film the crack and patch sections in District 1. It was operated four 10-hour days per week. A total of 160 hours was needed for one person to film the sections. Over 250,000 frames were taken using four 2-sided laser disks.

MANUAL REDUCTION

A 4′ x 4′ grid pattern was established on the video monitor screen for manual reduction. The crack and patch test procedure (Iowa Laboratory Test Method No. 1004-D) was followed as close as practical (Appendix A). One person reduced 181 sections from the video to paper in 140 hours.

The District crack and patch crews performed the biennial survey on the same sections in December 1991 and January and February 1992. Appendix B contains the results for the primary sections reduced by both methods.

RESULTS

The summaries of the results are shown in Figures 1 through 7.

PCC Results

Figures 1 through 3 show the results for number of transverse cracks, square feet of patching, and the D-cracking factor.

For transverse cracking (Figure 1), both surveys obtained about the same number of cracks for most sections. The video survey had more cracks on several sections. The videos were reviewed for errors. The person reducing the video apparently counted shadows, irregularities and staining as cracks. With the resolution of the picture; lighting conditions; and heavy texture, the difference is understandable. In the future, instructions will need to be given to only count cracks when the reviewer is sure.

For patching (Figure 2), both surveys obtained similar results.

FIGURE 1. PCC SECTIONS—TRANSVERSE CRACKS

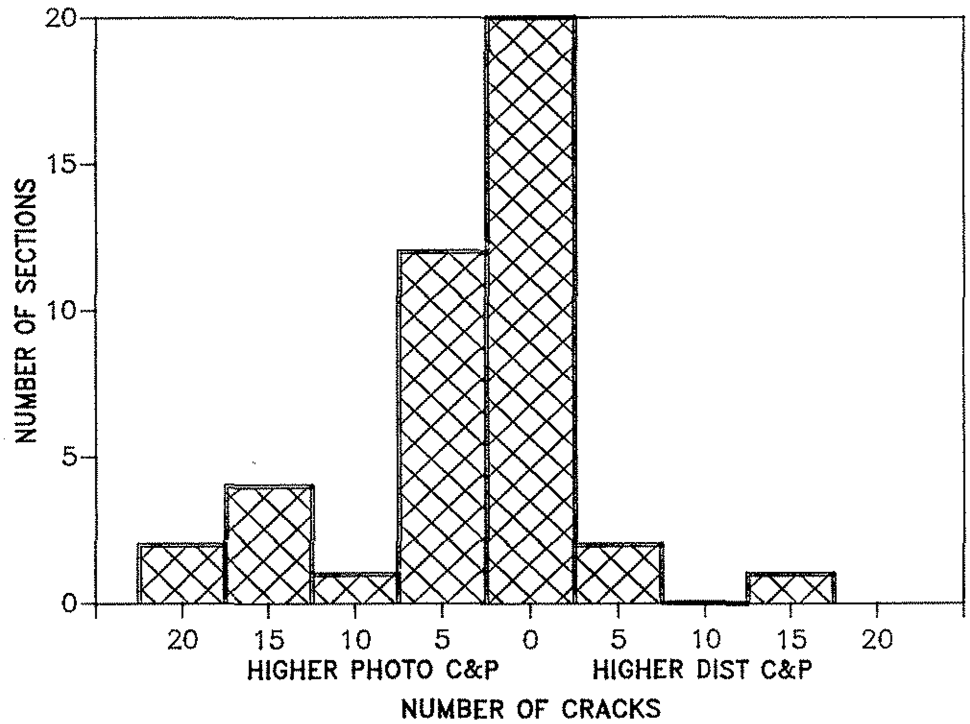
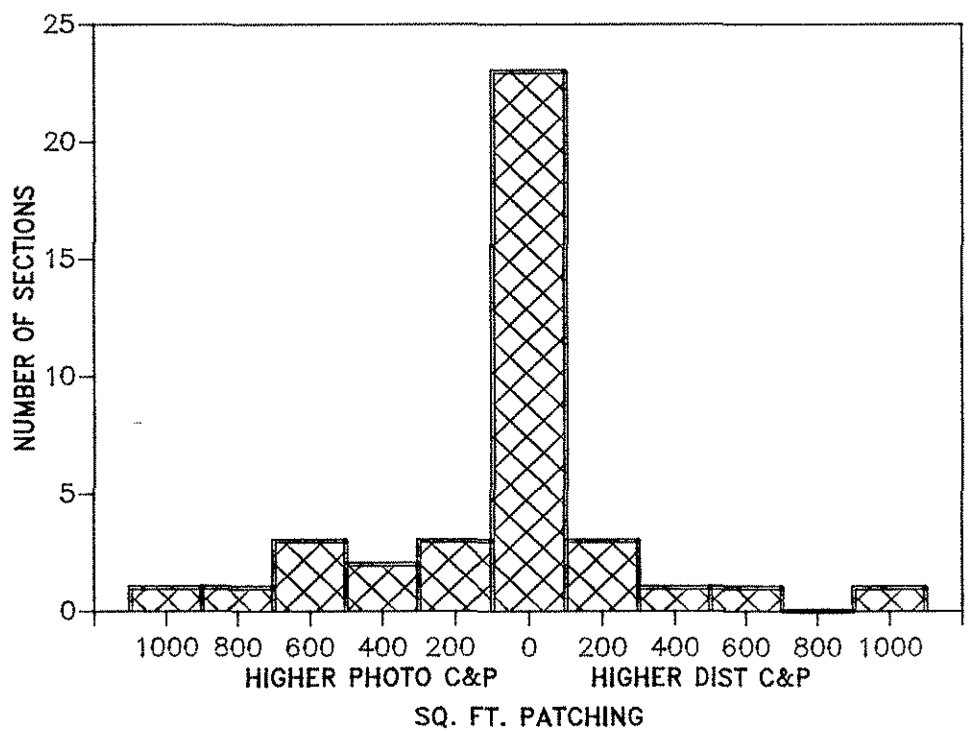
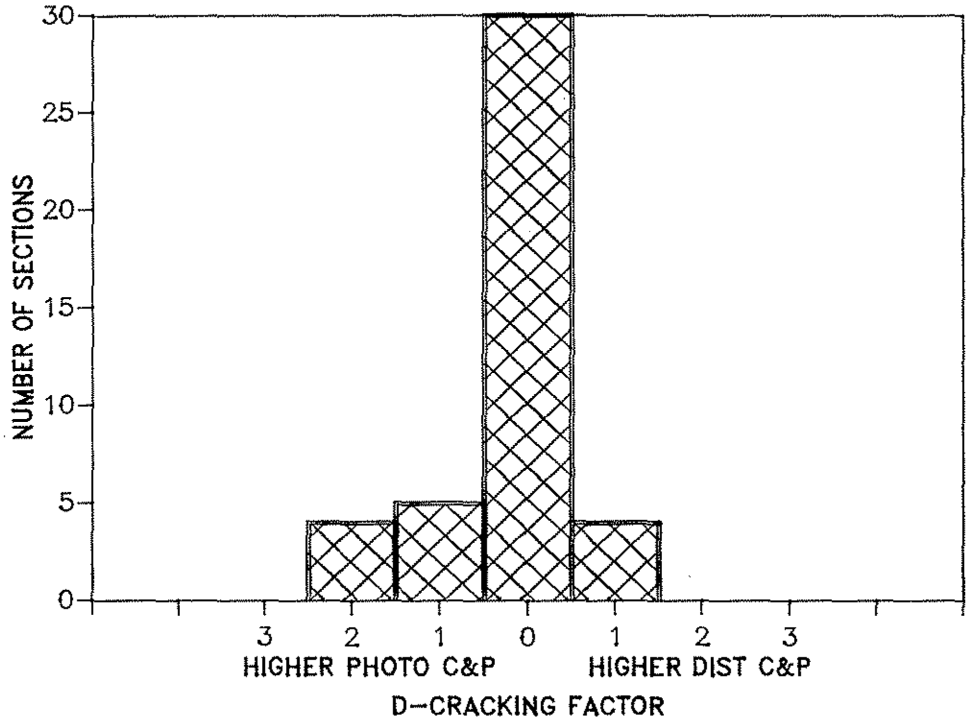


FIGURE 2. PCC SECTIONS—PATCHING



For the D-cracking factor (Figure 3), the results were the same for most of the sections. In a few cases, the reviewer rated the D-cracking higher than it should have been. With more experience and training, this difference could be reduced.

FIGURE 3. PCC SECTIONS—"D-CRACKING"



ACC Results

Figures 4 through 8 show the results for number of transverse cracks, number of longitudinal cracks, square feet of cracking, and square feet of patching.

For transverse cracking (Figure 4), both surveys obtained about the same number for most sections. The district survey was higher on a few sections. No one reason explained the differences. The reasons for the differences are:

1. Cracks could not always be seen on the photos.
2. Some cracks developed after the photo survey.
3. Some sections were sealed after photo survey.

For longitudinal cracking (Figure 5), the video reviewer found more longitudinal cracks on several sections. This problem is similar to the problem experienced on the PC transverse cracking. The reviewer counted what appeared to be cracks. In the future, instructions will need to be given to only count cracks when the reviewer is sure.

FIGURE 4. ACC SECTIONS—CRACKING

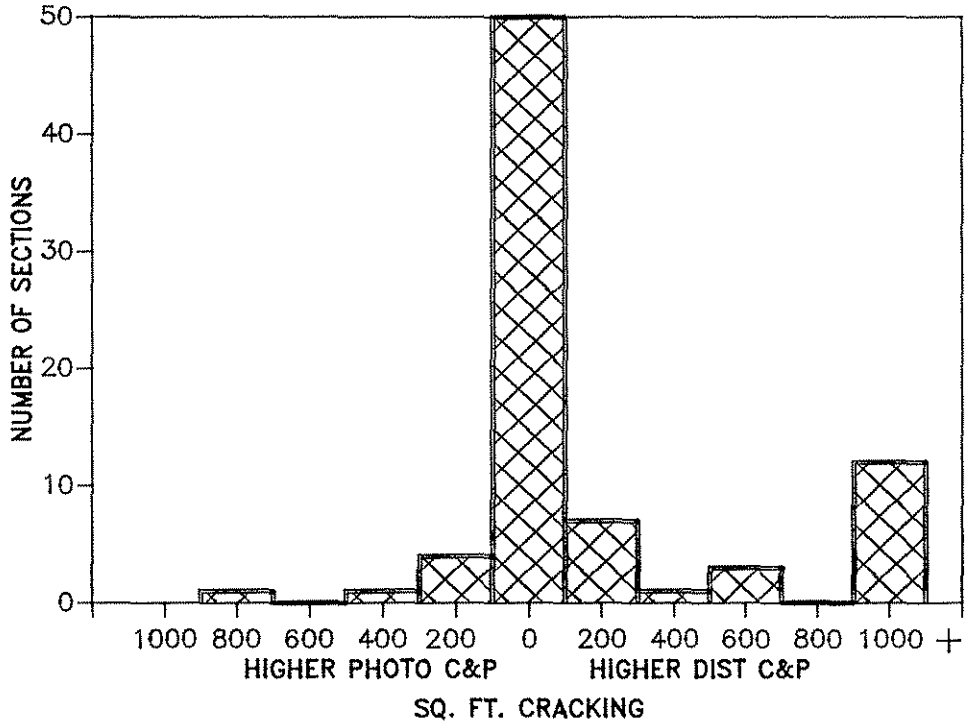
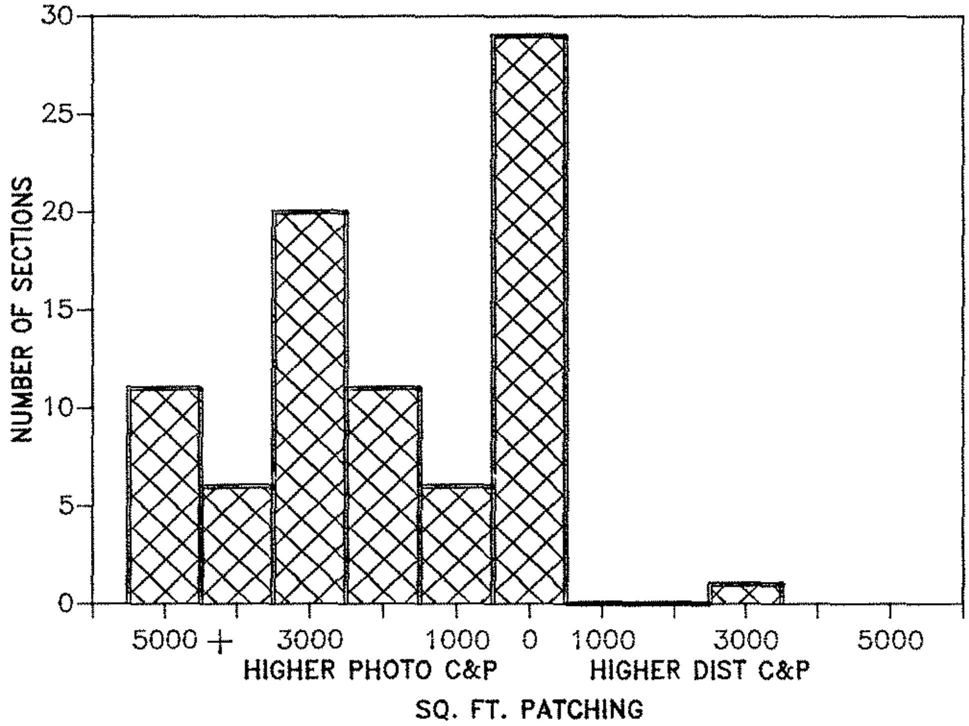


FIGURE 5. ACC SECTIONS—PATCHING



For fatigue cracking (Figure 6), both surveys were usually very close. On 12 sections, the District had much higher cracking. This was due to the poor light and camera angle. The cracking was present, but didn't show on the video.

For patching (Figure 7), the two surveys were close. Where there were large differences, it was due to interpretation of surface patching in the instructions. From the video survey, it appears the bituminous strip seals over longitudinal joints and cracks meet the criteria. The video survey counted all the bituminous strip seals as patching.

DISCUSSION OF RESULTS

The video survey gave sufficiently close results to the manual survey to warrant pursuing the procedure further. The camera position in the videolog van provides a good driver's view of the road, but doesn't provide the best picture for crack and patch survey work. A more direct or vertical angle would help with light "wash-out" of the cracking and would allow zooming in on the road surface. The resolution could be further improved by going to black and white camera equipment.

EQUIPMENT REQUIREMENTS

The equipment for the crack and patch video unit should be interchangeable with the Transportation Inventory unit where possible. An accident (like the videolog van had in 1988) or major vandalism could cause serious delays in the survey program or inventory program.

FIGURE 6. ACC SECTIONS—TRANSVERSE CRACKS

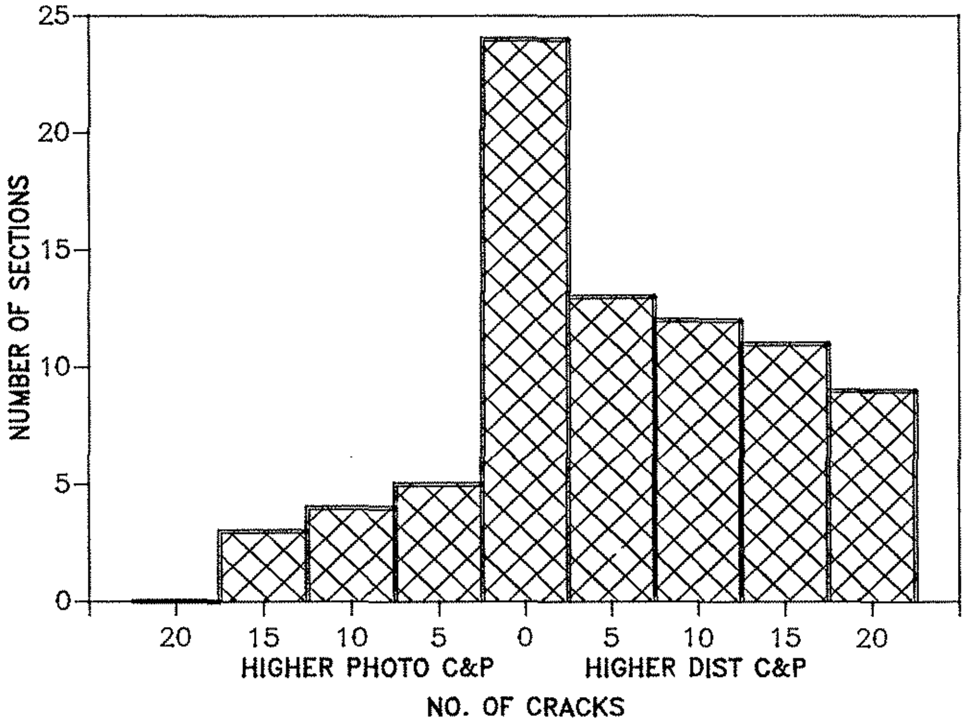
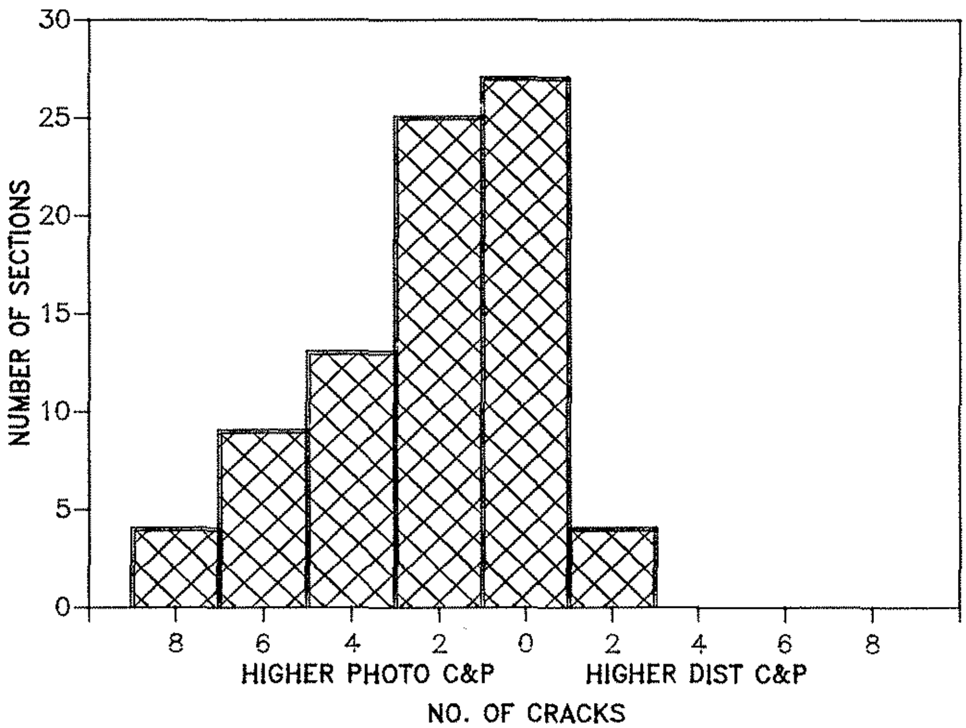


FIGURE 7. ACC SECTIONS—LONGITUDINAL CRACKS



The proposed mobile equipment would be the same as Transportation Inventory's unit (FHWA report number FHWA-DP-90-085-004) with the following exceptions:

1. Two black and white cameras of broadcast quality mounted outside the van. One in front and one in back to take advantages of the best lighting conditions. The lens should provide an 18-foot wide view at a reasonable mounting height.
2. The laser disc recorder will need to be black and white format.
3. No voice navigation hardware or software will be needed.

The office workstation would also be the same configuration with a few changes:

1. The laser disc player will need to be black and white format.
2. The monitor should be high resolution with a minimum 19-inch screen and preferably a 27-inch screen.
3. An IBM compatible workstation to record and summarize the survey information that is reduced.

Equipment cost estimates are as follows:

Camera and Lenses	$ 30-40,000
Process Controller	$ 20-30,000
12" Disk Recorder/Player	$ 20-30,000
Miscellaneous hardware, software and installation	$ 50-60,000
Modified Roadview III Workstation	$ 30-40,000
IBM Compatible Workstation	$ 5000.00

ADDITIONAL CONDITION DATA

Part of the crack and patch survey procedure is to measure faulting and transverse profile. With the video crack and patch survey, this data is not obtained. Different procedures would be needed if the Iowa DOT changes to the video survey.

Noticeable faulting would be noted by the survey crew filming the section. Those sections with noticeable faulting would be manually surveyed by the District the following winter.

Transverse profile information would be obtained from the South Dakota type profiler. Sections with a certain level of profile variation could be manually checked by the District the following winter.

COST ANALYSIS

A cost comparison was made between the current crack and patch procedure and the video crack and patch procedure. The cost analysis is as listed on the next page.

COST ESTIMATE
CRACK AND PATCH COSTS PER YEAR

	VIDEO C & P		MANUAL C & P	
Office	LAB	DIST	LAB	DIST
Salary	$35,000	$5,000	$14,000	$77,800
Expenses	3,500	100	1,200	2,200
Vehicle	7,500	1,000	1,800	8,700
Camera, etc*	20,000			
Disks	4,000			
TOTAL	$70,000	$6,100	$17,000	$88,700
Total C & P Cost	$76,100		$105,700	

*For estimate, a 10-year life was used. For budget, a 5-year depreciation should be used.

ASSUMPTIONS FOR VIDEO C & P

- Salary - 2 Tech 3s @ $17/hr, 2 Summer people @ $8/hr
- Camera, etc. 2 Cameras + hardware (10 yr. life)
  1 Workstation with large screen
  1 IBM Data Entry Workstation
- 1/2 the state surveyed per year in the summer
- 700 hours filming and 700 hours reducing
- Districts to do manual transverse profile or faulting survey on 200 sections @ $50/section

SUMMARY AND CONCLUSIONS

Video crack and patch surveying is a feasible alternative to the current crack and patch procedure. The cost per mile should be about 25 percent less than the current procedure. More importantly, the risk of accidents is reduced by getting the people and vehicles off the roadway and shoulder. Another benefit is the elimination of the negative public perceptions of the survey crew on the shoulder.

RECOMMENDATIONS

The following is recommended based on the study:

1. Purchase the suggested equipment in time to begin video surveying in 1993. Survey half the state per year.

2. Adjust budget and staff time between District Materials and Central Materials to reflect the change in responsibility.

Appendix A
Method of Determination of Present Serviceability Index

IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

Office of Materials

METHOD OF DETERMINATION OF PRESENT SERVICEABILITY INDEX

Scope

The Present Serviceability Index (PSI) was developed by the AASHTO Road Test as an objective means of evaluating the ability of a pavement to serve traffic. The Present Serviceability Index is primarily a function of longitudinal profile with some influence from cracking, patching and rut depth.

The AASHTO rating scale ranges from 0 to 5 with adjective designations of:

Very Poor	0 - 1
Poor	1 - 2
Fair	2 - 3
Good	3 - 4
Very Good	4 - 5

The test is conducted in two parts: (1) Determination of the Longitudinal Profile Value (LPV), (2) Determination of Deduction for Cracking, Patching and Rut Depth.

Part I. Determination of the Longitudinal Profile Value

Scope:

The Iowa DOT uses two methods for determinination of the longitudinal profile value:

1. BPR Type Road Roughometer
2. South Dakota Type Profiler

Test Procedure:

1. The determination of road rougness by the BPR Type Roughometer is described in Test Method No. Iowa 1001.

   The inches per mile result is converted to an LPV value by using the BPR/LPV correlation.

2. The determination of the International Roughness Index by the South Dakota Type Profiler is described in Test Method No. Iowa 1015.

   The meters per kilometer result is converted to an LPV value by using the IRI/LPV correlation.

Part II. Determination of Deduction for Cracking, Patching and Rut Depth

Scope:

The purpose of this portion of the test is to determine the value of the Present Serviceability Index lost due to physical deterioration of the roadway.

The evaluation is conducted according to general procedure established by the AASHTO Road Test and described in detail in the "Highway Research Board Special Report 61E".

Test Procedure -- Flexible Pavement:

The equation for Present Serviceability Index of flexible pavement is:

$$PSI = LPV - .01\ \sqrt{C+P} - 1.38\ \overline{RD}^2$$

where:

PSI = Present Serviceability Index

LPV = Longitudinal Profile Value

C+P = Measures of cracking and patching of the pavement.

$\overline{RD}$ = A measure of rutting in the wheel paths

Cracking, C, is defined as the square feet per 1000 square feet of pavement surface exhibiting alligator or fatigue cracking. This type of cracking is defined as load related cracking which has progressed to the state where cracks have connected together to form a grid like pattern resembling chicken wire or the skin of an alligator. This type of distress can advance to the point where the individual pieces become loosened.

Figure 1

Alligator cracking

Figure 2

Longitudinal Cracks

Patching, P, is the repair of the pavement surface by skin (i.e. widening joint strip seal) or full depth patching. It is measured in square feet per 1000 square feet of pavement surface.

Rut depth, $\overline{RD}$, is defined as the mean depth of rutting, in inches, in the wheel paths under a 4-ft. straightedge.

Cracking, L, is defined as the number of longitudinal (parallel to traffic flow) cracks which exceed 100 feet in length and 1) are open to a width of 1/4" over half their length or 2) have been sealed. If these cracks are observed to occur less than 3 feet from one another, the condition described under C should be looked for and if present reported instead of reporting the distress as longitudinal cracking.

Cracking, T, is defined as the number of transverse (right angles to traffic direction) cracks that are open to a width of 1/4" over half their length or have been sealed. Random or diagonal cracks are ignored.

Faulting, F, is defined as the mean vertical displacement, in inches, measured with a 4-ft. straightedge.

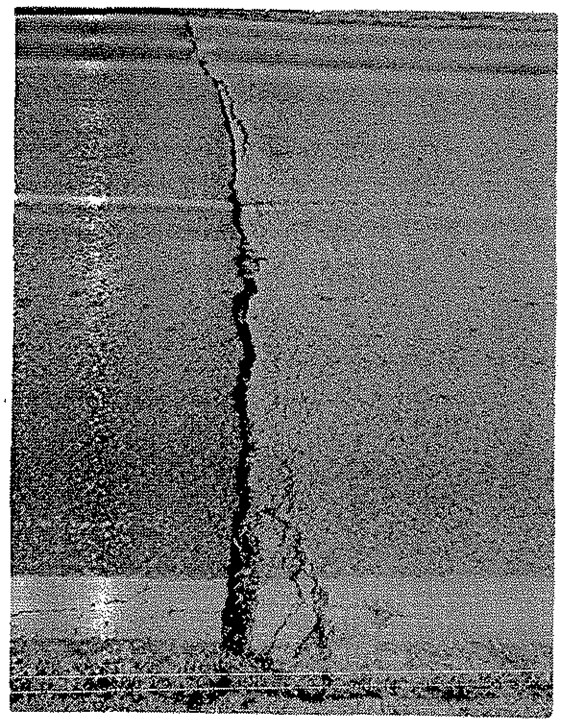


Figure 3

Transverse Cracks and Faulting

Test Procedure -- Rigid Pavement:

The equation for Present Serviceability Index of rigid pavement is:

$$PSI = LPV - .09 \sqrt{C+P}$$

where:

PSI = Present Serviceability Index

LPV = Longitudinal Profile Value

C+P = Measures of cracking and patching of the pavement

Cracking, C, is defined as the lineal feet of cracking per 1000 square feet of pavement surface. Only those cracks which are open to a width of 1/4" or more over half their length or which have been sealed are to be included.

Patching, P, is the repair of the pavement surface by skin or full depth patching. It is measured in square feet per 1000 square feet of pavement surface.

Rut depth, $\overline{RD}$, is defined as the mean depth of rutting, in inches, in the wheel paths under a 4-ft. straightedge.

Faulting, $\overline{F}$, is defined as the mean vertical displacement, in inches, measured with a 4-ft. straightedge.

D-cracking, D, refers to a characteristic pattern than can develop in portland cement concrete. Initially, the occurrence of D-cracking may be preceded and accompanied by staining of the pavement surface near joints and cracks. However, not all stained joints and cracks develop D-cracking. D-cracked concrete will first exhibit fine parallel cracks adjacent to the transverse and longitudinal joints at the interior corners. The D-cracks will bend around the corner in a concave or hourglass pattern. As the D-cracking progresses, the entire length of the transverse, longitudinal and random cracks will be affected. The cracked pieces may become loose and dislodged under the action of traffic. The occurence of D-cracking in the check sections will be rated on a point scale as described in the Test Procedure section.

Figure 4

D-cracking - Initial stages

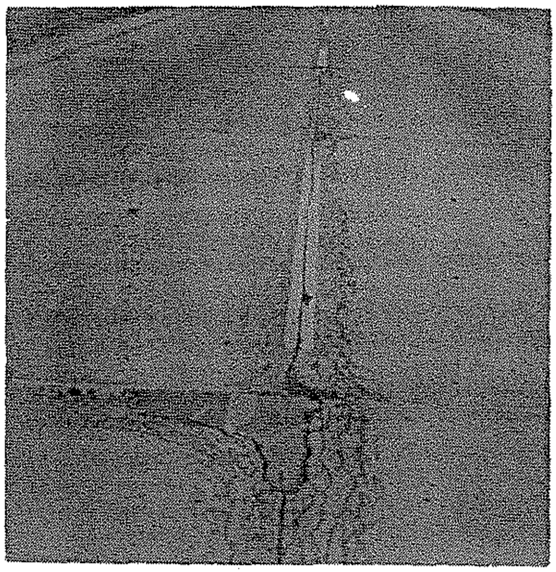


Figure 5

D-cracking - All joints affected

Procedure

A. Apparatus

1. A passenger vehicle with an accurate odometer.

2. A four foot long rut/fault gauge.

3. Mechanical counters.

4. A 50-foot tape.

5. Safety equipment -- hard hats, safety vests, survey signs.

B. Test Record Forms

1. Crack and Patch Survey worksheet (A.C. or P.C.C.).

2. Crack and Patch Calculation and Summary Sheet.

3. Present Serviceability Index Summary (Form 915).

C. Test Procedure

The control sections are as described in the "Control Sections by Mileposts" booklet. For control sections of 0 - 5.00 miles in length, one representative 1/2 mile test section will be evaluated. For 5.01-10.00 miles, two 1/2 mile test sections are used. Three 1/2 mile sections are used for any control section greater than 10.0 miles.

After determining a location for the representative 1/2 mile test section or sections, the county, highway number, beginning and ending control section milepost, pavement width, beginning and ending milepost of the 1/2 mile test section being surveyed, date of survey and names of those doing the survey shall be recorded on the worksheet.

Flexible

The procedure for evaluation of flexible pavement is to drive on the shoulder, if possible, and estimate the area of each instance of alligator cracking and patching recording them individually on the worksheet.

The rut depth is measured in the outside and inside wheeltrack in both lanes at 0.05 mile intervals and recorded (10 sets of readings per test section).

While driving the first and last 0.05 mile portion of the test section the number of longitudinal and transverse cracks meeting the previously described criteria will be counted and recorded. Transverse cracks extending across only one lane will be counted as "half cracks" and recorded as such.

While driving the first and last 0.05 mile portions, the occurrence of faulted cracks will be looked for and the worst instance in each portion will be measured. These measurements will be taken one foot in from the pavement edges at the two cracks selected and the data recorded.

Rigid

The procedure for rigid pavement is to drive on the shoulder, if possible, and count all cracks meeting the previously described criteria. Cracks extending across only one lane are recorded as "half cracks" and summed to full cracks during the data summary phase. Longitudinal, diagonal and random cracks are accounted for by estimating how many times they would extend across the roadway and recording that number.

The area of each patch is estimated and recorded individually on the worksheet.

The rut depth is measured in the outside and inside wheeltracks of both lanes. One set of measurements will be taken at the beginning of the 1/2 mile test section and one set at the end.

Faulting is measured one foot in from each pavement edge at 0.05 mile intervals and recorded (10 sets of readings per check section).

The D crack Occurrence Factor (DOF) in the test section will be evaluated and assigned a numerical rating based on the following description.

DOF Value

0 = No D-cracking noticeable.

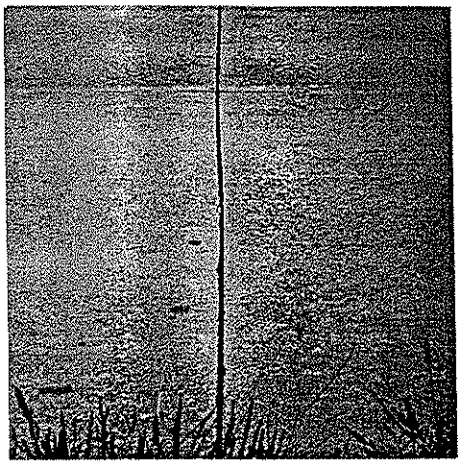
1 = D-cracking is evident at most joints and has progressed across width of slab. Pavement is in sound condition and no maintenance is required due to D-cracking.

2 = D-cracking is evident at most joints and has progressed across width of slab. Pavement is in sound condition and no maintenance is required due to D-cracking.

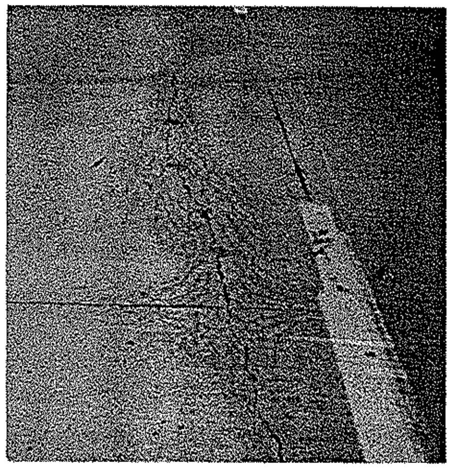
3 = D-cracking is evident at virtually all joints and random cracks. Minor raveling and spalling are occurring and traffic is causing some loosening of cracked pavement. Some minor maintenance of spalled areas is required.

4 = D-cracking very evident as in 3 above. Spalling and removal by traffic has progressed to point that regular maintenance quality of pavement is now noticeable.

5 = D-cracking has continued to progress at sites identified in 3 above and requires regular maintenance patching. Full depth patches may be necessary. Ride quality has deteriorated to point where reduced driving speed is necessary for comfort and safety.

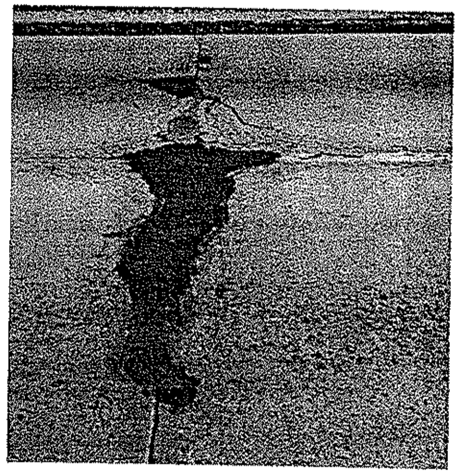


DOF = 0

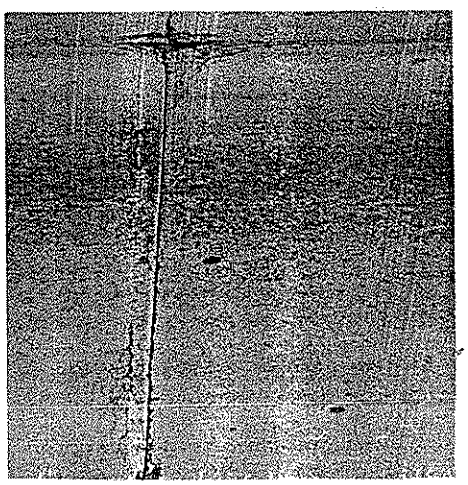


DOF = 3

DOF = 1



DOF = 4



DOF = 2

DOF = 5

Figure 6. Examples of D-crack occurence Factors

D. Calculations

1. Flexible Pavement

   a. The area of cracking is totaled and divided by the area of the test section in thousands of square feet to obtain C.

   b. The area of patching is totaled and divided by the area of the test section in thousands of square feet to obtain P.

   c. The rut depth measurements are totaled and averaged to obtain $\overline{RD}$.

   d. The number of longitudinal cracks in the two areas surveyed are totaled, averaged, and reported as L.

   e. The number of transverse cracks and 1/2 cracks (divided by 2) in the two areas surveyed are totaled, averaged, and reported as T.

   f. The faulting measurements are totaled and averaged to obtain F.

   g. Cracking (C), patching (P), and rut depth ($\overline{RD}$) as calculated above and LPV, as determined in Part I, are used in the following formula to determine the Present Serviceability Index (PSI):

   $$PSI = LPV - 0.01 \sqrt{C+P} - 1.38 \overline{RD}^2$$

2. Rigid Pavement

   a. The number of cracks and 1/2 cracks (divided by 2) are totaled and multiplied by the width of the roadway and divided by the area of the test section in thousands of square feet to obtain C.

   b. The area of patching is totaled and divided by the area of the test section in thousands of square feet to obtain P.

   c. The rut depth measurements are totaled and averaged to obtain $\overline{RD}$.

   d. The faulting measurements are totaled and averaged to obtain F.

   e. Cracking (c) and patching (P) as calculated above and LPV as determined in Part I are used in the following formula to determine the Present Serviceability Index (PSI):

   $$PSI = LPV - .09 \sqrt{C+P}$$

E. Reporting Results

1. Lab Number.
2. Beginning Milepost.
3. Ending Milepost.
4. Road Number.
5. Length.
6. Surface Type.
7. Direction and Lane.
8. LPV.
9. Deduction for cracking and patching.
10. Present Serviceability Index.

Rut Depth Gauge Calibration

A. Procedure

Place the rut depth gauge on a section of channel iron or any perfectly flat surface over 4 feet long. Make sure that the gauge is placed vertically perpendicular to the surface to insure accurate readings. Press the measuring scale down until it makes contact with the flat surface, while still keeping the ends of the gauge on the surface. Check to see that the scribed line on the plastic marker lines up with the '0' mark on the measuring scale.

If the marker does not line up with the '0' mark, remove the plastic marker and file the holding screw holes to allow the marker to slide up and down. This is accomplished by either filing the bottom of the screw holes to allow the marker to slide up or by filing the top of the screw holes to allow the marker to slide down.

Mount the plastic marker template but do not tighten the holding screws. Place the gauge on the flat surface making sure the gauge is perpendicular and the measuring scale is in contact with the surface. Line up the scribed line with the '0' mark and then tighten the holding screws.

The rut depth gauge should be calibrated at least once per year and before any rutting survey such as the statewide Crack and Patch Survey.

Appendix B
Survey Results

APPENDIX B SURVEY RESULTS

RT	DIR	PMS SECTION LIMITS BMP	PMS SECTION LIMITS EMP	TEST SECTION LIMITS BMP	TEST SECTION LIMITS EMP	PCC PAVEMENTS DISTRICT 1 SURVEY # OF CRACKS	PCC DISTRICT 1 SQ FT PATCH AREA	PCC DISTRICT 1 D-CRK	PCC VIDEO SURVEY # OF CRACKS	PCC VIDEO # OF HALF CRACK	PCC VIDEO SQ FT PATCH AREA	PCC VIDEO D-CRK	ACC PAVEMENTS DISTRICT 1 SURVEY SQ FT CRACK AREA	ACC DISTRICT 1 SQ FT PATCH AREA	ACC DISTRICT 1 # OF TRANS CRACK	ACC DISTRICT 1 # OF LONG CRACK	ACC VIDEO SURVEY SQ FT CRACK AREA	ACC VIDEO SQ FT PATCH AREA	ACC VIDEO # OF TRANS CRACK	ACC VIDEO # OF HALF CRACK	ACC VIDEO # OF LONG CRACK
14	SN	58.30	69.15	60.00	60.50	0.5	0	0	2	0	0	1									
14	SN	58.30	69.15	63.00	63.50	0	112	1	1	1	0	2									
14	SN	70.96	72.46	71.00	71.50	0	0	0	6	1	0	1									
14	SN	72.46	79.10	73.00	73.50	0	0	0	3	1	0	0									
14	SN	72.46	79.10	77.00	77.50	0	0	0	0	0	0	0									
14	SN	79.10	84.56	81.00	81.50								0	0	12	0	0	0	0	0	0
14	SN	84.56	89.11	86.00	86.50	93	980	0	218	12	1898	4									
14	SN	89.11	90.35	89.50	90.00	112	545	0	273	9	856	2									
14	SN	113.56	123.53	115.50	116.00								0	0	1	0	0	0	0	0	0
14	SN	113.56	123.53	117.00	117.50								0	0	1	0	0	0	0	0	0
14	SN	123.53	129.72	125.00	125.50								1200	8624	26	2	126	9350	38	17	13
14	SN	123.53	129.72	127.00	127.50								4200	5400	28	2	870	8124	40	99	9
14	SN	131.22	138.22	133.00	133.50								0	0	4	0	0	2691	7	4	0
14	SN	131.22	138.22	136.00	136.50								0	0	4	0	0	2770	9	3	1
14	SN	138.22	144.15	140.00	140.50	6.5	15680	0	3	2	8438	0									
14	SN	138.22	144.15	142.00	142.50	1	0	0	1	0	449	0									
17	SN	0.00	7.83	2.00	2.50	2	884	0	12	6	992	2									
17	SN	0.00	7.83	5.00	5.50	1	3431	0	7	2	3293	1									
17	SN	9.07	19.65	11.00	11.50								0	0	5	0	0	66	10	1	0
17	SN	9.07	19.65	14.00	14.50								0	0	5	1	0	195	7	0	0
17	SN	9.07	19.65	18.00	18.50								0	0	8	0	0	144	11	0	0
17	SN	19.65	21.83	21.00	21.50								0	0	6	0	0	304	7	1	0
17	SN	21.63	32.76	24.00	24.50	3	0	0	23	0	0	0									
17	SN	21.63	32.76	28.00	28.50	0	0	0	14	3	0	0									
17	SN	21.63	32.76	30.00	30.50	23	5200	0	15	7	5442	0									
17	SN	32.76	36.54	35.00	35.50	0	0	0	3	0	0	0									
17	SN	36.54	39.75	39.00	39.50	2	420	0	4	2	464	0									
17	SN	39.75	46.92	43.00	43.50	1	0	0	6	1	0	0									
17	SN	39.75	46.92	46.00	46.50	0	0	0	2	0	24	0									
17	SN	46.92	49.56	47.00	47.50	3	1008	0	6	3	0	0									
17	SN	54.42	56.02	55.50	56.00	6	540	1	7	1	72	0									
17	SN	56.33	62.28	58.00	58.50								38	0	11	1	0	2150	19	6	10
17	SN	56.33	62.28	60.00	60.50								108	70	20	0	52	240	26	11	0

APPENDIX B SURVEY RESULTS

						PCC PAVEMENTS							ACC PAVEMENTS								
						DISTRICT 1 SURVEY			VIDEO SURVEY				DISTRICT 1 SURVEY				VIDEO SURVEY				
		PMS SECTION LIMITS		TEST SECTION LIMITS			SQ FT			# OF	SQ FT		SQ FT	SQ FT	# OF	# OF	SQ FT	SQ FT	# OF	# OF	# OF
						# OF	PATCH	D-	# OF	HALF	PATCH	D-	CRACK	PATCH	TRANS	LONG	CRACK	PATCH	TRANS	HALF	LONG
RT	DIR	BMP	EMP	BMP	EMP	CRACKS	AREA	CRK	CRACKS	CRACK	AREA	CRK	AREA	AREA	CRACK	CRACK	AREA	AREA	CRACK	CRACK	CRACK
20	WE	208.16	220.43	210.00	210.50								0	0	4	0	0	0	10	5	4
20	WE	208.16	220.43	213.00	213.50								0	100	4	1	0	96	4	1	1
20	WE	208.16	220.43	216.00	216.50								0	8520	4	0	0	5672	5	0	1
21	SN	24.97	29.40	26.00	26.50								0	0	25	1	64	0	22	2	6
21	SN	29.40	41.32	32.00	32.50	0	44	1	1	0	51	2									
21	SN	29.40	41.32	35.00	35.50	0	10	1	5	0	41	1									
21	SN	29.40	41.32	38.00	38.50	0	0	0	0	0	168	2									
30	EE	131.31	138.98	133.00	133.50	6	170	1	4	2	48	0									
30	EE	131.31	138.98	137.00	137.50	0	40	1	1	1	47	0									
30	EE	138.98	143.68	142.00	142.50	21.5	300	4	5	0	1084	4									
30	WE	164.72	168.87	167.00	167.50	0	170	1	0	0	683	0									
35	NN	126.04	130.60	127.00	127.50	0	0	0	0	0	0	0									
35	SS	126.04	129.04	127.00	127.50								0	0	14	0	0	2684	31	8	0
35	NN	130.60	134.01	131.00	131.50	1.5	0	0	0	0	0	0									
35	SS	131.03	134.01	132.50	133.00	0	0	0	0	0	19	0									
35	SS	134.01	140.19	134.50	135.00	0	0	0	0	0	0	0									
35	NN	134.01	140.19	135.00	135.50	0	0	0	0	0	0	0									
35	SS	134.01	140.19	137.50	138.00	0	16	0	0	0	19	0									
35	NN	134.01	140.19	138.00	138.50	0	474	0	0	0	612	0									
35	NN	144.21	150.13	146.00	146.50	0	0	0	0	0	0	0									
35	SS	144.21	150.13	146.00	146.50	2	0	0	1	1	0	0									
35	NN	144.21	150.13	148.00	148.50	1	0	0	0	1	0	0									
35	SS	144.21	150.13	148.00	148.50	0	0	1	0	0	26	0									
57	WE	8.21	13.10	12.00	12.50								0	0	6	1	0	0	8	4	8
63	SN	82.77	87.78	84.00	84.50								0	8	11	3	0	0	17	1	4
63	SN	82.77	87.78	86.00	86.50								0	0	19	1	0	0	21	2	4
63	SN	89.12	96.69	92.00	92.50								0	0	26	2	0	0	29	2	13
63	SN	89.12	96.69	95.00	95.50								0	0	37	12	0	2028	38	3	21
63	SN	97.75	100.11	98.00	98.50								0	0	30	5	0	0	33	2	14
63	SN	97.75	100.11	99.50	100.00	4.5	105	1	21	4	101	3									
63	SN	102.15	110.21	104.00	104.50	13.5	5404	0	23	1	4815	0									
63	SN	102.15	110.21	106.00	106.50	0	0	0	7	1	2028	0									
65	SN	98.38	102.10	100.00	100.50								0	0	29	4	0	2856	36	7	13

APPENDIX B SURVEY RESULTS

		PMS SECTION LIMITS		TEST SECTION LIMITS		PCC PAVEMENTS DISTRICT 1 SURVEY			PCC PAVEMENTS VIDEO SURVEY				ACC PAVEMENTS DISTRICT 1 SURVEY				ACC PAVEMENTS VIDEO SURVEY				
RT	DIR	BMP	EMP	BMP	EMP	# OF CRACKS	SQ FT PATCH AREA	D-CRK	# OF CRACKS	# OF HALF CRACK	SQ FT PATCH AREA	D-CRK	SQ FT CRACK AREA	SQ FT PATCH AREA	# OF TRANS CRACK	# OF LONG CRACK	SQ FT CRACK AREA	SQ FT PATCH AREA	# OF TRANS CRACK	# OF HALF CRACK	# OF LONG CRACK
65	SN	102.10	113.65	103.00	103.50								0	0	45	0	95	3858	48	6	13
65	SN	102.10	113.65	107.00	107.50								75	0	57	0	118	3286	57	29	27
65	SN	102.10	113.65	110.00	110.50								75	0	42	0	44	3483	74	39	17
65	SN	113.65	125.97	116.00	116.50								200	0	40	0	0	8670	45	23	11
65	SN	113.65	125.97	119.00	119.50								0	0	52	0	0	8434	53	21	12
65	SN	113.65	125.97	124.00	124.50								0	0	65	0	0	8670	77	37	14
65	SN	125.97	132.59	129.00	129.50								5500	700	32	2	0	11002	45	57	16
65	SN	125.97	132.59	132.00	132.50								730	360	32	2	76	3049	35	20	10
65	SN	132.59	138.86	136.00	136.50								0	0	22	1	0	2688	34	16	12
65	SN	132.59	138.86	138.00	138.50								40	0	19	2	8	3748	19	33	7
65	SN	138.86	148.67	140.00	140.50								20	160	24	0	0	3168	52	25	4
65	SN	138.86	148.67	143.00	143.50								0	132	22	1	17	2760	55	39	18
65	SN	138.86	148.67	146.00	146.50								20	22	17	2	0	2654	27	17	16
85	WE	0.97	7.96	2.00	2.50								0	1300	38	2	92	6195	47	21	13
85	WE	0.97	7.96	4.00	4.50								0	1300	38	3	84	3428	37	12	6
96	WE	0.00	7.04	2.00	2.50								1600	3900	19	1	0	9468	41	244	11
96	WE	0.00	7.04	5.00	5.50								250	1720	16	2	74	5285	14	62	9
96	WE	7.04	10.07	8.00	8.50								2000	1615	7	0	0	5504	77	143	11
96	WE	10.07	16.65	12.00	12.50								0	1300	27	4	148	3036	23	8	9
96	WE	10.07	16.65	15.00	15.50								0	1300	17	4	32	5468	21	9	5
117	SN	0.57	5.30	3.00	3.50								0	0	12	0	0	0	9	1	3
117	SN	6.49	17.43	9.00	9.50								0	0	20	4	42	2640	22	3	7
117	SN	6.49	17.43	12.00	12.50								0	0	33	4	11	2688	21	10	10
117	SN	6.49	17.43	15.00	15.50								0	0	30	2	0	2700	21	6	4
146	SN	2.71	18.04	5.00	5.50								0	0	20	0	0	0	17	2	2
146	SN	2.71	18.04	9.00	9.50								0	0	18	0	0	0	17	4	3
146	SN	2.71	18.04	15.00	15.50								0	0	22	0	0	0	28	6	0
146	SS	18.04	20.94	19.00	19.50								0	0	18	2	137	0	28	12	10
146	NN	18.04	20.94	19.00	19.50	1	0	0	1	0	2357	0									
146	SN	22.98	29.96	28.00	28.50								500	0	16	2	0	7982	15	6	8
146	SN	29.96	32.83	32.00	32.50								0	0	15	6	0	2696	22	11	15
146	SN	32.83	40.72	35.00	35.50								8750	0	37	2	798	4579	33	18	12
175	WE	126.58	128.36	127.00	127.50								0	300	9	2	0	2684	31	8	0

APPENDIX B SURVEY RESULTS

		PMS SECTION LIMITS		TEST SECTION LIMITS		PCC PAVEMENTS							ACC PAVEMENTS									
						DISTRICT 1 SURVEY			VIDEO SURVEY				DISTRICT 1 SURVEY				VIDEO SURVEY					
RT	DIR	BMP	EMP	BMP	EMP	# OF CRACKS	SQ FT PATCH AREA	D-CRK	# OF CRACKS	# OF HALF CRACK	SQ FT PATCH AREA	D-CRK	SQ FT CRACK AREA	SQ FT PATCH AREA	# OF TRANS CRACK	# OF LONG CRACK	SQ FT CRACK AREA	SQ FT PATCH AREA	# OF TRANS CRACK	# OF HALF CRACK	# OF LONG CRACK
175	WE	145.65	153.65	150.00	150.50								55	2400	6	0	295	13886	36	15	13
175	WE	156.45	158.20	157.00	157.50	14	0	0	17	1	2640	0									
175	WE	158.95	164.53	160.00	160.50								300	1840	5	0	0	3287	1	1	4
175	WE	158.95	164.53	163.00	163.50								110	3270	8	1	0	5084	1	1	4
175	WE	164.53	172.21	167.00	167.50								170	3530	7	1	60	4242	3	2	7
175	WE	164.53	172.21	170.00	170.50								200	2200	7	0	16	4472	13	5	2
175	WE	178.41	185.22	180.00	180.50								690	11900	33	2	112	13416	64	31	20
175	WE	178.41	185.22	184.00	184.50								2150	12580	22	1	0	13542	50	19	9
175	WE	187.93	192.15	190.00	190.50	13.5	3070	0	7	1	368	0									
175	WE	192.15	197.10	194.00	194.50	3	1692	0	3	2	1764	0									
175	WE	204.79	216.81	206.00	206.50								5280	500	11	2	196	611	7	5	4
175	WE	204.79	216.81	208.00	208.50								8800	108	13	1	580	100	15	4	8
175	WE	204.79	216.81	212.00	212.50								10800	5500	14	2	1210	10832	26	14	7
214	SN	0.00	5.04	1.00	1.50	8	4	0	7	1	10	0									
214	SN	0.00	5.04	4.00	4.50	5	2	0	6	2	16	0									
215	SN	0.40	7.75	2.00	2.50								410	8600	22	2	169	16986	43	13	11
215	SN	0.40	7.75	6.00	6.50								510	11000	18	2	328	4744	19	12	6
221	WE	0.00	3.14	2.50	3.00								0	22942	1	0	0	24416	0	0	0
223	WE	0.00	7.30	3.00	3.50								0	0	38	2	79	0	32	4	4
223	WE	0.00	7.30	6.00	6.50								0	0	32	0	0	0	21	6	3
223	WE	7.30	12.24	9.00	9.50								0	0	29	0	11	1	28	3	5
224	SN	0.00	1.70	1.00	1.50								0	0	30	0	0	2644	20	9	5
224	SN	1.70	10.53	7.00	7.50								0	0	49	0	317	2787	42	19	18
224	SN	1.70	10.53	8.50	9.00								0	0	46	0	296	2640	36	44	8
225	WE	0.37	5.15	4.00	4.50								0	0	14	0	0	2289	37	13	9
225	WE	5.15	7.96	6.00	6.50								0	0	18	0	0	2466	35	9	3
229	WE	0.49	5.41	3.00	3.50								0	0	27	1	896	2770	30	14	11
299	SN	0.49	5.56	1.50	2.00								800	400	17	0	897	4008	31	8	10
330	SN	0.00	5.43	2.00	2.50	7.5	0	0	11	1	0	0									
330	SN	0.00	5.43	4.00	4.50	3	0	0	6	3	0	0									
330	SN	5.50	14.11	8.00	8.50	4	0	0	5	1	0	0									
330	SN	5.50	14.11	13.00	13.50	13.5	1470	0	27	2	2044	0									
330	SN	14.11	20.21	17.00	17.50	6	0	0	7	0	0	0									

APPENDIX B SURVEY RESULTS

					PCC PAVEMENTS							ACC PAVEMENTS								
	PMS SECTION LIMITS		TEST SECTION LIMITS		DISTRICT 1 SURVEY			VIDEO SURVEY				DISTRICT 1 SURVEY				VIDEO SURVEY				
RT DIR	BMP	EMP	BMP	EMP	# OF CRACKS	SQ FT PATCH AREA	D-CRK	# OF CRACKS	# OF HALF CRACK	SQ FT PATCH AREA	D-CRK	SQ FT CRACK AREA	SQ FT PATCH AREA	# OF TRANS CRACK	# OF LONG CRACK	SQ FT CRACK AREA	SQ FT PATCH AREA	# OF TRANS CRACK	# OF HALF CRACK	# OF LONG CRACK
330 SN	14.11	20.21	19.00	19.50	37.5	0	0	50	6	0	0									
415 NN	4.70	5.99	5.00	5.50	0	24	0	0	0	24	0									
415 SN	5.64	6.81	6.00	6.50								3200	70	35	3	0	185	24	4	34
415 SN	6.81	10.06	8.00	8.50								2100	0	27	1	105	972	16	21	57
415 SN	10.06	12.01	11.50	12.00	0.5	0	0	1	1	576	0									
415 SN	14.25	22.07	16.00	16.50								0	0	24	1	0	0	18	13	16
415 SN	14.25	22.07	19.50	20.00								0	50	25	0	0	1863	18	37	6
928 WE	10.20	13.64	11.00	11.50								100	0	22	2	24	2896	10	9	7
928 WE	13.64	16.05	14.50	15.00								0	48	19	2	0	120	125	15	0