HR 547

Evaluation of the PAVEDEX Road Survey System in Iowa

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16. Abstract

The Iowa Department of Transportation (DOT) evaluated the PAS I Road Survey System from PAVEDEX, Inc. of Spokane, Washington. This system uses video photography to identify and quantify pavement cracking and patching distresses. Comparisons were made to procedures currently used in the State.

Interstate highway, county roads and city streets, and two shoulder sections were evaluated. Variables included travel speeds, surface type and texture, and traffic control conditions. Repeatability and distress identification were excellent on rigid pavements. Differences in distress identification and the effect of surface textures in the flexible test sections limited the repeatability and correlation of data to that of the Iowa DOT method.

Cost data indicates that PAVEDEX is capable of providing comparable results with improved accuracy at a reasonable cost, but in excess of that experienced currently by the Iowa DOT. PAVEDEX is capable of providing network level pavement condition data at highway speeds and analysis of the data to identify 1/8-inch cracks at approximately 2-3 lane miles per hour with manual evaluation. Photo-logging capability is also included in the unit.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

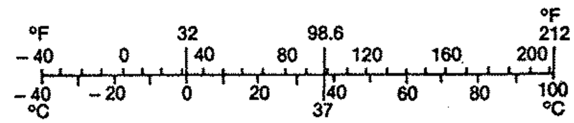
Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimetres	mm
ft	feet	0.305	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km
		AREA		
in^2	square inches	645.2	millimetres squared	mm^2
ft^2	square feet	0.093	metres squared	m^2
yd^2	square yards	0.836	metres squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometres squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft^3	cubic feet	0.028	metres cubed	m^3
yd^3	cubic yards	0.765	metres cubed	m^3

NOTE: Volumes greater than 1000 L shall be shown in m^3.

Symbol	When You Know	Multiply By	To Find	Symbol
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9	Celcius temperature	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi
		AREA		
mm^2	millimetres squared	0.0016	square inches	in^2
m^2	metres squared	10.764	square feet	ft^2
ha	hectares	2.47	acres	ac
km^2	kilometres squared	0.386	square miles	mi^2
		VOLUME		
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m^3	metres cubed	35.315	cubic feet	ft^3
m^3	metres cubed	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F



* SI is the symbol for the International System of Measurement

(Revised April 1989)

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1. INTRODUCTION

Past pavement condition evaluations have been accomplished using all available information gathered regarding the surface of the pavement and the structural strength of the materials used in road construction, so that a proper maintenance schedule could be developed. Most of this information was gathered manually; however, with the advent of computers and high technology, many of these activities have been automated.

The Iowa Department of Transportation (Iowa DOT) uses primarily manual procedures. The PAVEDEX Inc. system is partially automated to gather and analyze surface condition information. The surface condition information, as used in this study, comprises cracking and patching. Roughness and rut depth measuring equipment were not available on the equipment at the time of the field survey.

The Iowa Department of Transportation determines cracking and patching by sending a trained crew to estimate and measure this information in the field. The Iowa DOT also determines the rut depth from these field measurements and roughness by a response-type roadmeter that is calibrated against a standard instrument, the CHLOE profilometer. Using the combination of values, the Iowa DOT obtains a Present Serviceability Index (PSI) value that lies between zero and five (zero = bad, five = good) to evaluate the overall condition of the road.

The PAVEDEX Inc. system uses pairs of CCD video cameras mounted on each end of a standard truck van to photograph the pavement surface at highway speeds. The photos are analyzed by a trained observer using dual computer monitors to identify the distress types and amounts. Computer algorithms are used to summarize the type, amount, and severity of various types of cracks and patches.

The objective of this study is to evaluate PAVEDEX's automated system. Nine sections of roads in the vicinity of the Iowa DOT were evaluated with both the Iowa DOT and PAVEDEX methods. Many of these sections were also evaluated in a previous study of the PASCO system.

2. DESCRIPTION OF IOWA DOT METHOD

Since the Iowa Pavement Management System keys on the Present Serviceability Index value, it is important to understand how that value is obtained. The Iowa DOT defines the PSI of a road surface as

$$PSI = LPV - 0.01\ (Cac + P)^{1/2} - 1.38\ (\overline{RD})^{2} \qquad (1)$$

for asphalt surfaces and

$$PSI = LPV - 0.09\ (Cpc + P)^{1/2} \qquad (2)$$

for concrete surfaces where LPV is a function of the roughness of the road and

Cac = the number of square feet per 1,000 square feet of asphaltic concrete exhibiting "alligator" cracking.

Cpc = the linear feet per 1,000 square feet of portland cement pavement having cracks 1/4 inch wide or sealed

P = number of square feet per 1,000 square feet of pavement having skin or full depth patching.

RD = the mean depth of rutting, in inches, measured with a four-foot straightedge.

Thus, the PSI is made of two values, LPV and the deduction for cracking, patching, and rut depth. The LPV is selected so that a maximum LPV is five when the roughness is zero; thus, the PSI value can reflect values of five, indicating excellent, to zero, indicating poor road condition. The current Iowa DOT methods of obtaining values of roughness, cracking, patching, and rut depth are detailed in the Appendix A. A general description is provided in the following sections.

Roughness

Roughness can be defined as the deviation of the surface from a smooth profile, a constant gradient longitudinal profile. The Iowa DOT uses the Bureau of Public Roads (BPR) roughometer to obtain the roughness in terms of inches of roughness per mile. The BPR roughometer consists of a single road wheel attached to an accumulating counter by a one-way clutch. As the wheel moves up and down while being towed, all movements in one direction are summed. Another counter records the number of revolutions of the tire so that distance traveled can be calculated (see Appendix A). The

BPR readings are calibrated against a standard device (CHLOE Profilometer) to obtain Longitudinal Profile Values (LPV's). The BPR roughometer can be operated at 20 mph.

Cracking, Patching, and Rut Depth

The method of determining the cracking, patching, and rut depth by the Iowa DOT is presented in detail in the Appendix A. The Department uses crews of three to five persons to observe and record the extent of cracking, patching, and rut depth as defined below:

Cracking (asphalt)

Cac = number of square feet per 1,000 square feet of asphaltic concrete exhibiting "alligator" or "fatigue" cracking.

Cpc = linear feet of cracking per 1,000 square feet of portland cement pavement.

Only those cracks that are open to a width of 1/4 inch or more along half their length or those that are sealed are to be included.

Patching

P = number of square feet per 1,000 square feet repaired by skin (widening joint strip seal) or full depth patching.

Rut Depth

RD = mean depth of rutting, in inches, measured with a four-foot straightedge.

The crew drives on the shoulder, if possible, estimates the areas of cracking and patching, and records them on a work sheet. A typical work sheet is shown in Appendix A. The rut depth is measured at every 0.05 miles for asphalt pavement, and one set of readings is taken at the beginning and end of a half-mile test section of concrete pavement.

The area of cracking in asphalt pavement is totaled and divided by the area of the test section in thousands of square feet to obtain Cac for use in Equation (1). 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 sections in thousands of square feet to use (Cpc) in Equation (2). The area of patching is totaled and divided by the area of the test section in thousands of square feet to obtain P for Equation (1) or (2). The rut depth measurements are totaled and averaged to obtain RD in Equation (1).

3. DESCRIPTION OF PAVEDEX METHODS

The PAVEDEX system employs the use of a one-half ton van, with a heavy duty (100 amp) alternator and auxiliary air conditioner. A 1-KW invertor in the van supplies the power for the recording and photographic equipment.

Two NEC/CCD cameras are mounted on each end of the van and a fifth is mounted on the roof of the vehicle as shown in Fig 1. The front two cameras (Fig. 2) are focused on the road surface at a 20 degree angle to the vertical as shown in Figure 3; and the rear cameras are positioned at 15 degrees to the vertical as shown in Figure 4.

Figure 1. PAVEDEX PAS I Unit

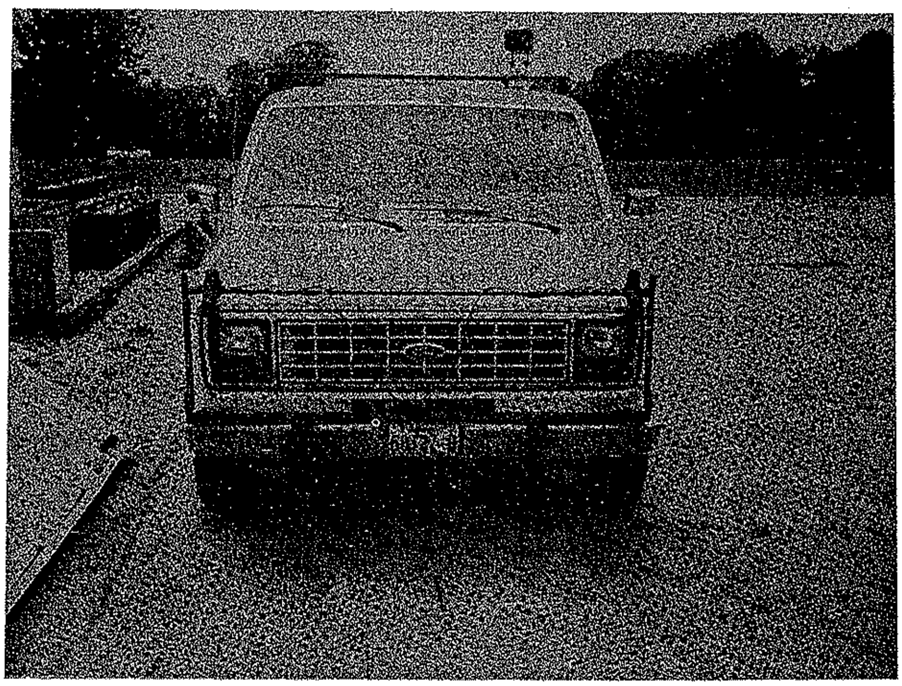


Figure 2. Front Mounted Cameras

Synchronization of the equipment allows for the use of any pair of the cameras at the same time. Each camera provides a continuous picture of an area 512 pixels by 512 pixels, with a shutter speed of 1/1,000 second producing 30 frames per second. The vehicle and the cameras are synchronized to provide a picture of 6-feet 6-inches wide (with a 6-inch overlap at the center of the lane) and 4-feet long.

VHS recorders, shown in the lower right portion of Figure 5, provide 400 lines of resolution each, and are mounted in the van to record on two-hour, 1/2-inch, black-and-white or color film video tapes. Considering the abilities of the cameras, the recorders are the primary bottleneck in the current system. The 400-line resolution prevents the equipment from gathering the level of detail that the cameras can provide. Three such recorders are shown in Figure 5. Two are used to record data from the selected downward-looking cameras (front or rear) and the third is used with the forward-looking (overhead) camera. The recorders are arranged to allow the recorder person to switch cameras and recorders with the switch box (shown in the lower portion of Figure 5), while the vehicle is in motion. The top recorder unit gathers data from the right side of the vehicle, the middle recorder gathers data from the left side and the lower recorder is connected to the forward-looking camera for this test. The switch box allows the operator to select from the left or right side cameras and the front or back cameras while in motion. This feature is very helpful

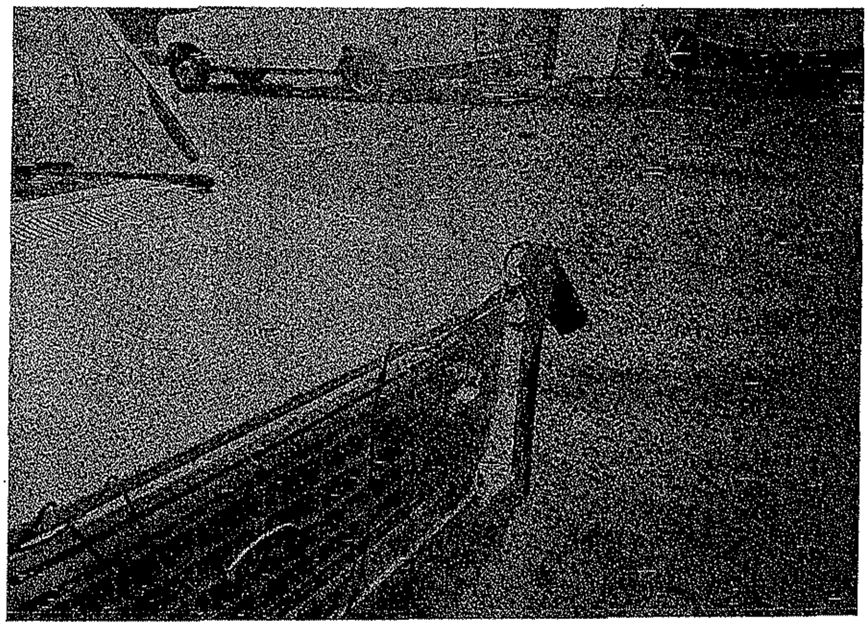


Figure 3. Front Camera Mounting and Position

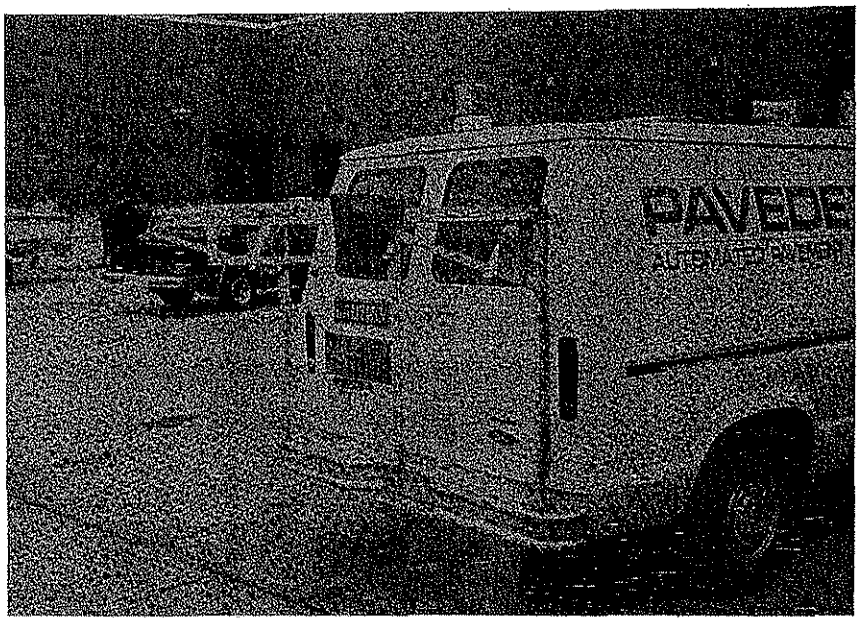


Figure 4. Rear Camera Mountings and Position

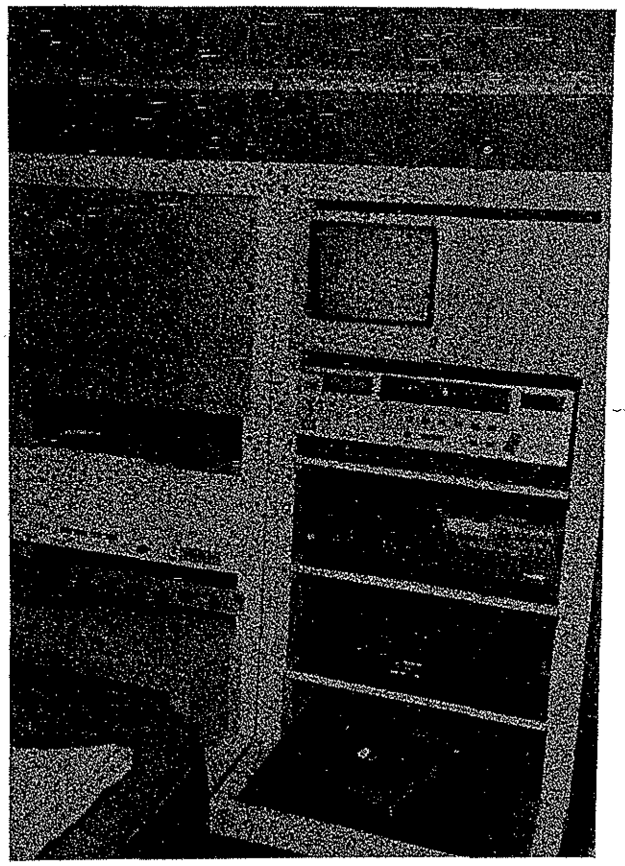


Figure 5. Rack-Mounted Recording/Control Equipment

in determining the best angle for gathering data that will eliminate the most shadow from the van.

Also shown in Figure 5 are distance measuring electronics (lower left), the 100-amp generator (middle left) and the three VCR drives and digitizers (upper left).
A Panasonic model 6200 monitor in the upper right portion of the rack allows the recorder to view the same picture that is being recorded at any time.

An encoder attached (Fig. 6) to the odometer delivers information (with 1-inch resolution) every 30 milliseconds to the film for recording the time, date, road segment number, location (to the nearest foot) from the section origin and the frame count number for each frame.

The roof mounted camera shown in Figure 7, is designed to provide the same type of information on roadside inventory.

Image processing is accomplished using a trained observer and computer control of the VCR's playback using an inverted RS232 interface with a time-based corrector conditioning the signals. A decoder reads the header board data on each frame to provide the computer with correct data on the time and location of the frame. As the computer advances the film a frame at a time, the trained observer identifies the distress type, severity and amount via keyboard codes. The computer collates all of the distress data for each customer designed project segment and stores the information.

Figure 6. Data Location Encoder

Figure 7. Roof-Mounted Roadside Camera

4. COMPARISON OF PAVEDEX AND IOWA DOT METHODS

In order to judge the PAVEDEX method of evaluating the surface condition of the road, we decided to survey the surface of nine sections of roadway and two shoulder sections, approximately one mile in length, in the vicinity of the Iowa DOT. The sites represent the various pavement and traffic conditions that the Iowa DOT actually encounters in rehabilitating and maintaining the primary road system. Many of the sites (sites A-E) have been used in previous studies to evaluate equipment such as the PASCO System for evaluating pavement condition. The sites are briefly described below:

A. Interstate 35 northbound lanes (between the Ia. 210 Interchange and the abandoned railroad bridge) milepost 103 to 104. This 10-inch, mesh-reinforced portland cement concrete pavement with 76.5-foot joint spacings was constructed in 1965 on 4 inches of granular subbase and 8 inches of asphalt treated base and is used as an approach to a weigh-in-motion site.

B. Interstate 35 northbound lanes (between the 13th Street Interchange and the Story County Road E-29 Interchange) from mile post 114 to 115. This section of 10-inch, joint-reinforced portland cement concrete pavement with 20-foot joint spacings was reconstructed in 1984 on 6 inches of recycled portland cement concrete. A reconstructed asphalt concrete shoulder is also included in the evaluation. Part of this section is used by the Iowa DOT in their annual evaluation of the road roughness measuring equipment. The outside, 10-foot wide shoulder is also included as a separate condition rating section.

C. Interstate 35 southbound lanes (between Story County Road E-29 and the 13th Street Interchange) from mile post 115 to 114. This section contains 8-inch continuously reinforced portland cement and eight inches of asphalt-treated base in the southbound lanes. The northbound lanes were replaced with 10 inches of joint reinforced concrete in 1985, over 6 inches of recycled concrete. Shoulders on the northbound lane were overlaid with asphaltic concrete at the same time. Various areas of the driving surface in the southbound lane were overlaid with asphaltic concrete in 1984 in conjunction with maintenance operations. The outside, 10-foot shoulder in each direction is also included in the evaluation and is in varying stages of distress.

D. Dayton road between Lincoln Way and 13th Street in Ames. This section was constructed of a 4-inch granular subbase and a 6-inch rolled stone base and was surfaced with three inches of asphaltic concrete in 1959. It was sealcoated in 1965 and resurfaced with two inches of asphaltic concrete in 1968 and sealed in 1980. The surface offers varying amounts of distress to measure, including a railroad crossing. This city street has a 45 mph speed limit.

E. Dayton Road between Lincoln Way and U.S. Highway 30. This 8-inch portland cement surface constructed in 1981 shows relatively little deterioration and is in a 45 mph speed zone. It does provide a way to review the effect of transverse surface texturing in the condition results.

F. Story County Road E-41 east of Ames beginning one-half mile east of I-35 and continuing one mile east. This section is made up of a thickened edge portland cement concrete section (10"-7"-10") placed in 1928. The section was widened from 18 to 24 feet in 1955 with portland cement concrete. In 1956, three inches of asphaltic concrete was placed over the entire section. In 1978, an open-graded surface course (research project) was added. Thicknesses range from 1-1/2 inches (1/2 inch mix size) to 1 inch (sand mix). Conventional mixes and thicknesses were used in various segments of the test section. Seven different pavement surface textures were applied. That surface provides difficulty for many types of condition measuring devices in determining the level and type of distress present. The route contains evidence of centerline joint deterioration, and both longitudinal and transverse cracking.

G. U.S. 69 from Airport Road south to Ken Maril Street. This is one of the original sections of U.S. 69 and contains the thickened edge design (10-7-10 inch) portland cement base placed in 1929 with a two-foot asphalt widening and overlay placed in 1948. The composite section is in a 50 mph zone and includes a large amount of cracking of various types and patterns.

H. Story County Road E-41 and Lincoln Way from Dayton Road easterly 0.7 mile to the beginning of the asphalt section noted in Section F. It was also built in 1928 with the thickened edge section as in Section F. It was overlaid and widened from 18 feet to 24 feet in 1954 with a minimum of 6 inches of mesh reinforced portland cement concrete. This section exhibits several areas of joint failures, punchouts and popouts of the surface aggregate.

I. Mortenson Road between Elwood Drive and Ash Street. This is a 25 mph section that exhibited large amounts of longitudinal and transverse cracking and joint deterioration at the time of section selection. It was constructed in 1978, with 7 inches of plain jointed portland cement concrete.

The City of Ames repaired this section in 1989 prior to the PAVEDEX survey and therefore it should exhibit only minor amounts of distress and new patches of large size.

Iowa DOT Observations

The Iowa DOT collected the necessary data (patching, cracking, roughness (LPV) and rut measurements) to compute the PSI values on all sections.

The BPR roughometer was used to determine the LPV values. On May 23, 1989 crack and patch surveys were conducted on all sections. The BPR survey was conducted on June 5, 1989 over all sections, except the shoulders of I-35. Roughness measurements are not currently conducted on shoulder areas in Iowa. Three passes were made in each wheel track of each section, excluding the shoulders of I-35. Using the current correlation table (BPR method versus LPVs), the LPVs corresponding to the BPR method were obtained and are shown in the results (see Tables 1 for portland cement and 2 for asphaltic concrete sections). Columns 1 and 2 of Tables 1 and 2 identify each test section by letter and location. Columns 3 and 4 identify the field mile post reference locations of each end of the sections. City and county sections do not have the milepost references and therefore begin with zero and end with the length of section in miles. Column 5 identifies the length of each section in miles and column 6 indicates the width of the driving lanes.

Table 1. P.C. Pavement
Present Serviceability Index
(Test Site Values)

Site	Route	From MP	To MP	Length (Miles)	Width (Feet)	Date of C&P Survey	Crack (Lin.Ft)	C	Patch (Sq.Ft.)	P	$.09\sqrt{C+P}$	Fault (In.)	RD (In.)	D.O.F.	Date of BPR Survey	RR (In/Mi)	LPV	PSI
A	I-35 NB	103	104	1.0	12	5-23-89	528	8.33	93	1.47	.28	.17	.17	0	6-5-89	84	3.83	3.55
B	I-35 NB	114	115	1.0	12	5-23-89	0	0.00	0	0.00	0	.03	.07	0	6-5-89	80	3.95	3.95
E	Dayton Rd. (US 30 to Lincoln Way)	0	1	1.0	24	5-23-89	0	0.00	2	.016	.01	.09	.04	0	6-5-89 6-5-89	153 NB 143 SB	2.86 2.95	2.85 2.94
H	E-41	0	0.85	0.85	24	5-23-89	48	.446	346	3.212	.17	.11	.02	3	6-5-89 6-5-89	123 EB 129 WB	3.14 3.08	2.97 2.91
I	Mortenson Rd. WB (Elwood Dr. to Ash St.)	0.5	0	0.50	24	5-23-89	60	.947	0	0	.09	.05	.02	0	6-5-89	155 WB	2.84	2.75
I	Mortenson Rd. EB (Elwood Dr. to Ash St.)	0.00	0.5	0.50	24	5-23-89	132	2.083	7162	113.04	.97	.06	.02	0	6-5-89	184 EB	2.64	1.67

Table 2. A.C. Pavement
Present Serviceability Index
(Test Site Values)

Site	Route	From MP	To MP	Length (Miles)	Width (Feet)	Date of C&P Survey	Crack (Sq. Ft)	C	Patch (Sq.Ft.)	P	$.01\sqrt{C+P}$	RD (In)	$.01\sqrt{C+P}+1.38RD^2$	Date of BPR Survey	RR (In/Mi)	LPV	PSI
B	I-35 NB (Shoulder)	114	115	1.0	10	5-23-89	0	0	0	0.00	0	—	0	—	—	—	—
C	I-35 SB	115	114	1.0	12	5-23-89	0	0	150	2.367	.0154	.082	.02	6-5-89	84	3.35	3.33
C	I-35 SB (Shoulder)	115	114	1.0	10	5-23-89	0	0	112	2.121	.0146	—	.01	—	—	—	—
D	Dayton Rd. (Lincoln Way to 13th St.)	0	0.75	0.75	24	5-23-89	1020	10.732	654	6.881	.042	.179	.09	6-5-89 6-5-89	145 NB 154 SB	2.39 2.31	2.30 2.22
F	E-41	0	1.10	1.10	24	5-23-89	16	.115	875	6.277	0.25	.095	.04	6-5-89 6-5-89	129 EB 137 WB	2.55 2.47	2.51 2.43
G	US 69	112.80	113.80	1.0	24	5-23-89	1272	10.038	3065	24.187	0.59	.160	.09	6-5-89 6-5-89	130 NB 126 SB	2.54 2.59	2.45 2.50

The Interstate sections have a 12-foot width related to the area surveyed of the total 24-foot width. Shoulders are 10-feet wide for the surveyed area and all other sections were surveyed in both directions of the 24-foot width pavement. The date of the crack and patch survey is shown in column 7. Columns 8 and 9 represent the amount of cracking measured and the appropriate value per thousand square feet for the calculation of PSI. Similar values for the amount of patching identified are shown in columns 10 and 11. Column 11 combines the crack and patch figures into one deduct value. The faulting noted in a set of measurements for portland cement concrete is noted in column 12 and the measured rut depth is shown in column 13. The presence of "D" cracking is identified in column 14 according to level of severity from 0 illustrating no presence to 5 representing segments in need of full depth patching or replacement of the concrete pavement. The BPR date of survey and the recorded inches per mile of roughness are shown in columns 14 and 15. The corresponding longitudinal profile for the BPR data is shown in column 16. The PSI shown in the last column represents the LPV value minus the deductions shown in column 14 for asphalt surfaces and column 12 for portland cement concrete. Rut depth is noted for concrete pavements, but not used in the calculation of PSI.

PAVEDEX Observations

PAVEDEX employs the use of a standard Ford Econoline van equipped with video cameras at each of the corners of the van to photograph the pavement. The equipment used in this test was equipped to photograph the pavement from any combination of the four cameras. Continuous video images of consecutive passes of the vehicle were made of each of the test sections of road and the two shoulder sections on I-35. A series of four tapes were made on this test, representing film of the left and right portions of the surveyed lane for approximately 90 miles of pavement at various speeds.

PAVEDEX Data Collection Procedures

The PAVEDEX van comes ready to use in a matter of minutes. The cameras can be covered during travel between sites to protect them from road debris or carried in the ready position. Cameras are usually removed at the end of the day for security reasons. Remounting time for the next day's work is completed in 10 - 15 minutes through the use of single cable connections and quick mounts for the camera assembly.

The cameras used to measure pavement distress are mounted on two simple bar assemblies attached to the front and rear bumpers. A separate camera can be mounted on the top of the van to provide a separate view of the roadway and right-of-way features, such as traffic controls that can be associated with the pavement surface in determining safety strategies. The data from each camera is stored on VHS tape for analysis.

The vehicle can be operated by one person, but as in the case with most of the pavement distress vehicles, a two-person staff is recommended. The use of two people allows the vehicle operator to control position of the vehicle, and identify any particular items on the pavement that may create problems in computer identification. The recorder can operate the controls to determine the best camera arrangement and record on a dictaphone, any miscellaneous distress items to be concerned with at a given location.

Power for the van recording system comes from a special 100-amp alternator and the van engine. This makes the system self-contained and removes the requirement for additional power sources.

The camera used on this project is the NEC Model TI-23A CCD. It is designed to photograph the pavement in black and white. This 1/2-inch, totally solid-state TV camera uses a charge-coupled device (CCD), a solid-state imaging device, as a photoelectric transfer element instead of the pickup tube generally used. This provides a black-and-white camera with higher sensitivity, higher image quality, and lower after image. Pictures are highly uniform and free of geometric distortion and sticking. The camera's compactness, light weight, long service life and high resistance to shocks and vibration make it ideal for a wide range of applications, such as pavement evaluation. Previous video cameras have not provided the clarity needed to determine pavement condition. The camera provides the same type of image that the 35mm cameras can provide in terms of a shuttered effect to freeze a particular portion of the pavement for evaluation.

Camera features that affect the reliability and effectiveness of this unit include:

1. The use of two, solid-state CCDs in one camera to provide an interline transfer imaging device and embedded channel signal readout register to eliminate any resolution degradation due to higher transfer efficiency. A higher modulation factor also guarantees clear, crisp pictures.

2. Signals photoelectrically transferred by the solid-state imaging device are converted to video signals with digital scanning, a technique that reduces geometric distortion.

3. The image does not stick, even when the camera is shooting a bright subject.

4. The solid-state device provides improved resistance to shocks and vibrations that often destroy conventional pickup tube cameras.

5. The CCD solid-state imaging device provide much longer life than the conventional vacuum tube cameras.

6. The electronic shutter speed on the cameras used in this test is 1/1000 second in the shutter mode.

7. A single cable and quick coupling arrangement are used to speed the attachment of the camera to the mounting and provide a watertight connection.

The front pair of cameras are mounted on a simple metal box bar frame that is mounted approximately 45 inches above the pavement surface. The actual distance from the camera lens vertically to the pavement is 41 inches. A 74-inch long mounting bar allows the manufacturer to change the location of the cameras and concentrate on any given area of the pavement surface with a minimum of downtime. Cameras were centered over each half of the pavement lane for the Iowa Test (see Figure 8) with a distance of 64 inches between cameras. These cameras were focused on the pavement at an angle of approximately 20 degrees from the vertical.

The rear cameras are mounted on two cantilever arms attached to a similar bar as used on the front of the vehicle (see Figure 9). Cameras are attached some 30 inches behind the vehicle on the end of the cantilevers and focused at 15 degres from the vertical, on the pavement at a height of 5 feet. Camera spacing is held at the same 64 inches as on the front of the vehicle.

Mounting arrangements for the cameras provide a way of viewing the entire 12-foot lane with an overlap area of 6 inches in the center of the lane transversely. Camera mountings and shutter speeds allow for a single picture of an area 6-feet (plus overlap) wide by 4-feet longitudinally to be taken by each camera with only minimal overlap in successive pictures. The camera mounting heights also provide protection from road spray and allow the unit to be used during periods when the pavement is wet immediately after a rain. Use is not recommended during periods when the pavement exhibits standing water due to the reflective nature of the surface.

The cameras are each synchronized with the left rear

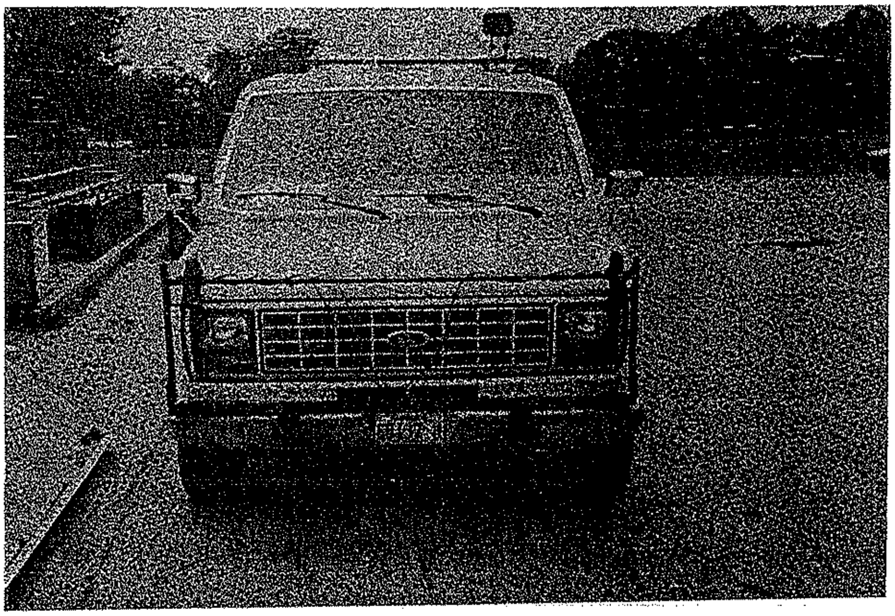


Figure 8. Front Camera Mounting Bar

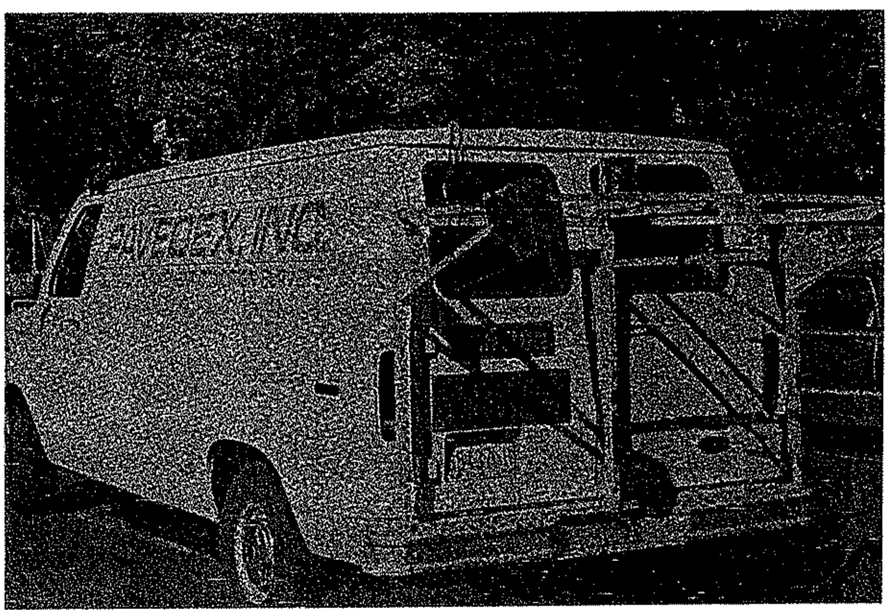


Figure 9. Rear Camera Mounting Frame

camera and can be operated independently or in combination with one or more other cameras. Shutter speed is controlled by the speed of the vehicle, but is established at 1/1,000 second and 30 frames per second. The recording rates allow for the collection of approximately 35-40 miles of data at 25 mph (urban conditions) or 100-140 miles of data at 55 mph (rural conditions) per video tape.

Data from the cameras are recorded on one of three recorders (one for the overhead camera and one for each of the pair of pavement cameras being used) housed in the van. A simple rack mounting frame with 1/2-inch cushioning materials for each recorder help provide improved quality of data. The entire rack mount (see Fig. 5) is cushioned on a 1-inch thick blanket of rock mining matt over one inch of plywood. A special header board on each frame of the film provides two lines of information on the time and location of the picture. Line one includes six digits of time (hour, minutes, seconds) in military time, and the frame number from 1-29. The second line includes five digits of distance measurement from the beginning of the section and the last three identify the road segment number assigned by the operator.

Other equipment in the van includes a generator, digitizer, distance measuring computer, TV monitor, and switch box to provide the recorder a way of monitoring all the camera outputs from one visual monitor. The monitor also provides a way to view the time and distance header board information at any time. Switch box controls allow the operator to change from front to rear or left to right camera views and operation.

A model NC-15 CCD color camera is used for the top mounting to photograph the right of way. It performs in the same manner as the TI-23A, but provides color pictures. It was not used in the Iowa test due to the type of information required. The camera is mounted over the driver's head on the roof of the van and is controlled by the operator or recorder person. It is capable of being mounted in variable positions on a bar across the van. The camera can be adjusted to a given vertical angle and horizontal angle relative to the area of the right of way, desired for viewing.

The equipment used for the Iowa demonstration included the capability to photograph and measure cracking in the form of longitudinal, transverse and alligator cracking. Manual evaluation done with the use of the dictaphone could increase the types of data gathered to include flushing, ravelling, patching, and block cracking. The van did not include equipment to measure rut depth or longitudinal or transverse profile.

PAVEDEX Data

Data collection was carried out on June 29 and June 30, 1989 on the nine test sections. Both days of data collection for this test were sunny with temperatures ranging to 85 degrees fahrenheit on the first day and 89 degrees on the second day. Little or no wind was encountered either day.

The sections measured the first day included three passes each of sections A, B, C, and the shoulder sections noted as BB and CC, during the mid portion of the day (10:30 am - 2:30 pm) to record the effect of the sun being directly overhead. The last run on section CC was made during the 3:00 pm - 6:00 pm period due to the timing involved. Runs on A, B, and C were made at 55 mph and those made on the shoulders BB and CC were made at speeds ranging from 40-55 mph depending on the particular run. Rear cameras were employed on the northbound runs (sections A, B, and BB) and front cameras on the southbound runs (sections C and CC). The system is very quick to operate and the only time spent was that to drive the section and move to the next section. Three runs on most sections could be accomplished in 15 to 30 minutes.

A series of afternoon (3:00 pm to 6:00 pm) runs were also made on sections A, D, F, G, H, and I. This completed the runs on section A and provided half the information required on the other two-lane sections. The odd numbered runs on section D and E are in a northerly direction and the even numbered runs represent southbound runs. Speeds on these sections ranged from 30-45 mph. Rear cameras were employed in the northbound direction and front cameras in the opposite direction. Speed limits, stops and railroad crossings indicated no particular problems for the recording equipment.

On sections F and H, the odd numbers represent the eastbound runs and the even numbers the westbound. On these sections, the speeds ranged from 35 to 50 mph depending on the traffic flow at a given run. Rear cameras were used in the eastbound direction and the front cameras in the westbound direction.

Odd numbered runs were made in the westbound direction on section I, and evens in the eastbound direction. The first run was made at 15 mph and the two successive runs were made at 25 mph. This section employed the use of the front cameras in the westbound direction and rear cameras in the eastbound direction. The curvilinear alignment of this section presented no particular data collection problems for the system.

Section G runs were made with the odd numbers representing the southbound direction and the evens the northbound direction. The speeds used were 35 mph on the first two runs and 40 mph on the last run. Front-mounted cameras were used in both directions on this segment. This marks the first section where the angle of the sun started to become a factor in camera selection.

A final series of afternoon runs was made on section A at speeds of 50-55 mph employing the front cameras only.

Camera determination was made prior to the beginning of each run by the recorder person based on a survey of the camera views to remove the most shadow from the van. This vehicle operates with only natural sunlight and camera selection is based on the angle of the sun and direction of travel.

The second day began at 9:25 am and ended at 1:34 pm with the final runs being made on sections B, C, D, E, F, G, H, and I. In this case, the front-mounted cameras were used on all runs made on sections B and C at speeds of 45-55 mph.

Sections D and E presented the reverse problem of camera selection noted in the afternoon of the first day. Initial camera selection used the front cameras for one run and then employed the rear camera for the remaining runs to reduce shadow problems.

Runs on sections F and H were made at speeds of 38-46 mph with the cameras being reversed from the previous day. Front cameras were used in the eastbound direction and rear cameras in the westbound direction.

Section G presented the same camera selection as the other north-south sections. Speeds of 39-45 mph were employed and camera selection center mainly on the use of the front camera with two northbound uses of the rear camera.

All runs on section I were made using the front mounted camera and speeds of 26-30 mph.

Speeds shown above were identified from the odometer on the vehicle and should be considered representative of the actual speeds across the sections.

Data collection moves very quickly and smoothly with the PAVEDEX system. With proper planning of the routes to be surveyed, the only time lost would be that in dead heading over completed sections to move to the next section. This could be reduced through correlation of the tape header data during retrieval and employment of long sections (days run) of the same route.

Comparison of Iowa DOT and PAVEDEX Results

The original test had been set up to compare the distress, ride and rut depth measurements. The PAVEDEX equipment used for the test had not been outfitted to provide rut depth or longitudinal profile information. Only distress data from the two systems (PAVEDEX and Iowa DOT) can be compared from the tests.

In terms of crack measurement, the Iowa DOT method has been to count the number of cracks in several ways based on the surface type and crack type. The predominant crack type is first identified and then the severity and extent applied. Alligator cracking is measured in square feet per 1,000 square feet of surface area. Longitudinal cracks in asphaltic concrete pavement must exceed 100 feet in length and be 1/4-inch wide. They are also measured in number on asphaltic concrete pavement per 0.05 mile. Transverse cracks can be open over 1/4 inch or sealed and measured as the number per 0.05 mile on asphaltic concrete pavement.

PAVEDEX does not provide the number of cracks, but does provide more detail on the cracks. The cracks are identified by type and severity. The alligator and longitudinal cracks are identified by length in feet of cracks of a given severity (L = low severity cracks of 1/4 inch or less in width, M = medium severity cracks of 1/4-1/2 inch in width and H = high severity cracks are those with width greater than 1/2 inch). Transverse cracks were counted per segment as those that cross at least one wheel path. "D" cracking is measured by occurrence and value scale.

Using the Iowa method, patched areas are measured in square feet. The same is done in the PAVEDEX method, except the patch's condition is subdivided into two categories (good and poor) that correspond to the relative surface appearance at the joints and across the patch.

Comparison of Iowa DOT Visual Crack and Patch Survey Versus PAVEDEX Survey Method

Two items of information used in the evaluation make a one for one comparison of the Iowa method and the PAVEDEX methods difficult. The first is the difference in definitions of cracks and patches. Iowa looks at cracks by direction, greater than 1/4 inch in width and certain lengths, while PAVEDEX identifies all cracks down to 1/8 inch in width and subdivides them by their type and direction. PAVEDEX rates the condition and area of the patch, while the Iowa method looks only at the area of the patching.

The second difference comes in the definitions used by the trained observer in each case. Crack patterns and policies on how to rate sealed cracks differ with the two systems.

PAVEDEX summary data was provided to the authors in the form of floppy disks containing LOTUS spreadsheet files, and

Figure 10. Sample PAVEDEX Rigid Pavement Output (Section A)

PAVEDEX, INC. SPOKANE, WA SEPT 1989
IOWA DEMONSTRATION
"A" ROAD I-35 NORTH

SORT #	SEG	TAPE	SEG #	CC #	CC %SLAB	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES G SQFT	PATCHES G % AREA	PATCHES F SQFT	PATCHES F % AREA	PATCHES P SQFT	PATCHES P % AREA	TSC #	TSC %SLABS
1	A1	1	130	0	0	3	15	0	0	0	0	0	0	0	0	0	0	0	0	11	18
1	A2	1	140	0	0	8	11	0	0	0	0	0	0	0	0	0	0	0	0	14	19
1	A3	1	150	0	0	12	15	0	0	0	0	0	0	0	0	0	0	0	0	15	19
1	A4	1	493	0	0	10	12	0	0	0	0	0	0	0	0	0	0	0	0	13	16
1	A5	1	503	0	0	11	18	0	0	0	0	0	0	0	0	0	0	0	0	9	15
1	A6	1	513	0	0	13	15	0	0	0	0	0	0	0	0	0	0	0	0	13	15
2	A1	1	131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4
2	A2	1	141	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
2	A3	1	151	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3
2	A4	1	494	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
2	A5	1	504	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	3	4
2	A6	1	514	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1
3	A1	1	132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	A2	1	142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	A3	1	152	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	A4	1	495	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	A5	1	505	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	A6	1	515	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	A1	1	133	0	0	2	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0
4	A2	1	143	0	0	2	3	0	0	2	3	0	0	0	0	0	0	0	0	0	0
4	A3	1	153	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
4	A4	1	496	0	0	3	3	0	0	2	2	0	0	15	0.23	0	0	0	0	0	0
4	A5	1	506	0	0	2	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0
4	A6	1	516	0	0	2	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0
5	A1	1	134	0	0	2	2	0	0	2	2	0	0	30	0.57	0	0	0	0	0	0
5	A2	1	144	0	0	1	1	0	0	0	0	0	0	30	0.64	0	0	0	0	0	0
5	A3	1	154	0	0	2	2	0	0	1	1	0	0	30	0.56	0	0	0	0	0	0
5	A4	1	497	0	0	2	4	0	0	2	4	0	0	15	0.45	0	0	0	0	0	0
5	A5	1	507	0	0	2	3	0	0	3	4	0	0	30	0.66	0	0	0	0	0	0
5	A6	1	517	0	0	3	4	0	0	3	4	0	0	30	0.67	0	0	0	0	0	0
6	A1	1	135	0	0	3	3	0	0	2	2	0	0	15	0.28	0	0	0	0	0	0
6	A2	1	145	0	0	3	4	0	0	2	2	0	0	15	0.30	0	0	0	0	0	0
6	A3	1	155	0	0	3	4	0	0	2	3	0	0	15	0.31	0	0	0	0	0	0
6	A4	1	498	0	0	3	3	0	0	2	2	0	0	15	0.27	0	0	0	0	0	0
6	A5	1	508	0	0	5	6	0	0	2	3	0	0	15	0.32	0	0	0	0	0	0
6	A6	1	518	0	0	4	4	0	0	2	2	0	0	15	0.25	0	0	0	0	0	0
7	A1	1	136	0	0	1	1	0	0	1	1	0	0	30	0.60	0	0	0	0	0	0
7	A2	1	146	0	0	2	2	0	0	1	1	0	0	30	0.58	0	0	0	0	0	0
7	A3	1	156	0	0	1	1	0	0	2	3	0	0	30	0.67	0	0	0	0	0	0
7	A4	1	499	0	0	1	1	0	0	2	2	0	0	30	0.60	0	0	0	0	0	0
7	A5	1	509	0	0	2	2	0	0	2	2	0	0	30	0.54	0	0	0	0	0	0
7	A6	1	519	0	0	2	2	1	1	1	1	0	0	30	0.59	0	0	0	0	0	0

Figure 11. Sample PAVEDEX Flexible Pavement Output (Sec. C)

PAVEDEX, INC. SPOKANE, WA SEPT 1983
IOWA DEMONSTRATION
"C" ROAD I 35 SOUTH

SORT #	SEG	TAPE	SEG #	ALLIGATOR FEET L	M	H	LONGITUDINAL FEET L	M	H	TRANSVERSE # L	M	H	PATCHES SQ FEET P1	P2
1	C1	1	34	0	0	0	0	0	0	0	0	0	0	0
1	C2	1	55	0	0	0	0	0	0	0	0	0	0	0
1	C3	1	76	0	0	0	0	0	0	0	0	0	0	0
1	C4	2	11	0	0	0	0	0	0	2	0	0	0	0
1	C5	2	31	0	0	0	0	0	0	0	0	0	0	0
1	C6	2	49	0	0	0	0	0	0	1	0	0	0	0
2	C1	1	35	0	0	0	0	0	0	2	0	0	0	0
2	C2	1	56	0	0	0	0	0	0	2	0	0	0	0
2	C3	1	77	0	0	0	0	0	0	0	0	0	0	0
2	C4	2	12	0	0	0	0	0	0	0	0	0	0	0
2	C5	2	32	0	0	0	0	0	0	1	0	0	0	0
2	C6	2	50	0	0	0	0	0	0	0	0	0	0	0
3	C1	1	36	0	0	0	0	0	0	6	0	0	0	15
3	C2	1	57	0	0	0	0	0	0	5	0	0	0	15
3	C3	1	78	0	0	0	0	0	0	5	0	0	0	15
3	C4	2	13	0	0	0	0	0	0	3	0	0	0	15
3	C5	2	33	0	0	0	0	0	0	4	0	0	0	15
3	C6	2	51	0	0	0	0	0	0	5	0	0	0	15
4	C1	1	37	0	0	0	0	0	0	8	0	0	0	15
4	C2	1	58	0	0	0	0	0	0	8	0	0	0	15
4	C3	1	79	0	0	0	0	0	0	9	0	0	0	15
4	C4	2	14	0	0	0	0	0	0	10	0	0	0	15
4	C5	2	34	0	0	0	0	0	0	8	0	0	0	15
4	C6	2	52	0	0	0	0	0	0	8	0	0	0	15
5	C1	1	38	0	0	0	0	0	0	15	0	0	15	0
5	C2	1	59	0	0	0	0	0	0	17	0	0	15	0
5	C3	1	80	0	0	0	6	0	0	13	0	0	15	0
5	C4	2	15	0	0	0	0	0	0	17	0	0	15	0
5	C5	2	35	0	0	0	0	0	0	17	0	0	15	0
5	C6	2	53	0	0	0	0	0	0	14	0	0	15	0
6	C1	1	39	0	0	0	0	0	0	27	0	0	0	0
6	C2	1	60	0	0	0	0	0	0	28	0	0	0	0
6	C3	1	81	0	0	0	0	0	0	24	0	0	0	0
6	C4	2	16	0	0	0	0	0	0	24	0	0	0	0
6	C5	2	36	0	0	0	0	0	0	21	0	0	0	0
6	C6	2	54	0	0	0	0	0	0	24	0	0	0	0
7	C1	1	40	0	0	0	0	0	0	23	0	0	0	0
7	C2	1	61	0	0	0	0	0	0	25	0	0	0	0
7	C3	1	82	0	0	0	0	0	0	21	0	0	0	0
7	C4	2	17	0	0	0	0	0	0	26	0	0	0	0
7	C5	2	37	0	0	0	0	0	0	23	0	0	0	0
7	C6	2	55	0	0	0	0	0	0	25	0	0	0	0

paper copies of the same data. Partial examples of that data are illustrated in Figure 10 for section A and Figure 11 for section C. The remaining summaries are in Appendix C.

In an attempt to evaluate the two systems, the author assumed some values for the length of cracks as noted in the PAVEDEX information. These included an average length of 2 feet for corner cracks (CC), 12 feet for first and second stage cracks (FSC), and 18 feet for third stage cracks. The following observations were made from the PAVEDEX summaries and the Iowa DOT summary forms.

Section A - The PAVEDEX information identifies some 534 feet of cracking and 110 square feet of patching compared to the Iowa DOT 528 feet of cracking and 93 square feet of patching. This is very good, but one should expect this on a continuously reinforced slab. It should be noted that the percent of slabs columns assume an imaginary slab length of 5 feet for calculations, rather than the fact that the slab has no joints.

Section B - Some 24 feet of cracking and no patching were identified by PAVEDEX, while the Iowa DOT identified none of either distress. This represents only two cracks and could have been missed in the standard DOT test method.

Section C - PAVEDEX identified some 100 feet of longitudinal and transverse cracks and 90 square feet of patching, while Iowa DOT found no cracks and 120 square feet of patching. The difference may be the result of problems in identification of transverse cracks vs changes in surface type (asphalt and concrete) or surface texturing differences across the section.

Section D - The PAVEDEX system identified some 1950 feet of cracking (majority being longitudinal in nature) and no patching. Iowa DOT figures indicate 1020 feet of cracking and 654 square feet of patching.

Section E - Some 20 feet of cracking, two spalls, and no patching were identified by PAVEDEX. The Iowa DOT noted no cracking and 2 square feet of patching. This section has areas where poor concrete placement has been noted and could be identified as spalls. The cracking could have been missed in the standard Iowa test method. The patch difference is most likely the result of one area and a difference in recognition by the observers in each case.

Section F - The PAVEDEX system found some 2,500 feet of cracks and no patch areas on this section. The Iowa DOT found 16 feet of cracking and 875 square feet of patching on this site. It appears that the manufacturer's equipment experienced problems in the recognition of cracks and patches due to the surface texture of the former research test sites on this section of pavement.

Section G - This section produced some 8,750 feet of cracking and 313 square feet of patching by the PAVEDEX evaluation. The Iowa DOT identified some 1,272 feet of cracking and 3065 square feet of patching. The differences in this location are primarily due to the definitions being used by each observer for identifying the primary direction and condition of cracks in the surface. The surface does not fit either system well and could be better measured in terms of percent of area block cracked.

Section H - Some 496 feet of cracking and 2,210 square feet of patching were identified by the PAVEDEX method along with 44 spalls. The Iowa method produced 48 feet of cracking and 346 square feet of patching. The bulk of the difference is found in the definition of patching at the I-35 bridge approaches and the Dayton Ave. returns adjacent to the test slab.

Section I - The PAVEDEX system identified some 230 feet of cracking, 18 spalled areas, several replaced slabs, and no patches. The Iowa DOT identified some 182 feet of cracking and 7,162 square feet of patching. The difference here is in the manner of addressing the replacement slabs. It represents one of the problems facing any equipment evaluation.

General comments - The PAVEDEX equipment did not try to measure the pavement-shoulder joint problems on the interstate highway sections. Section E presented some problems with coarse aggregate popouts and ravelling that are not addressed at this time by PAVEDEX.

5. EVALUATION OF RESULTS

General

The system is easy to operate, quick to become operational at the site, and relatively maintenance free. It provides a way to survey pavement surface condition and the roadway environment with one pass of the vehicle and provide quick copies of the two-camera views for various highway segments. This information can then be utilized in planning, design and maintenance of the road and surrounding features. The system can be used for network or project level survey information collection.

Correlation of Data

The general correlation of the data gathered by the Iowa DOT and the PAVEDEX equipment has been discussed in the previous sections. The surface texture properties of the county and city streets appear to have caused the most differences in measured distress. The difference in policy-type decision definitions regarding distress types is the major factor on asphalt surfaces. The equipment did well on the concrete pavement distress identification and quantification, but did not do as well on the asphalt surfaces.

Some of the objectives of this study included the evaluation of the effect of rural/urban setting, surface type and texture, traffic control, railroad crossing effect, angle of the sun and repeatability of the equipment.

The results indicate no particular problems with obtaining useful data in either rural or urban locations. The effect of the railroad crossing and stopping and starting at intersections made no appreciable difference on the results.

The location of the beginning of filming on each site does have an effect. A small number of the film segments could not be correlated due to differences in initial points on the pavement, and were therefore not evaluated for distress. Future uses of this equipment should include the addition of some physical identification marks on or near the pavement edge to assure specific starting and ending points for evaluations.

An evaluation was made to determine the effect of the sun's position on the recorded distress types and amounts by taking data at differing times of day. Data was collected during the mid-portion of the day when the sun is nearly directly above the machine and during the early morning or late afternoon hours. A series of three passes was made over each of the pavement sections during the midday and one of the other two time periods to test both the sun's effect and repeatability. The results were tabulated in terms of mean values of each distress type, for each of the passes and time periods. A 95% confidence level was used to test the variability between passes and time periods. A tabulation of values illustrating the repeatability of measuring each distress type is shown in the Tables in Appendix C.

The statistical analysis indicates the equipment does very well in determining the amounts and type of rigid pavement distress. All values for successive passes and time period differences were found to be in the confidence interval, except those for patching and severe spalling. The patching quantities reflect a potential problem in the criteria that was employed to select a patch from a pavement slab. Class 3 spalling differences in Section H are related to the areas around the bridge approaches and are an isolated instance. All types of distresses were measured in various sections, but the reader is cautioned to note that the levels of distress are relatively light in all the rigid sections tested.

Testing on the asphalt sections reflected a variety of statistical answers. Interstate Section C met the 95% confidence interval for all values tested.

Six tests were made in each direction on the remaining roads and the equipment experienced problems in identification of alligator, longitudinal, and transverse cracks consistently in successive passes or time periods. The best results came in the identification of severe transverse cracks and patches, but no test met the 95% criteria. Each of the two-lane sections exhibited large amounts of cracking or patching. This creates large problems for both the trained field observer and the PAVEDEX office trained observer in being consistent. It is one of the areas the computer can bring the most objectivity to in the future. Visual observation of the standard deviations associated with this portion of the data indicates much lower values for work done during the mid portion of the day than the morning or afternoon. Direction of travel did not make a large difference in result. It did make a difference in determining the camera selection. Afternoon selection of cameras in north-south passes required differing arrangements due to the shadows of the camera mountings on the picture area.

Tabulations of the data by test section and distress type are included in Appendix B for the user inspection.

Costs and Productivity

The current trained observer method of evaluating the pavement distresses by PAVEDEX, used approximately 18 person hours to evaluate 54 miles of pavement. This assumes that two computer monitors and two separate cassette tapes are being viewed simultaneously. This translates into 3 lane miles per hour and compares favorably to the estimated one lane mile per hour being estimated for computer analysis of such films.

The Iowa DOT cost of a roughness survey is approximately $173 per test section including $107 for crack and patch survey. It should be noted that the crack and patch survey is done on a short segment of a construction project length of approximately 5 miles. This would translate into a cost of $10-15 per lane mile of project and includes all field costs. The cost estimated for PAVEDEX to do the field survey and analysis of the data is $20-25 per lane mile for state highways, $19-22 per Interstate lane mile, $30-50 per county lane mile and $50-60 per city lane mile. The PAVEDEX cost includes measurement of alligator, longitudinal, transverse and block cracks and patching for flexible pavements and corner cracks, slab cracks and patching of rigid pavements. Other types of distress measurements are negotiable.

PAVEDEX has the capability to provide a full-color perspective view of the road and roadside environment for addressing things such as sign inventories, drainage, curb condition, sidewalks and paint striping. This is identified as an additional cost of $3.00 per lane mile.

Special maintenance reports that show the amount and location of distress every 500 feet within the pavement section can be developed for a cost of $3.50 per lane mile.

The Iowa DOT conducted the survey of the nine sections in one day. PAVEDEX took one and one-half days to make all the runs over each section. Some time was lost in waiting for the angle of the sun to change before taking more test runs on some sections. Approximately 18 hours of time were expended by a PAVEDEX trained observer to analyze the 54 lane miles of pavement and 12 lane miles of shoulder.

An operator and recorder were used to collect the PAVEDEX data. Analysis of the tapes was accomplished in Spokane, Washington by a trained technician. Two technicians from the Iowa DOT were used to collect the Iowa DOT data. Computations for the Iowa DOT data were done in Ames, Iowa by qualified engineers. In either case the data collection and analysis can be accomplished by trained technicians, rather than using engineers for this operation.

Speed of Data Collection

Field data collection with the PAVEDEX system can be accomplished at any highway speed due to the synchronization of the cameras and the recording equipment. Due to the shuttering effect of the cameras, the system samples the pavement surface as the speed of the vehicle increases. Assuming that 30 frames per second are obtained regardless of speed, the record does provide a continuous strip of film of the entire pavement as would be the case with some other types of equipment. It is quite adequate for network analysis and in most cases could be regulated by speed to provide project level design details. Reduced travel speeds will allow for a greater portion of lane length to be photographed for distress identification and quantification.

Potential Uses of the PAVEDEX System

The PAVEDEX system would work very well in replacement of the existing field survey crews that are trained to take crack and patch measurements. If purchased, the equipment would require the training of one or more observers to review the film and determine the distress types, extent and severity levels. If the system was purchased as a service, all crack and patch data collection and analysis would be included in the contract and the Department could receive summaries in the form of tabular reports, computer disks, or film copies or a combination of all items. Disk information could be directly input into pavement management system data banks and films could be copied for district, design, and maintenance personnel use in planning and constructing rehabilitation projects. Summary tabular reports could be used in the same manner as current crack and patch reports are by the Department.

Addition of the forward looking camera, profile equipment and rut depth measurement capability would provide a one unit pavement rehabilitation data collection source. The use of combined pavement and safety observers could provide measurements of both pavement, and related signing, and capacity problems in the portions being observed. The use of films that are coordinated for illustrating the relationship of pavement condition, capacity and roadside safety problems at one time to administrators would be very helpful in overall roadway improvement and rehabilitation programming.

Potential Modifications

The equipment potential can be improved by the addition of equipment or methods of analyzing longitudinal and transverse profile, computer analysis of the distress types, and the provision for the viewing of individual sections of highway by the user. Longitudinal profile is a must for most all pavement management systems to respond to the users. PAVEDEX does not currently have this capability, but is negotiating for the addition of such equipment to the test unit.

Transverse profile or rut depth measurement is essential for distress measurement of asphalt pavement surfaces. It is not present on the test unit. PAVEDEX is in the process of developing a method that utilizes two cameras and overlapping photos to identify surface relief or profile for this purpose.

The analysis system used in this test employed the use of two computer monitors and a trained observer to determine the type and amounts of each distress present. To remove the subjectivity in this process, the computer algorithms are being developed to identify and quantify the common distress types by use of the computer by the PAVEDEX Corporation.

The Iowa DOT uses photolog film for many demonstrations and decisions involving pavement rehabilitation and design. Such film is used at all levels of the agency for decision support material. It is imperative that the user can identify where they are on the PAVEDEX film and relate pavement surface conditions to the roadside environment around the pavement. The current PAVEDEX system allows this to happen only through the use of a special decoder. Consideration by PAVEDEX should be given to this enhancement to meet the needs of Iowa DOT and other state highway agencies and local government units.

Accuracy of Measurements

The capabilities of the camera allow it to view a 0.15-inch (approximately 1/8-inch) crack in the transverse direction and 0.09 inch (less than 1/8 inch) in the longitudinal direction. This is based on the 512 x 512 pixel area of camera view that covers an area of 6-feet 6-inches transversely and 4-feet longitudinally with each frame. The capability is diminished somewhat by the fact that the VHS recorder limitation of 400 lines per frame cannot capture all that the camera sees. We would be correct in saying that the system can identify 1/4-inch cracks in any direction under ideal lighting, and analysis procedures can identify and quantify 1/8-inch cracks. The 1/4-1/8 inch cracks provide a threshold value that can be used by designers and maintenance personnel to plan and design crack rehabilitation.

The system is not designed to measure the 1/32-inch crack usually identified as a hairline crack in "D" crack susceptible pavements. Other algorithms will be required to determine the presence of "D" cracking in its early stages.

PAVEDEX Applications in Iowa

PAVEDEX information and the system can be employed best at the network level for both the DOT and local units of government. It provides objective crack and patch measurements for analysis of haul roads, detours, and pavement rehabilitation projects for all highway decision makers. It reduces manpower needs in the pavement evaluation area while increasing the objectivity and repeatability of such information.

Information taken by this unit at proper speeds can provide project level measurement of distress types and amounts for rehabilitation contract quantities. Data collected in conjunction with the forward looking camera, can provide complete pavement environment information for safety and capacity considerations in the programming process.

6. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The PAVEDEX system is capable of collecting pavement condition data at highway speeds on various types of surfaces. Its current trained observer analysis is a limitation on the system. The addition of a smart computer that can be programmed to user distress selection criteria will complete the user needs. It can be currently used successfully on rigid pavements with only minor analysis modifications to account for Iowa transverse grooving texturing. Prior training by the observer and selection of flexible pavement distress measures could very well bring the results into acceptable ranges for use by the Iowa DOT.

Recommendations and Potential Uses

The equipment evaluated can be used on Iowa highways to evaluate network level pavement condition. It is limited by the training of the distress observer in Iowa distress criteria and in how to evaluate some of the rigid and flexible surface textures. The current cost of data collection and analysis makes the equipment useful only in urban, high traffic, multilane areas where pavement surveys are expensive and dangerous to the surveyors. The PAVEDEX system would be useful in the area of pavement condition and photolog data collection during daylight hours. It could be used currently in the analysis of before and after haul road and detour analysis without disruption of traffic during the survey.

7. BIBLIOGRAPHY

Davis, John C. Statistics and Data Analysis in Geology. John Wiley & Sons, New York, 1973.

Highway Research Board. "The AASHO Road Test," Special Report 73, Proceedings of a Conference held May 16-18, 1962, St. Louis, Mo.

Iowa Department of Transportation. "Method of Determining Longitudinal Profile Value by Means of the CHLOE Profilometer," Feb. 1971.

Iowa Department of Transportation. "Method for Determining Present Serviceability Index," Dec. 1981.

Iowa Department of Transportation, Highway Division, Office of Materials. "Method of Determining Longitudinal Profile Value Using IJK Ride Indicator," March 1976.

Potter, Charles J. "PSI analysis for FHWA PASCO Study," Iowa Department of Transportation, Ames, Iowa July 1986.

U.S. Department of Transportation, Federal Highway Administration, Iowa Department of Transportation, "Demonstration Projects No. 72, Automated Pavement Data Collection Equipment, Iowa DOT Evaluation of the PASCO Road Survey System," FHWA-DP-72-2, April 1987.

APPENDIX A: DESCRIPTION OF IOWA DOT SYSTEMS

Test Method No. Iowa 1001-A
May 1970

IOWA STATE HIGHWAY COMMISSION

Materials Department

METHOD OF TEST FOR B.P.R. TYPE ROAD ROUGHNESS MEASUREMENT

Scope

The road roughness indicated by this method is a comparative index expressed as inches of roughness per mile of driving lame tested.

The surface test provides a measure at 20 miles per hour with summation of one way movement of standard towed trailer built in accordance to plans originally drawn by the Bureau of Public Roads Administration in 1941, and revised at various later dates.

Procedure

A. Apparatus

1. Towing vehicle with accurate tachometer for speed control.
2. Roughometer trailer consisting of a frame, integrator, and a standard 6.70-15" automobile tire.
3. Electrical components.
   a. Revolution counters in towing unit.
   b. Integral counter on vertical movement.
   c. Duplicate sets of counters with switch over to change counters for recording facilities without stopping, and a master switch.
4. Signs and rotating beacons on trailing vehicles in accordance with Traffic and Safety minimum requirements.

B. Test Record Forms

1. Use work sheet labeled, Road Roughness Measurement, Field Work Sheet, for recording field measurements.
2. For Laboratory final report, the form is labeled Road Roughness Report.

C. Test Procedure

1. Stop and remove trailer wheels from single wheel roughometer.
2. Engage wheel revolution counter and integrating roughness counter.
3. Check the damping fluid level in the damping pots, and add if needed.
4. The entire unit must be warmed up prior to testing a pavement section for roughness. Check tire inflation (27 p.s.i.) before and after warm-up period. The warm-up period consists of towing the unit at a speed of 30 mph. for a distance of approximately 10 miles with the counters turned on for the last two miles. A longer period is required during cool weather.
5. Set the roughometer counters and wheel revolution counters to zero ready for a start on test section, with the vehicle far enough from the beginning of the section to safely accelerate the vehicle to a constant 20 mph. speed, before reaching the test section. Maintain this speed for all tests.
6. Turn on the master switch at the beginning of the test section. Omit bridges and railroad tracks during the actual test run, by switching the master switch off and on at the proper times.
7. During the run through the project, the predetermined sections within the project are checked by the recorder, switching from one set of counters to another, when the revolution counter shows the proper interval. The usual normal section length is predetermined by the following rule:

No. of Miles In Project	No. of Revolutions in Sections (*)	Appropriate Chosen Interval (Mi.)
Less than 2.0	186	1/4
2.0 to 5.0	372	1/2
Greater than 5.0	744	1

* Note: Based on present calibrated rate of test tire revolutions per measured mile with 27 p.s.i. tire pressure.

The above rule is followed unless a special request is made to have the reading units changed on a certain project, or by the recorder noticing an exceptionally rough section that he wishes to isolate in the notes, or report as a special section. Keep the units in each two lane roadway identical as to stationing from beginning to end of section.

D. Reporting Results

1. The field work sheet provides places to note the project number, contractor, actual number of miles in project, weather conditions, description of location and the tested section itself, Testing personnel are reported along with visiting personnel riding as observers. Starting locations are recorded with readings and section lengths. The remarks column is used to help describe any special events, conditions, etc.

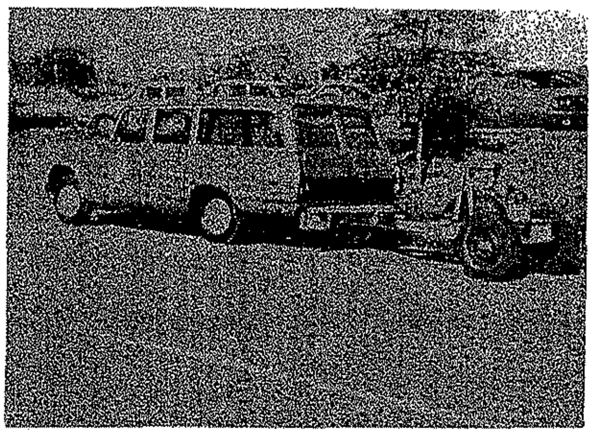


Fig. 1
Roughometer in Towing Position

E. Normal Check Calibrations

1. Each year all the bearings on the trailer unit including spring bearings are to be cleaned, checked regreased and renewed as required. The tire is also to be checked for roundness to .010" maximum variation. The center of percussion is checked on unit, and adjusted by changing balance weights on frame if necessary.

2. Before each week of operation, a check over standard measured courses is made to determine if counters, integrators and dash pots are performing properly. If at any time during the weeks work the operator feels that the results are not correct, an extra check may be made.

F. Precautions

1. The Resident or County Engineer must be notified before arriving on his project for testing, so that he may have the work readied for testing, and to arrange for any observers to accompany the testing crew.

2. Temperatures below freezing may affect the integrator by reducing its sensitivity to slip and grab in its check of slight movements.

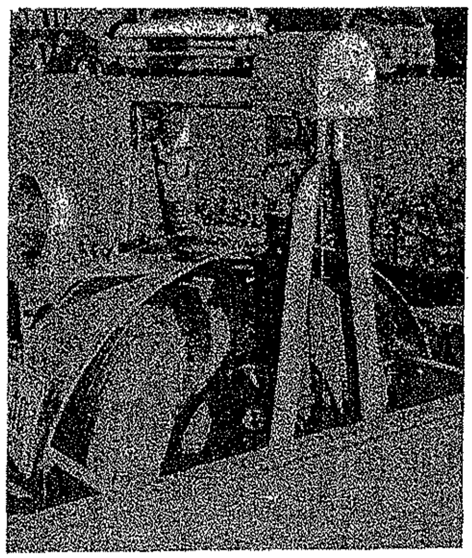


Fig. 2
Close-up of Roughometer

Test Method No. Iowa 1002-B
March 1976

IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

Office of Materials

METHOD OF DETERMINATION OF LONGITUDINAL PROFILE VALUE USING THE IJK RIDE INDICATOR

Scope

This testing method is used to determine the Longitudinal Profile Value (LPV) using the IJK Ride Indicator. The Longitudinal Profile Value is used to determine the Present Serviceability Index (P.S.I.), a concept developed by the American Association of State Highway Officials (AASHO) Road Test. It (P.S.I.) is used as an indicator of the ability of a pavement to serve the traveling public and as an objective method of highway evaluation.

The IJK (Iowa-Johannsen-Kirk) Ride Indicator was developed by the Iowa Department of Transportation Materials Laboratory.

Procedure

A. Apparatus

1. IJK Ride Indicator (An electro-mechanical device mounted on the differential of a standard automobile)(Fig. 1 to 4).
2. Tire pressure gauge.
3. Portable calculator.

B. Test Record Forms and Section Identification

1. Longitudinal Profile Value Worksheet (Form 921).
2. Final Report (Forms 915 or 922).
3. "Test Sections by Milepost" booklet.
4. Correlation Table (Longitudinal Profile Value vs. Sum/Length for testing unit).

C. Personnel

1. Two personnel are required. One is assigned to drive while the other operates the counters and makes calculations.

D. Correlation

1. The Longitudinal Profile Value is derived from equations of the AASHO Road Test using a correlation between the CHLOE Profilometer and the IJK Ride Indicator. The CHLOE is used as a correlation standard because it is not affected by possible changes in suspension but primarily is dependent only on proper electrical operation. The relationship between the CHLOE and the IJK Ride Indicator is determined through a computer program by the least square parabolic method ($Y=CX^2+MX+B$).

E. Test Procedure

1. Drive the test vehicle at least 10 miles before beginning testing.
2. Operate the vehicle in a careful, legal, conscientious manner.
3. Be sure the IJK unit is accurately zeroed before mounting on the vehicle.
4. Be sure the dampening fluid level is correct. This should be checked weekly during continuous operation.
5. During continuous testing, the unit should be tested on eight conveniently close correlation sections weekly to verify proper operation.
6. When ready to begin testing, disengage the IJK arm lock.
7. Start the test vehicle far enough from the beginning of the test section to insure adequate distance for acceleration to the standard test speed of 50 MPH. Turn the main switch to the "ON" position as the rear wheels pass the start of the test section. It is turned off in the same position at the end of the section.

8. Turn the main switch off while crossing railroad tracks and bridges (including approaches). This length and roughness counts are electrically omitted.

9. There is a rotary switch to change from one bank of recording counters to the other so testing can be continuous.

10. Record the counter values and calculate the Sum/L.

11. If there is some reason to indicate possible erroneous data a repeat run should be made. Valid runs are expected to check within 10% of each other.

12. Using the Sum/L, obtain the proper Longitudinal Profile Value from the table to the closest 0.05 (3.95, 4.15 etc.).

F. Precautions

1. Maintain the tire pressure at 25 psi cold, 28 psi, warm. If any tire alignment or balancing problems are noted, have them corrected.

2. Be sure to engage the IJK arm lock when not testing.

3. Keep the vehicle in a neat orderly condition.

4. Have the automobile serviced at the proper interval.

G. Calculations for Longitudinal Profile Value

1. Enter the necessary descriptive data in the heading portion of the LPV worksheet. The method of calculation is as follows: the summation of counts from counter no. 1 x 1, counter no. 2 x 2, counter no. 3 x 3, etc. These products are totaled and divided by the tested length (in miles) to obtain the Sum/L. This sum/length is then used to find the Longitudinal Profile Value from the correlation table.

H. Reporting Results

1. The final report for all testing uses the same data that was necessary for the worksheet. Form 915 is used for county inventory testing and Form 922 is used for testing individual projects. A deduction for cracking, patching and rut depth is used (from the most recent survey) to yield a Present Serviceability Index.

Fig. 1

The IJK Ride Indicator Vehicle

Fig. 2

The IJK Ride Indicator Control Console, showing Visual Indicators, Switches and Electrical Counters on the floor of the automobile.

Fig. 3

The IJK Ride Indicator Sensing Unit

Fig. 4

The IJK Ride Indicator Sensing Unit with Cover as Mounted on the Rear Differential Housing of the Vehicle

CORRELATION TABLE
IJK RIDE INDICATOR UNIT E
JULY 1975

	SUM/LENGTH			SUM/LENGTH			SUM/LENGTH	
LPV	AC	PC	LPV	AC	PC	LPV	AC	PC
0.000	18770	29735	2.000	4449	7023	4.000	502	985
0.025	18462	29233	2.025	4360	6886	4.025	481	952
0.050	18159	28790	2.050	4272	6750	4.050	460	920
0.075	17860	28304	2.075	4185	6617	4.075	440	889
0.100	17566	27825	2.100	4100	6486	4.100	420	858
0.125	17276	27355	2.125	4016	6357	4.125	401	828
0.150	16991	26891	2.150	3933	6231	4.150	382	799
0.175	16710	26435	2.175	3852	6106	4.175	364	770
0.200	16433	25987	2.200	3772	5984	4.200	346	742
0.225	16160	25545	2.225	3693	5863	4.225	328	715
0.250	15892	25111	2.250	3615	5744	4.250	311	688
0.275	15628	24684	2.275	3539	5628	4.275	294	661
0.300	15367	24263	2.300	3464	5513	4.300	277	635
0.325	15110	23849	2.325	3391	5400	4.325	261	610
0.350	14858	23441	2.350	3318	5290	4.350	245	585
0.375	14609	23041	2.375	3247	5181	4.375	230	561
0.400	14364	22646	2.400	3176	5073	4.400	215	538
0.425	14122	22258	2.425	3107	4968	4.425	200	515
0.450	13885	21876	2.450	3039	4864	4.450	186	492
0.475	13650	21500	2.475	2973	4762	4.475	172	470
0.500	13420	21130	2.500	2907	4662	4.500	158	448
0.525	13193	20766	2.525	2842	4563	4.525	145	427
0.550	12969	20407	2.550	2779	4467	4.550	132	407
0.575	12749	20055	2.575	2716	4371	4.575	119	387
0.600	12532	19708	2.600	2655	4278	4.600	107	367
0.625	12318	19366	2.625	2594	4186	4.625	94	348
0.650	12107	19030	2.650	2535	4095	4.650	83	329
0.675	11900	18700	2.675	2477	4006	4.675	71	311
0.700	11696	18374	2.700	2419	3919	4.700	60	293
0.725	11495	18054	2.725	2363	3833	4.725	49	275
0.750	11297	17739	2.750	2307	3748	4.750	38	258
0.775	11102	17429	2.775	2253	3665	4.775	27	242
0.800	10910	17124	2.800	2199	3583	4.800	17	225
0.825	10721	16824	2.825	2146	3503	4.825	7	210
0.850	10534	16529	2.850	2095	3424	4.850	1	194
0.875	10351	16238	2.875	2044	3347	4.875		179
0.900	10170	15952	2.900	1994	3270	4.900		164
0.925	9992	15670	2.925	1944	3196	4.925		150
0.950	9817	15393	2.950	1896	3122	4.950		136
0.975	9645	15121	2.975	1849	3050	4.975		122
1.000	9475	14853	3.000	1802	2979	5.000		109
1.025	9308	14589	3.025	1756	2909	5.025		96
1.050	9143	14329	3.050	1711	2840	5.050		84
1.075	8981	14074	3.075	1667	2773	5.075		71
1.100	8821	13822	3.100	1624	2707	5.100		59
1.125	8663	13575	3.125	1581	2642	5.125		48
1.150	8509	13332	3.150	1539	2578	5.150		36
1.175	8356	13092	3.175	1498	2515	5.175		25
1.200	8206	12856	3.200	1458	2454	5.200		14
1.225	8058	12625	3.225	1418	2393	5.225		4
1.250	7912	12396	3.250	1379	2334			
1.275	7769	12172	3.275	1341	2275			
1.300	7628	11951	3.300	1303	2218			
1.325	7489	11734	3.325	1267	2162			
1.350	7352	11520	3.350	1231	2107			
1.375	7217	11309	3.375	1195	2052			
1.400	7084	11102	3.400	1160	1999			
1.425	6953	10899	3.425	1126	1947			
1.450	6825	10698	3.450	1093	1896			
1.475	6698	10501	3.475	1060	1845			
1.500	6573	10307	3.500	1028	1796			
1.525	6451	10116	3.525	996	1748			
1.550	6330	9928	3.550	965	1700			
1.575	6211	9744	3.575	935	1653			
1.600	6094	9562	3.600	905	1608			
1.625	5978	9383	3.625	876	1563			
1.650	5865	9207	3.650	847	1519			
1.675	5753	9034	3.675	819	1475			
1.700	5643	8863	3.700	791	1433			
1.725	5534	8696	3.725	764	1391			
1.750	5428	8531	3.750	738	1351			
1.775	5323	8369	3.775	712	1311			
1.800	5220	8209	3.800	687	1272			
1.825	5118	8052	3.825	662	1233			
1.850	5018	7898	3.850	637	1196			
1.875	4919	7746	3.875	614	1159			
1.900	4822	7597	3.900	590	1123			
1.925	4727	7450	3.925	567	1087			
1.950	4633	7305	3.950	545	1052			
1.975	4540	7163	3.975	523	1018			

Form 921 Test Method No. Iowa 1002-B

Page 6 March 1976

IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OFFICE OF MATERIALS

Unit E Worksheet

Road No. I-35 County Story Lab. No.
Year Built Date Tested 7-29-69 Date Reported
Contractor Hallett Construction Company Project No. I-IG-35-4/12/1
Location From Polk Co. line to Jct. New US 30

Weather Clear Wind NE 5-8 mph Temp. 71° F.
Speed 50 mph Test Personnel Dalbey & Robinson Surface P.C.

S.T. P.C. D. 0-NB			S.T. D. 0-SB		
EMP	13.87		EMP	24.17	
BMP	3.95		BMP	14.20	
Length	9.92		Length	9.97	
1	4031	4031	1	4075	4075
2	1794	3588	2	1740	3480
3	412	1236	3	403	1209
4	91	364	4	132	528
5	25	125	5	60	300
6	6	36	6	27	162
7	1	7	7	12	84
8	—	—	8	4	32
9	—	—	9	1	9
10	—	—	10	—	—
Sum		9387	Sum		9879
Sum/L		946	Sum/L		990
LPV		4.65	LPV		4.66

C.S. S.T. D.		C.S. S.T. D.	
End		End	
Start		Start	
Length		Length	
Deduct		Deduct	
Length		Length	
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
Sum		Sum	
Sum/L		Sum/L	
RMRV		RMRV	

Notes

S.T = Surface Type D = Direction

IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OFFICE OF MATERIALS

Road Meter
County
J. McCaskey
V.R. Snyder (2)

1976 Present Serviceability Index Summary for Jones County (53)

Date Reported 3-16-76 Lab. No. LV6-44 to 57

Lab. No. LV-	Beginning Milepost	Ending Milepost	Road No.	Length (Miles)	Surface Type	Dir. & Lane	Longitudinal Profile Value of March 1976	Winter 75-76 Ded. for Cracking Patching	Present Serviceability Index
44	20.77	22.24	US 151	1.47	AC	EB	3.70	.05	3.65
						WB	3.70	.05	3.65
45	22.24	27.34	US 151	5.10	AC	EB	3.65	.10	3.55
						WB	3.65	.10	3.55
46	27.34	37.61	US 151	(5.58)	AC	EB	3.55	.05	3.50
						WB	3.60	.05	3.55
				(4.26)	PC	EB	3.30	.15	3.15
						WB	3.50	.15	3.35
47	38.69	48.07	US 151	(6.68)	AC	EB	3.55	.05	3.50
						WB	3.55	.05	3.50
				(2.52)	PC	EB	3.35	.10	3.25
						WB	3.25	.10	3.15
48	0.00	21.22	IA 64	(14.47)	AC	EB	3.15	.00	3.15
						WB	3.20	.00	3.20
				(5.16)	PC	EB	3.25	.70	2.55
						WB	3.25	.70	2.55
49	115.78	119.25	IA 1	3.47	AC	NB	3.05	.35	2.70
						SB	3.10	.35	2.75
50	39.10	42.44	IA 38	3.34	AC	NB	4.00	.00	4.00
						SB	3.95	.00	3.95
51	43.45	47.81	IA 38	4.36	AC	NB	3.55	.10	3.45
						SB	3.50	.10	3.40
52	50.01	53.39	IA 38	3.38	AC	NB	3.55	.00	3.55
						SB	3.55	.00	3.55
53	53.39	63.50	IA 38	10.11	AC	NB	4.00	.00	4.00
						SB	4.00	.00	4.00
54	65.11	68.41	IA 38	3.30	PC	NB	4.05	.00	4.05
						SB	4.05	.00	4.05
55	43.16	53.42	IA 136	10.26	AC	NB	3.85	.00	3.85
						SB	3.85	.00	3.85
56	54.79	58.39	IA 136	3.60	AC	NB	3.75	.05	3.70
						SB	3.80	.05	3.75
57	58.39	72.04	IA 136	13.65	AC	NB	3.90	.00	3.90
						SB	3.95	.00	3.95

Deductions for cracking and patching were calculated on a 2 lane roadway basis.

(Length) indicates tested length on an AC/PC section.

IOWA DEPARTMENT OF TRANSPORTATION

HIGHWAY DIVISION

OFFICE OF MATERIALS

LPV REPORT

Road No. I-35 County Story Lab Rep. No. LV-9-522

Year Built 1965 Date Tested 7-29-69 Date Reported 8-15-69

Contractor Hallett Construction Company Project No. I-IG-35-4/12/103

Project Length (Miles) 10.03 Surface Type PC

Location From Polk County line north to Junction New US 30

Weather Clear Wind NE 5-8 mph Temperature 71°

Test Personnel, Dalbey and Robinson

	N Outside Bound Lane	S Outside Bound Lane
Length Tested	9.97	10.02
Longitudinal Profile Value	4.05	4.00
Average Longitudinal Profile Value		4.05
Deducation for Cracking, Patching and Rut Depth		0.05
Present Serviceability Index		4.00

Test Method No. Iowa 1003-A
February 1971

IOWA STATE HIGHWAY COMMISSION

Materials Department

METHOD OF DETERMINATION OF LONGITUDINAL PROFILE VALUE BY MEANS OF THE CHLOE PROFILOMETER

Scope

This method is used to determine the Longitudinal Profile Value (LPV) of pavement by the CHLOE Profilometer. The test is conducted at 5 mph, while obtaining the summation of a value $Y_{(i)}$ which can be related to the slope of the pavement and that of the square of $Y_{(i)}$, where $i = 1,2,3 \cdots N$, and N is the total number of points at 6-inch intervals. The values of N, Yi, and Yi^2, are used to determine the CHLOE Slope Variance (CSV), Road Test System Slope Variance (SV), and the Longitudinal Profile Value (LPV).

Procedure

A. Apparatus

1. CHLOE Profilometer

   a. Electronic Computer Indicator (Fig. 1).

   b. CHLOE trailer section (Fig. 2).

2. Towing and transporting vehicle.

3. Safety support vehicles as needed to insure safe operation.

B. Test Record Form

Use work sheet "LPV for PC or AC Pavement" for recording field measurements.

C. General Procedure

1. Calibration Procedure

   a. Attach the CHLOE trailer section to the towing vehicle.

   b. The roller contact, switch plate, and electronic computer indicator should be checked before beginning the road test. Anytime the data appears to be in error a check should be made and if an error is verified the malfunction should be corrected. The procedure for checking is as follows: First turn the electric eye switch at the rear of the trailer section from the road test to the manual position, then with the slope wheels up, the upright arm of the slope wheels is moved forward until the roller contact goes off the switch plate. While turning the calibrating crank, slowly move the upright arm to the rear until the roller contact impinges on the first switch segment. Hold this position and set the electronic computer indicator to zero, then turn the calibrating crank slowly until N = 10. Check to see if the quantities indicated ($\Sigma Y, \Sigma Y^2$) are correct. (Table I gives the values that should be obtained for each segment). If correct, reset the electronic computer indicator to zero, move the upright arm rearward until the number two switch segment is contacted and follow the same procedure used for the first switch segment. Continue this procedure until all 29 switch segments have been checked.

   c. Check to see if the pressure in the CHLOE trailer tires is 45 $\pm$ 0.5 psi.

   d. The position of the trailer hitch should be such that a slope mean ($\Sigma Y \div N$) between 14 and 15 is obtained. To check this, lower the slope wheels, set the electric eye switch to the road test position, and zero the electronic computer indicator. Pull the CHLOE Profilometer ahead until N = 100. The ΣY value should be between 1400 and 1500. If it is not, the trailer tongue should be raised or lowered by turning the crank at the front of the trailer section. Turning the crank counterclockwise lowers the ΣY value and turning it clockwise raises the ΣY value. Repeat the procedure if necessary.

   e. The downward force of the CHLOE slope wheels should be between 150 and 160 lbs. To check this a bathroom scale and two wooden blocks of the same thickness as the scale are needed. Pull the CHLOE carriage wheels onto the wooden blocks, then place the scale under the slope wheels and lower them. If the scale does not read between 150 and 160 lbs., adjustment can be made by turning the 3/16" knurled screw located at the bottom of the connector box fastened to the lift motor. Turning this screw clockwise will decrease the force and turning it counterclockwise will increase the force.

f. For more detailed instructions on the operation of the CHLOE Profilometer see CHLOE Profilometer Operating and Servicing Instructions.

2. Testing Procedure

a. Set the electric eye to "road test" and lower the slope wheels.

b. Set the electronic computer indicator to a zero reading.

c. Turn the counter switch on when the slope wheels reach the beginning of a test section and turn it off at the end of the section.

d. When running a test section, the speed of the towing vehicle should be about 5 mph.

e. Record the values of N, ΣY, and ΣY^2.

f. Compute the LPV as described in "Calculations".

D. Calculations (See "Typical Calculation Example.)

1. Enter the values of N, ΣY, and ΣY^2 on lines 6, 7 and 8 respectively.

2. Divide ΣY by N to an accuracy of one ten-thousandth (0.0001) and enter on line 9.

3. Square this number and record the result to the nearest thousandth (0.001) on line 11.

4. Divide ΣY^2 by N, round the answer to the nearest thousandth, and record it on line 10.

5. Subtract line 11 from line 10 and enter the result on line 12.

6. Multiply line 12 by 8.46 to obtain the CHLOE Slope Variance (line 13).

7. Subtract 2.00 from the CHLOE Slope Variance and place the result on line 14.

8. Find the log of line 14, record it on line 15.

9. Multiply line 15 by 1.80 if the surface type is PC or 1.91 if AC, and record this result on line 17.

10. On line 16 enter 5.41 if the surface type is PC or 5.03 if the surface type is AC.

11. Subtract line 17 from line 16 to obtain the Longitudinal Profile Value (LPV) of the test section.

Precautions

A. The voltage supply to the CHLOE Profilometer from the batteries must not be less than 11.5 V.

B. The operator must watch the electronic computer indicator closely to insure that it is working properly.

Reporting of Results

Enter state, county, route no., location, project, weather, date and test personnel in the appropriate places on the work sheet.

The LPV determined by the CHLOE Profilometer may be used along with other factors to calculate a Present Serviceability Index as described in "Method of Determination of Present Serviceability Index". (Test Method No. Iowa 1004.)

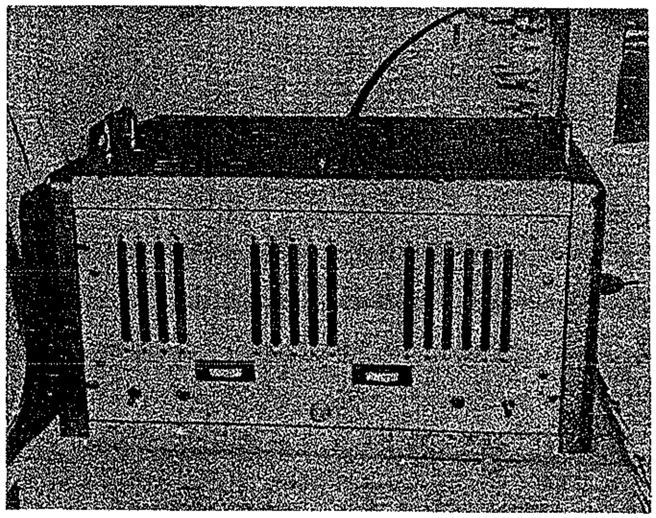


Fig. 1
Electronic Computer Indicator

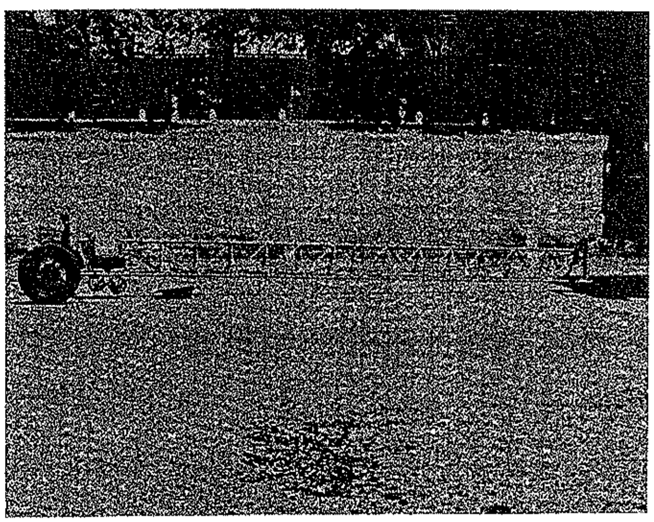


Fig. 2
CHLOE Trailer Section

TABLE I

Switch Segment	N=10 Y	Y^2
1	10	10
2	20	40
3	30	90
4	40	160
5	50	250
6	60	360
7	70	490
8	80	640
9	90	810
10	100	1,000
11	110	1,210
12	120	1,440
13	130	1,690
14	140	1,960
15	150	2,250
16	160	2,560
17	170	2,890
18	180	3,240
19	190	3,610
20	200	4,000
21	210	4,410
22	220	4,840
23	230	5,290
24	240	5,760
25	250	6,250
26	260	6,760
27	270	7,290
28	280	7,840
29	290	8,410

TYPICAL CALCULATION EXAMPLE
LPV for PC or AC Pavement

State Iowa — Location E. of Ames — Date 4-16-70

County Story — Project ____ — Test Personnel ____

Route No. 13th Street — Weather ____

1	Section No.	10									
2	Location	1648-1673									
3	Surface Type	PC									
4	Direction	EB									
5	Wheelpath	0									
6	No. of readings (N)	4951									
7	ΣY	71733									
8	ΣY^2	1044724									
9	$(\Sigma Y/N)$	14.4886									
10	$\Sigma Y^2/N$	211.013									
11	$(\Sigma Y/N)^2$	209.920									
12	(line 10 - line 11)	1.093									
13	CSV = (line 12) x 8.46	9.247									
14	(1 + SV) = (line 13 - 2)*	7.247									
15	Log (1 + SV) = Log (line 14)	0.8596									
16	Enter 5.41 for PC, or 5.03 for AC	5.41									
17	If PC 1.80 x line 15 If AC 1.91 x line 15	1.55									
18	LPV = (line 16 - line 17)	3.86									

* SV = CSV - 3

LPV(PC) = 5.41 - 1.80 Log (1+SV)

LPV(AC) = 5.03 - 1.91 Log (1+SV)

Test Method No. Iowa 1004-C
December 1981

IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

Office of Materials

METHOD OF DETERMINATION OF PRESENT SERVICEABILITY INDEX

General Scope

The Present Serviceability Index (PSI) was developed by the AASHO 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 AASHO 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 Bureau of Public Roads has a similar scale with the following designations which are more realistic in the evaluation of new pavements:

PSI	Rating
Above 4.5	Outstanding
4.5 - 4.1	Excellent
4.1 - 3.7	Good
3.7 - 3.3	Fair
Below 3.3	Poor

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 three methods for determination of the longitudinal profile value:

1. CHLOE Profilometer
2. BPR Type Road Roughometer
3. IJK Type Road Meter

Test Procedure:

1. The determination of longitudinal profile value by the CHLOE Profilometer is described in Test Method No. Iowa 1003-A.

2. The determination of road roughness by the BPR Type Roughometer is described in Test Method No. Iowa 1001-A. The inches per mile as described therein is then used in conjunction with the most current correlation of road roughness (inches/mile) vs. longitudinal profile value (LPV) determined by the CHLOE Profilometer to obtain a longitudinal profile value.

3. The determination of the road meter roughness value, which is the same as the Longitudinal Profile Value, by the IJK Type Road Meter, is described in Test Method No. Iowa 1002-B.

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 AASHO 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.

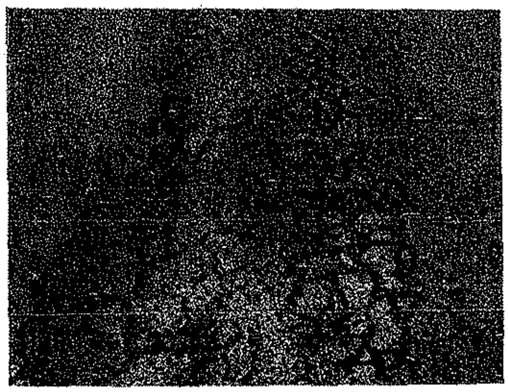


Figure 1.

Alligator cracking

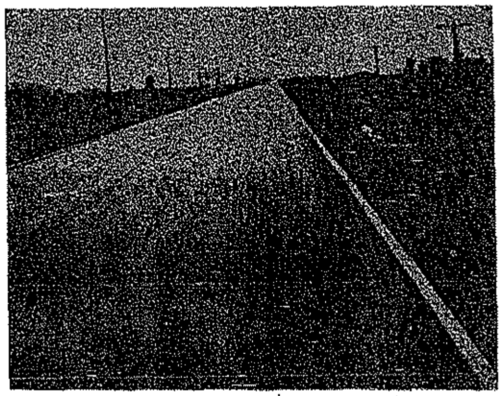


Figure 2.

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 excede 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.

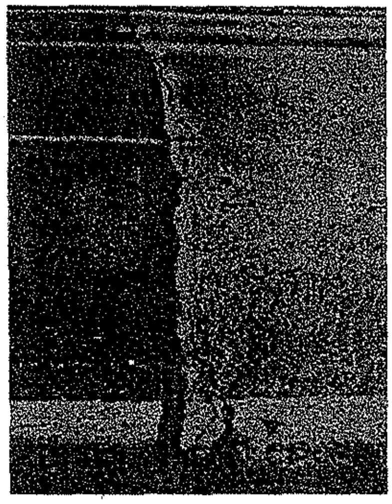


Figure 3.

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, 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 occurrence of D-cracking in the check sections will be rated on a point scale as described in the Test Procedure section.

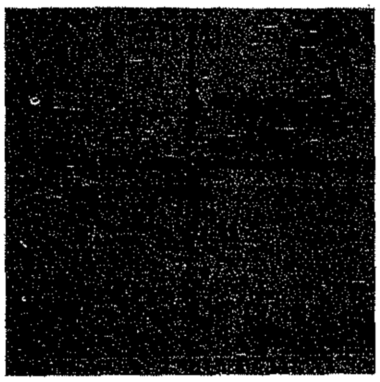


Figure 4.

D-cracking - Initial stages

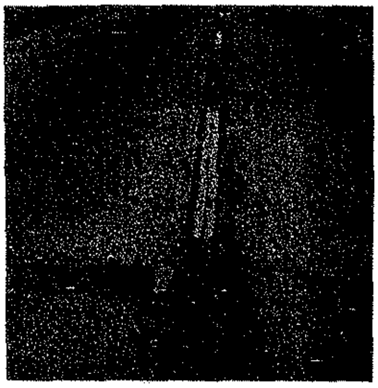


Figure 5.

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

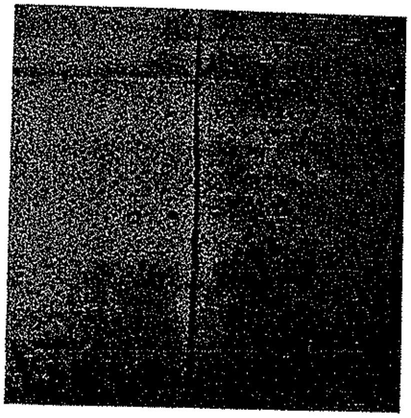
1 = D-cracking is evident at some joints especially the interior corners. Pavement is sound condition and no maintenance is required due to D-cracks.

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.

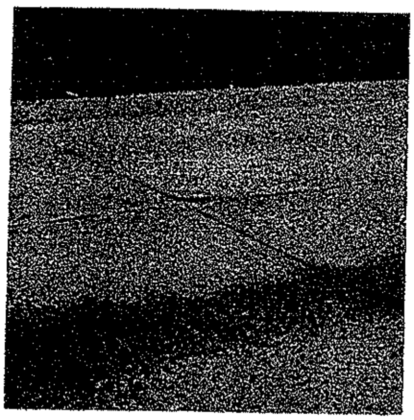
3 = D-cracking is evident at virtually all joints and random cracks. Minor raveling and spalling are occurring and traffic is causing some loosening of cracked pavement. Some minor maintenance of spalled areas is required.

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

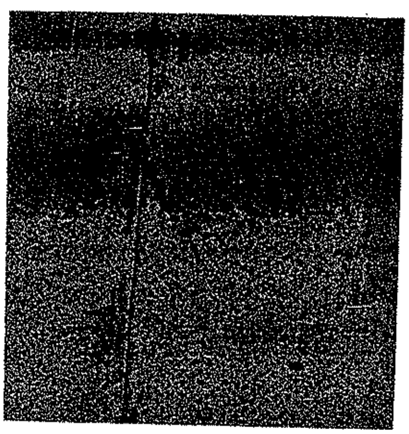
5 = D-cracking has continued to progress at sites identified in 3 above and requires regular maintenance patching. Full depth patches may be necessary. Ride quality has deteriorated to point where reduced driving speed is necessary for comfort and safety.



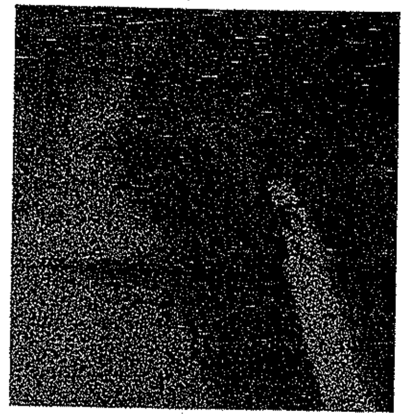
DOF = 0



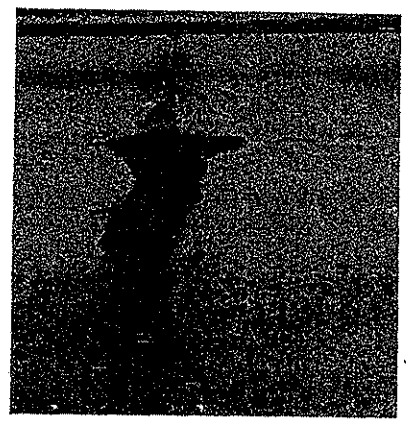
DOF = 1



DOF = 2



DOF = 3



DOF = 4

DOF = 5

Figure 6. Examples of D-crack Occurrence 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. RMRV or 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.

WB Lincolnway & Duff to Lincolnway + Grand

CRACK AND PATCH SURVEY REPORT SHEET (P C.)

Co No 85 · Hwy Sys U (I-Interstate U-U.S. S-Iowa C-County) · Route 0030

Beg Mp 114.90 · End Mp 116.90

Beg Mp of 1/2 Mi Test 115.455 · End Mp of 1/2 Mi Test 115.955

1 · Date 072186 · Width 24

Survey Conducted By Chaoliang

Total No of Cracks 0071
(1/4 wide over 1/2 crack length or sealed)

Total No of Half Cracks 0049

Total Sq Ft of Patched Area (Full Depth or Surface) 06602
2292
(138x24)+(24x45)+48+10+60+60+7.
(12x24)+48+60+3+10+36+10+100
60+12+21+400+48+8+48+36+36
12+140+144+12+232+144+36+10

D - Cracking Occurrence Factor (0 to 5) 2

2 · FAULTING AND RUT DEPTH (10 Locations 0.05 Miles Apart)

(Driving Lane For 4 Lane Highways)

1 Ft From Edge	.12	0.00	0.02	0.07	0.05	0.13	0.55	0.32	0.42	0.15
OWT	0.06									0.00
Inside W B										
IWT	0.14									0.02

(Passing Lane For 4 Lane Highways)

IWT	0.00									0.00
Inside W B										
OWT	0.10									0.00
1 Ft From Edge	0.20	0.00	0.03	0.30	0.00	0.09	0.32	0.08	0.38	0.

Shoulder Width N/E 90 (Driving Lane) · S/W 00 (Passing Lane)

3 · Remarks

APPENDIX B: DESCRIPTION OF PAVEDEX SYSTEMS OPERATION

OPERATION OF THE PAVEDEX PAS I SYSTEM

Data Acquisition

A one-half ton commercial van, with heavy duty (100 amp) alternator and auxiliary air conditioner is utilized as a basic vehicle. A 1-KW invertor in the van is the power supply.

There are four NEC CCD cameras mounted on the van: two in front focused at the road at a 20 degree angle from the vertical; and two in the rear, mounted at a 15 degree angle from the vertical. One pair of cameras is operated at any given time, through the use of video switcher controls inside the van, to provide images with the optimum lighting conditions.

The cameras provide images of 512 pixels by 512 pixels covering an area 6 feet 6 inches by 4 feet. A 6-inch overlap is obtained in the transverse direction. The cameras are synchronized with the speed of the vehicle to allow videotaping at speeds up to 55 mph and produce very clear frames of video distress with resolutions below 1/8 inch. The camera shutter speed is set at 1/1000 of a second producing 30 frames per second. The resolution is limited currently by the 400 lines of resolution obtained in the two super VHS Panasonic recorders in the van that provide two hours of 1/2-inch tape storage.

An encoder, mounted in the van, receives the signal from an optical odometer (with 1-inch resolution) every 30 milliseconds which is transmitted to each frame. The time, date, codes road segment number, the location in feet (to the nearest foot) from the beginning of a designated road segment and the frame count are encoded on each frame.

An additional color videocamera is mounted on top of the van and focused on the roadway and surroundings ahead of the vehicle showing a "perspective view" suitable for taking inventories of road signs, traffic lights, curbs etc. and monitoring conditions along the road such as vegetation growth. A third VCR records this camera and the same information is input to each frame as on the pavement oriented cameras. A schematic diagram of the survey van and equipment is shown in Figure 12.

<u>Image Processing</u>

Computer controlled VCR's are utilized incorporating an inverted RS232 interface with a time base corrector conditioning the signals. A decoder converts the encoded data enabling the computer to know the time and location of each frame. The computer advances the tape in the VCR to the next frame containing none of the roadway from the previously analyzed and stops. A trained operator observes the pavement distress, if any, on the stopped frame, and inputs the classification, severity and amount of distress, for each distress observed, via keyboard codes. The computer collates all the distress data for each customer-designated road project segment and stores the information for later

Figure 12. Survey Van Operations Flowchart

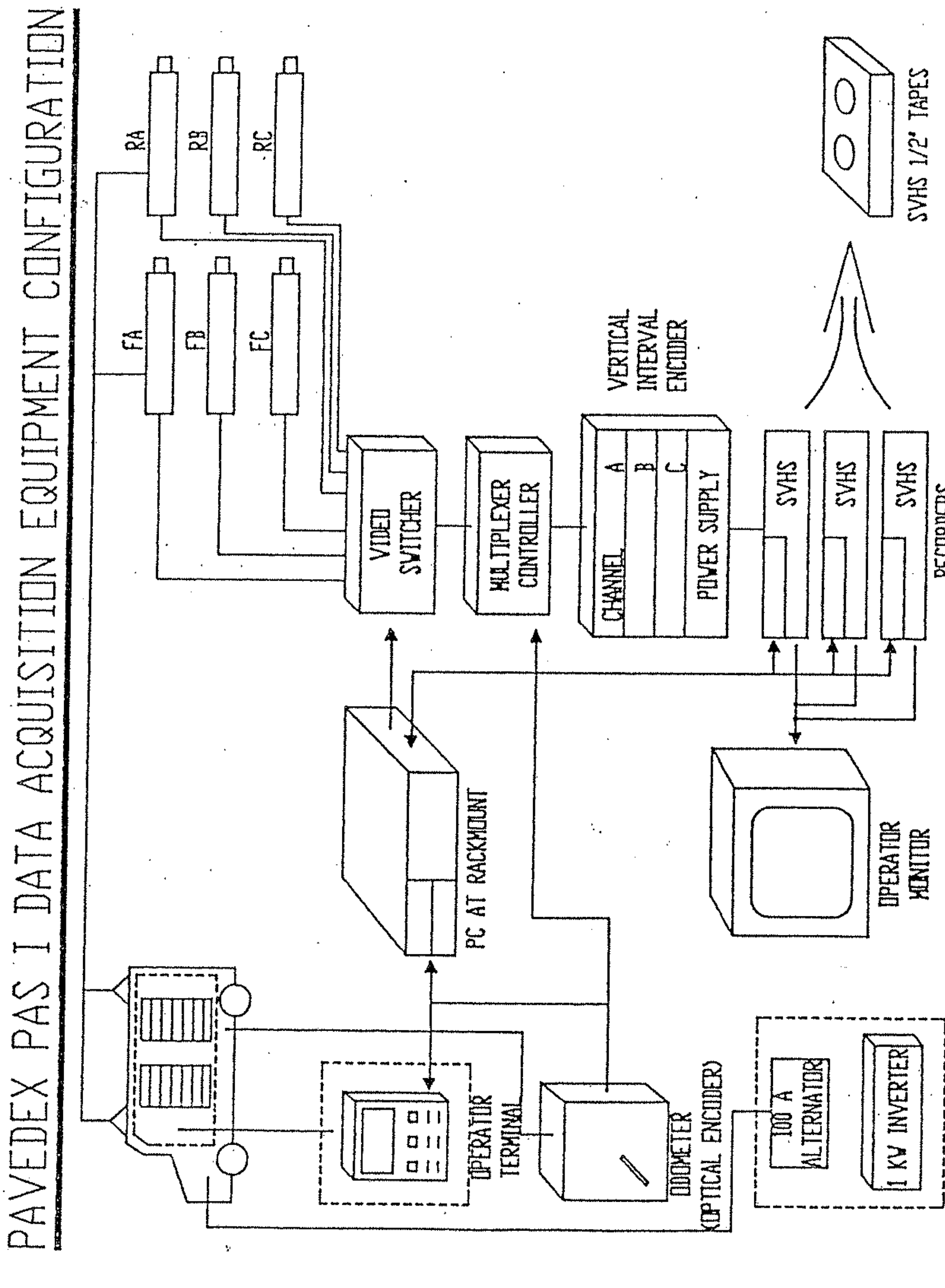
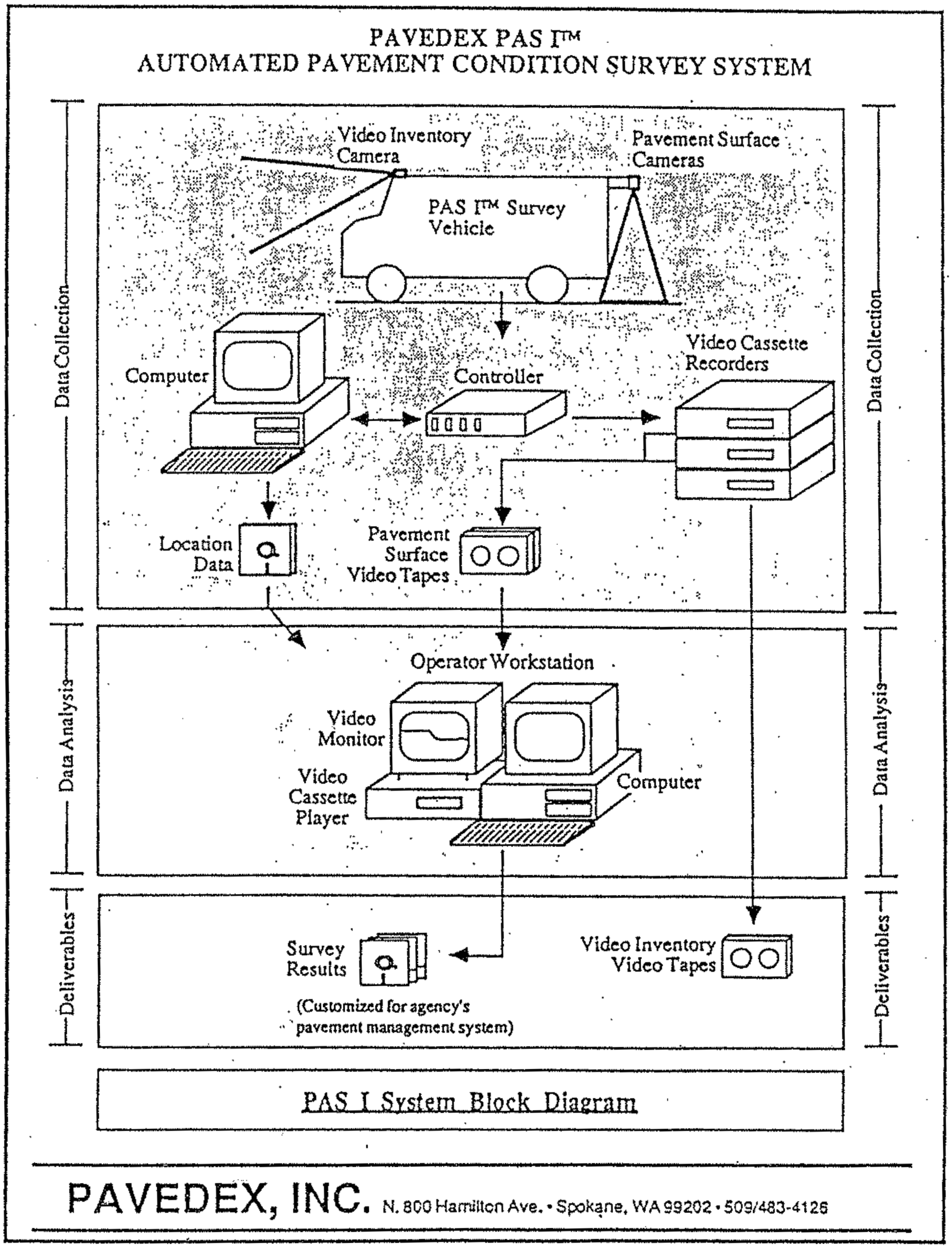


Figure 13. Image Processing Flowchart



printing. The entire process is shown in schematic view in Figure 13.

Computer Image Processing

PAVEDEX has developed proprietary software for automatic computer image processing of video images. Electronic equipment is just now demonstrating the processing speeds required to render automatic processing less expensive than visual processing. PAVEDEX plans to convert entirely to automatic computer image processing during the fourth quarter of 1989 or, at the latest, the first quarter of 1990.

The output of the PAVEDEX system used in Iowa was summarized in a LOTUS spreadsheet. This allowed the manufacturer to group the data from the various runs for each 0.1 mile section of the test pavements. Copies of the spreadsheets are included. Those spreadsheets identifying portland cement concrete pavements contain the following information and headings:

1. Sort # - Reference to the 0.1 mile segment of the pavement tested.

2. Seg - Segment of the tape that refers to the test site.

3. Tape - Number of the video tape containing the data.

4. Seg # - Segment identifying number on the tape that correlates it to a given test section.

5. CC # and % slabs - Corner Cracks. The number of diagonal cracks that meets both a transverse and longitudinal

edge. The percentage of slabs column is number of slabs effected in the 0.1-mile segment, by the distress. The computer will accept any slab length the user inputs. In this case the manufacturer used 5 foot as a pseudo length due to the variation in slabs on the sites.

6. FSC # and % slabs - First and Second Stage Cracks. The number of transverse, longitudinal or diagonal cracks that divide the slab into two or more pieces and the percentage of slabs effected by this type of distress.

7, 8, 9. Spalling # and % slabs - Spalling is defined as the breakdown or disintegration of edge cracks, resulting in the loss of concrete and progressive widening of the cracks. These columns identify the number of occurrences with an indication of the severity (size) of the distress. The mean width for column 1 is less than 1/2 inch, for column 2 it is less than 1 1/2 inches, and for column 3 it is greater than 1 1/2 inches.

10, 11, 12. Patches G F P, Sq.ft. and % area - The G, F, P relates the condition of the patches identified. The area in square feet is a measurement of the patch size and the percentage of area is the patch area divided by the total area of the segment (length in feet by 12 foot of width).

13. TSC # and % - Third State Cracks. Interconnected cracks that divide the slab into three or more pieces and the percentage of the slabs that are effected.

Different headings are used on the survey summaries concerning asphaltic concrete surfaces. They include:

1. Sort #, Seg, Tape, Seg # - These are the same identifiers used on the portland cement concrete forms.

2. Alligator Feet L, M, H - Number of linear feet of alligator cracks in the test segment of a given severity as defined by width of opening such as Low, Medium, High. This could be set by the operator, but in this case the Iowa DOT standards were used.

3. Longitudinal Feet L, M, H - Number of linear feet of longitudinal cracks in the test segment of a given severity as defined by width of opening by the Iowa DOT standard. This can be varied by the user.

4. Patches P1, P2, Sq.ft - The area of patches in various stages of deterioration in square feet of surface as identified by the P1 and P2.

The following pages contain copies of all the spreadsheet summaries and Figures associated with each of the distresses shown in the summaries. The bars on each Figure are arranged in the same order as the test runs were conducted (1-3 or 1-6).

PAVEDEX, INC. SPOKANE, WA SEPT 1989
IOWA DEMONSTRATION
"A" ROAD I-35 NORTH

SORT #	SEG	TAPE	SEG #	CC #	CC %SLAB	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES G SQFT	PATCHES G % AREA	PATCHES F SQFT	PATCHES F % AREA	PATCHES P SQFT	PATCHES P % AREA	TSC #	TSC %SLABS
1	A1	1	130	0	0	9	15	0	0	0	0	0	0	0	0	0	0	0	0	11	18
1	A2	1	140	0	0	8	11	0	0	0	0	0	0	0	0	0	0	0	0	14	19
1	A3	1	150	0	0	12	15	0	0	0	0	0	0	0	0	0	0	0	0	15	19
1	A4	1	493	0	0	10	12	0	0	0	0	0	0	0	0	0	0	0	0	13	16
1	A5	1	503	0	0	11	18	0	0	0	0	0	0	0	0	0	0	0	0	9	15
1	A6	1	513	0	0	13	15	0	0	0	0	0	0	0	0	0	0	0	0	13	15
2	A1	1	131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4
2	A2	1	141	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
2	A3	1	151	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3
2	A4	1	494	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
2	A5	1	504	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	3	4
2	A6	1	514	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1
3	A1	1	132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	A2	1	142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	A3	1	152	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	A4	1	495	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	A5	1	505	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	A6	1	515	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	A1	1	133	0	0	2	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0
4	A2	1	143	0	0	2	3	0	0	2	3	0	0	0	0	0	0	0	0	0	0
4	A3	1	153	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
4	A4	1	496	0	0	3	3	0	0	2	2	0	0	15	0.23	0	0	0	0	0	0
4	A5	1	506	0	0	2	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0
4	A6	1	516	0	0	2	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0
5	A1	1	134	0	0	2	2	0	0	2	2	0	0	30	0.57	0	0	0	0	0	0
5	A2	1	144	0	0	1	1	0	0	0	0	0	0	30	0.64	0	0	0	0	0	0
5	A3	1	154	0	0	2	2	0	0	1	1	0	0	30	0.56	0	0	0	0	0	0
5	A4	1	497	0	0	2	4	0	0	2	4	0	0	15	0.45	0	0	0	0	0	0
5	A5	1	507	0	0	2	3	0	0	3	4	0	0	30	0.66	0	0	0	0	0	0
5	A6	1	517	0	0	3	4	0	0	3	4	0	0	30	0.67	0	0	0	0	0	0
6	A1	1	135	0	0	3	3	0	0	2	2	0	0	15	0.28	0	0	0	0	0	0
6	A2	1	145	0	0	3	4	0	0	2	2	0	0	15	0.30	0	0	0	0	0	0
6	A3	1	155	0	0	3	4	0	0	2	3	0	0	15	0.31	0	0	0	0	0	0
6	A4	1	498	0	0	3	3	0	0	2	2	0	0	15	0.27	0	0	0	0	0	0
6	A5	1	508	0	0	5	6	0	0	2	3	0	0	15	0.32	0	0	0	0	0	0
6	A6	1	518	0	0	4	4	0	0	2	2	0	0	15	0.25	0	0	0	0	0	0
7	A1	1	136	0	0	1	1	0	0	1	1	0	0	30	0.60	0	0	0	0	0	0
7	A2	1	146	0	0	2	2	0	0	1	1	0	0	30	0.58	0	0	0	0	0	0
7	A3	1	156	0	0	1	1	0	0	2	3	0	0	30	0.67	0	0	0	0	0	0
7	A4	1	499	0	0	1	1	0	0	2	2	0	0	30	0.60	0	0	0	0	0	0
7	A5	1	509	0	0	2	2	0	0	2	2	0	0	30	0.54	0	0	0	0	0	0
7	A6	1	519	0	0	2	2	1	1	1	1	0	0	30	0.59	0	0	0	0	0	0

"A" ROAD I-35 NORTH (CONT)

SORT #	SEG	TAPE	SEG #	CC #	CC %SLAB	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES G SQFT	PATCHES G % AREA	PATCHES F SQFT	PATCHES F % AREA	PATCHES P SQFT	PATCHES P % AREA	TSC #	TSC %SLABS
8	A1	1	137	0	0	0	0	0	0	0	0	0	0	15	0.32	0	0	0	0	0	0
8	A2	1	147	0	0	0	0	0	0	0	0	0	0	15	0.32	0	0	0	0	0	0
8	A3	1	157	0	0	0	0	0	0	0	0	0	0	15	0.29	0	0	0	0	0	0
8	A4	1	500	0	0	0	0	0	0	0	0	0	0	15	0.32	0	0	0	0	0	0
8	A5	1	510	0	0	0	0	0	0	0	0	0	0	15	0.28	0	0	0	0	0	0
8	A6	1	520	0	0	0	0	0	0	0	0	0	0	15	0.29	0	0	0	0	0	0
9	A1	1	138	0	0	1	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0
9	A2	1	148	0	0	1	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0
9	A3	1	158	0	0	2	2	0	0	1	1	1	1	0	0	0	0	0	0	0	0
9	A4	1	501	0	0	1	2	0	0	1	2	1	2	0	0	0	0	0	0	0	0
9	A5	1	511	0	0	2	2	0	0	4	5	1	1	0	0	0	0	0	0	0	0
9	A6	1	521	0	0	1	2	0	0	2	3	1	2	0	0	0	0	0	0	0	0
10	A1	1	139	0	0	1	2	0	0	0	0	0	0	30	1.02	0	0	0	0	0	0
10	A2	1	149	0	0	1	2	0	0	0	0	0	0	30	0.96	0	0	0	0	1	2
10	A3	1	159	0	0	1	2	0	0	0	0	0	0	30	1.00	0	0	0	0	0	0
10	A4	1	502	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10	A5	1	512	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10	A6	1	522	0	0	2	2	0	0	1	1	0	0	30	0.52	0	0	0	0	0	0

PAVEDEX, INC. SPOKANE, WA SEPT 1989
IOWA DEMONSTRATION
"BB" SHOULDER I-35 NORTH

SORT #	SEG	TYPE	SEG #	ALLIGATORS FEET L	ALLIGATORS FEET M	ALLIGATORS FEET H	LONGITUDINAL FEET L	LONGITUDINAL FEET M	LONGITUDINAL FEET H	TRANSVERSE # L	TRANSVERSE # M	TRANSVERSE # H	PATCHES SQ FT P1	PATCHES SQ FT P2
1	001	1	64	0	0	0	84	0	0	51	0	0	0	0
1	002	1	86	0	0	0	85	0	0	50	0	0	0	0
1	003	1	108	0	0	0	84	0	0	52	0	0	0	0
2	001	1	65	0	0	0	0	0	0	13	0	0	0	0
2	002	1	87	0	0	0	0	0	0	13	0	0	0	0
2	003	1	109	0	0	0	0	0	0	12	0	0	0	0
3	001	1	66	0	0	0	12	6	0	2	4	0	0	0
3	002	1	88	0	0	0	6	6	0	3	4	0	0	0
3	003	1	110	0	0	0	6	6	0	3	4	0	0	0
4	001	1	67	0	0	0	16	0	0	3	0	0	0	0
4	002	1	89	0	0	0	13	0	0	3	0	0	0	0
4	003	1	111	0	0	0	20	0	0	5	0	0	0	0
5	001	1	68	0	0	0	76	0	0	5	0	0	0	0
5	002	1	90	0	0	0	72	0	0	5	0	0	0	0
5	003	1	112	0	0	0	65	0	0	3	0	0	0	0
6	001	1	69	0	0	0	7	0	0	3	0	0	0	0
6	002	1	91	0	0	0	13	0	0	3	0	0	0	0
6	003	1	113	0	0	0	14	0	0	4	0	0	0	0
7	001	1	70	16	0	0	40	0	0	14	0	0	0	0
7	002	1	92	22	0	0	44	0	0	12	0	0	0	0
7	003	1	114	24	0	0	57	0	0	13	0	0	0	0
8	001	1	71	0	0	0	0	0	0	3	0	0	0	0
8	002	1	93	0	0	0	0	0	0	1	0	0	0	0
8	003	1	115	0	0	0	0	0	0	0	0	0	0	0
9	001	1	72	0	0	0	0	0	0	1	1	0	0	0
9	002	1	94	0	0	0	0	0	0	3	1	0	0	0
9	003	1	116	0	0	0	0	0	0	4	1	0	0	0
10	001	1	73	0	0	0	30	0	0	6	0	0	0	0
10	002	1	95	0	0	0	26	0	0	7	0	0	0	0
10	003	1	117	0	0	0	28	0	0	6	0	0	0	0

PAVEDEX, INC. SPOKANE, WA SEPT 1989
IOWA DEMONSTRATION
"B" ROAD I-35 NORTH

SURV #	SEG	TAPE	SEG #	CC #	FSC #	SPALLING # 1	SPALLING # 2	SPALLING # 3	PATCHES SQ FT G	PATCHES SQ FT F	PATCHES SQ FT P	TSC #
1	B1	1	2	0	0	0	0	0	0	0	0	0
1	B2	1	23	0	0	0	0	0	0	0	0	0
1	B3	1	44	0	0	0	0	0	0	0	0	0
1	B4	2	1	0	0	0	0	0	0	0	0	0
1	B5	2	21	0	0	0	0	0	0	0	0	0
1	B6	2	41	0	0	0	0	0	0	0	0	0
2	B1	1	3	0	0	0	0	0	0	0	0	0
2	B2	1	24	0	0	0	0	0	0	0	0	0
2	B3	1	45	0	0	0	0	0	0	0	0	0
2	B4	2	2	0	0	1	0	0	0	0	0	0
2	B5	2	22	0	0	0	0	0	0	0	0	0
2	B6	2	42	0	0	1	0	0	0	0	0	0
3	B1	1	4	0	0	0	0	0	0	0	0	0
3	B2	1	25	0	0	0	0	0	0	0	0	0
3	B3	1	46	0	0	0	0	0	0	0	0	0
3	B4	2	3	0	0	1	0	0	0	0	0	0
3	B5	2	23	0	0	0	0	0	0	0	0	0
3	B6	2	43	0	0	1	0	0	0	0	0	0
4	B1	1	5	0	0	0	0	0	0	0	0	0
4	B2	1	26	0	0	0	0	0	0	0	0	0
4	B3	1	47	0	0	0	0	0	0	0	0	0
4	B4	2	4	0	0	0	0	0	0	0	0	0
4	B5	2	24	0	0	0	0	0	0	0	0	0
4	B6	2	44	0	0	0	0	0	0	0	0	0
5	B1	1	6	0	0	0	0	0	0	0	0	0
5	B2	1	27	0	0	0	0	0	0	0	0	0
5	B3	1	48	0	0	0	0	0	0	0	0	0
5	B4	2	5	0	0	0	0	0	0	0	0	0
5	B5	2	25	0	0	0	0	0	0	0	0	0
5	B6	2	45	0	0	0	0	0	0	0	0	0
6	B1	1	7	0	2	0	0	0	0	0	0	0
6	B2	1	28	0	2	0	0	0	0	0	0	0
6	B3	1	49	0	2	0	0	0	0	0	0	0
6	B4	2	6	0	2	0	0	0	0	0	0	0
6	B5	2	26	0	2	0	0	0	0	0	0	0
6	B6	2	46	0	2	0	0	0	0	0	0	0
7	B1	1	8	0	0	0	0	0	0	0	0	0
7	B2	1	29	0	0	0	0	0	0	0	0	0
7	B3	1	50	0	0	0	0	0	0	0	0	0
7	B4	2	7	0	0	0	0	0	0	0	0	0
7	B5	2	27	0	0	0	0	0	0	0	0	0
7	B6	2	47	0	0	0	0	0	0	0	0	0

"B" ROAD I-35 NORTH (CONT)

SORT #	SEG	TAPE	SEG #	CC #	FSC #	SPALLING # 1	# 2	# 3	PATCHES SQ FT G	F	P	TSC #
8	B1	1	9	0	0	0	0	0	0	0	0	0
8	B2	1	30	0	0	0	0	0	0	0	0	0
8	B3	1	51	0	0	0	0	0	0	0	0	0
8	B4	2	8	0	0	0	0	0	0	0	0	0
8	B5	2	28	0	0	0	0	0	0	0	0	0
8	B6	2	48	0	0	0	0	0	0	0	0	0
9	B1	1	10	0	0	0	0	0	0	0	0	0
9	B2	1	31	0	0	0	0	0	0	0	0	0
9	B3	1	52	0	0	0	0	0	0	0	0	0
9	B4	2	9	0	0	0	0	0	0	0	0	0
9	B5	2	29	0	0	0	0	0	0	0	0	0
9	B6	2	49	0	0	0	0	0	0	0	0	0
10	B1	1	11	0	0	0	0	0	0	0	0	0
10	B2	1	32	0	0	0	0	0	0	0	0	0
10	B3	1	53	0	0	0	0	0	0	0	0	0
10	B4	2	10	0	0	0	0	0	0	0	0	0
10	B5	2	30	0	0	0	0	0	0	0	0	0
10	B6	2	50	0	0	0	0	0	0	0	0	0

PAVEDEX, INC. SPOKANE. WA SEPT 1989
IOWA DEMONSTRATION
"CC" SHOULDER I-35 SOUTH

SCRT	SEG	TAPE	SEG	ALLIGATORS FEET			LONGITUDINAL FEET			TRANSVERSE #			PATCHES SQ FT	
#			#	L	M	H	L	M	H	L	M	H	P1	P2
11	CC1	1	98	0	0	0	0	0	0	11	2	0	0	0
11	CC2	1	119	0	0	0	8	0	0	11	0	0	0	0
11	CC3	1	485	0	0	0	0	0	0	10	0	0	0	0
12	CC1	1	99	0	0	0	0	0	0	3	0	0	0	0
12	CC2	1	120	0	0	0	0	0	0	3	0	0	0	0
12	CC3	1	486	0	0	0	0	0	0	3	0	0	0	0
13	CC1	1	100	0	0	0	0	0	0	4	0	0	0	0
13	CC2	1	121	0	0	0	0	0	0	3	0	0	0	0
13	CC3	1	487	0	0	0	0	0	0	3	0	0	0	0
14	CC1	1	101	0	0	0	0	0	0	6	0	0	0	0
14	CC2	1	122	0	0	0	0	0	0	6	0	0	0	0
14	CC3	1	488	0	0	0	7	0	0	5	0	0	0	0
15	CC1	1	102	0	0	0	0	0	0	10	0	0	18	0
15	CC2	1	123	0	0	0	0	0	0	14	0	0	18	0
15	CC3	1	489	0	0	0	0	0	0	13	0	0	24	0
16	CC1	1	103	0	0	0	0	0	0	10	0	0	20	0
16	CC2	1	124	0	0	0	0	0	0	10	0	0	21	0
16	CC3	1	490	0	0	0	0	0	0	12	0	0	20	0
17	CC1	1	104	0	0	0	0	0	0	18	0	0	21	0
17	CC2	1	125	0	0	0	0	0	0	20	0	0	20	0
17	CC3	1	491	0	0	0	0	0	0	18	0	0	19	0
18	CC1	1	105	0	0	0	0	0	0	21	0	0	0	0
18	CC2	1	126	0	0	0	0	0	0	21	0	0	0	0
18	CC3	1	492	0	0	0	0	0	0	22	0	0	0	0
19	CC1	1	106	0	0	0	0	0	0	12	0	0	20	0
19	CC2	1	127	0	0	0	0	0	0	10	0	0	19	0
19	CC3	1	493	0	0	0	0	0	0	10	0	0	20	0
20	CC1	1	107	0	0	0	0	0	0	5	0	0	40	0
20	CC2	1	128	0	0	0	0	0	0	8	0	0	47	0
20	CC3	1	494	0	0	0	0	0	0	8	0	0	64	0

PAVEDEX, INC. SPOKANE, WA SEPT 1989
IOWA DEMONSTRATION
"C" ROAD I 35 SOUTH

SORT #	CHG	TAPE	SEQ #	ALLIGATOR FEET L	M	H	LONGITUDINAL FEET L	M	H	TRANSVERSE # L	M	H	PATCHES SQ FEET P1	P2
1	C1	1	34	0	0	0	0	0	0	0	0	0	0	0
1	C2	1	35	0	0	0	0	0	0	0	0	0	0	0
1	C3	1	76	0	0	0	0	0	0	0	0	0	0	0
1	C4	2	11	0	0	0	0	0	0	2	0	0	0	0
1	C5	2	31	0	0	0	0	0	0	0	0	0	0	0
1	C6	2	49	0	0	0	0	0	0	1	0	0	0	0
2	C1	1	35	0	0	0	0	0	0	2	0	0	0	0
2	C2	1	55	0	0	0	0	0	0	2	0	0	0	0
2	C3	1	77	0	0	0	0	0	0	0	0	0	0	0
2	C4	2	12	0	0	0	0	0	0	0	0	0	0	0
2	C5	2	32	0	0	0	0	0	0	1	0	0	0	0
2	C6	2	50	0	0	0	0	0	0	0	0	0	0	0
3	C1	1	36	0	0	0	0	0	0	6	0	0	0	15
3	C2	1	57	0	0	0	0	0	0	5	0	0	0	15
3	C3	1	78	0	0	0	0	0	0	5	0	0	0	15
3	C4	2	13	0	0	0	0	0	0	3	0	0	0	15
3	C5	2	33	0	0	0	0	0	0	4	0	0	0	15
3	C6	2	51	0	0	0	0	0	0	5	0	0	0	15
4	C1	1	37	0	0	0	0	0	0	8	0	0	0	15
4	C2	1	58	0	0	0	0	0	0	8	0	0	0	15
4	C3	1	79	0	0	3	0	0	0	9	0	0	0	15
4	C4	2	14	0	0	0	0	0	0	10	0	0	0	15
4	C5	2	34	0	0	0	0	0	0	8	0	0	0	15
4	C6	2	52	0	0	0	0	0	0	8	0	0	0	15
5	C1	1	38	0	0	0	0	0	0	15	0	0	15	0
5	C2	1	59	0	0	0	0	0	0	17	0	0	15	0
5	C3	1	80	0	0	0	6	0	0	13	0	0	15	0
5	C4	2	15	0	0	0	0	0	0	17	0	0	15	0
5	C5	2	35	0	0	0	0	0	0	17	0	0	15	0
5	C6	2	53	0	0	0	0	0	0	14	0	0	15	0
6	C1	1	39	0	0	0	0	0	0	27	0	0	0	0
6	C2	1	60	0	0	0	0	0	0	28	0	0	0	0
6	C3	1	81	0	0	0	0	0	0	24	0	0	0	0
6	C4	2	16	0	0	0	0	0	0	24	0	0	0	0
6	C5	2	36	0	0	0	0	0	0	21	0	0	0	0
6	C6	2	54	0	0	0	0	0	0	24	0	0	0	0
7	C1	1	40	0	0	0	0	0	0	23	0	0	0	0
7	C2	1	61	0	0	0	0	0	0	25	0	0	0	0
7	C3	1	82	0	0	0	0	0	0	21	0	0	0	0
7	C4	2	17	0	0	0	0	0	0	26	0	0	0	0
7	C5	2	37	0	0	0	0	0	0	23	0	0	0	0
7	C6	2	55	0	0	0	0	0	0	25	0	0	0	0

"C" ROAD I 35 SOUTH (CONT)

SORT #	SEG	TAPE	SEG #	ALLIGATOR FEET L	ALLIGATOR FEET M	ALLIGATOR FEET H	LONGITUDINAL FEET L	LONGITUDINAL FEET M	LONGITUDINAL FEET H	TRANSVERSE # L	TRANSVERSE # M	TRANSVERSE # H	PATCHES SQ FEET P1	PATCHES SQ FEET P2
8	C1	1	41	0	0	0	0	0	0	8	0	0	0	0
8	C2	1	62	0	0	0	0	0	0	8	0	0	0	0
8	C3	1	83	0	0	0	0	0	0	8	0	0	0	0
8	C4	2	18	0	0	0	0	0	0	7	0	0	0	0
8	C5	2	38	0	0	0	0	0	0	9	0	0	0	0
[illegible]	C6	2	36	0	0	0	0	0	0	10	0	0	0	0
9	C1	1	42	0	0	0	5	0	0	4	0	0	0	0
9	C2	1	63	0	0	0	0	0	0	4	0	0	0	0
9	C3	1	84	0	0	0	0	0	0	3	0	0	0	0
9	C4	2	19	0	0	0	6	0	0	2	0	0	0	0
9	C5	2	39	0	0	0	7	0	0	4	0	0	0	0
9	C6	2	57	0	0	0	5	0	0	2	0	0	0	0
10	C1	1	43	0	0	0	0	0	0	6	0	0	0	0
10	C2	1	64	0	0	0	0	0	0	6	0	0	0	0
10	C3	1	85	0	0	0	0	0	0	6	0	0	0	0
12	C4	2	20	0	0	0	0	0	0	7	0	0	0	0
10	C5	2	40	0	0	0	0	0	0	7	0	0	0	0
10	C5	2	58	0	0	0	0	0	0	7	0	0	0	0

PAVEDEX, INC. SPOKANE, WA SEPT. 1989
IOWA DEMONSTRATION "D" ROAD DAYTON ROAD NORTH

SEG	SEG	TAPE	SORT	SORT	ALLIGATOR FEET			LONGITUDINAL FEET			TRANSVERSE #			PATCHES SQ FEET	
	#		#	#	L	M	H	L	M	H	L	M	H	P1	P2
D1	171	1	1	1	0	0	0	30	2	0	35	0	0	0	0
D3	207	1	1	2	0	0	0	77	0	0	46	0	0	0	0
D5	243	1	1	3	0	0	0	85	7	0	41	0	0	0	0
D8	88	2	1	4	0	0	0	23	0	0	38	0	0	0	0
D10	124	2	1	5	0	0	0	81	0	0	44	0	0	0	0
D12	159	2	1	6	0	0	0	45	0	0	42	0	0	0	0
D1	172	1	2	1	0	0	0	137	0	0	49	0	0	0	0
D3	208	1	2	2	0	0	0	169	0	0	50	0	0	0	0
D5	244	1	2	3	0	0	0	146	0	0	48	0	0	0	0
D8	89	2	2	4	0	0	0	99	0	0	54	0	0	0	0
D10	125	2	2	5	0	0	0	94	0	0	46	0	0	0	0
D12	160	2	2	6	0	0	0	134	0	0	52	0	0	0	0
D1	173	1	3	1	0	0	0	105	72	0	39	9	0	0	0
D3	209	1	3	2	18	0	0	159	35	0	46	4	0	0	0
D5	245	1	3	3	0	0	0	140	47	0	41	5	0	0	0
D8	90	2	3	4	0	0	0	150	30	0	51	0	0	0	0
D10	126	2	3	5	0	0	0	149	37	0	43	0	0	0	0
D12	161	2	3	6	0	0	0	159	25	0	48	0	0	0	0
D1	174	1	4	1	0	0	0	104	0	0	36	1	0	0	0
D3	210	1	4	2	0	0	0	75	5	0	34	1	0	0	0
D5	246	1	4	3	0	0	0	105	0	0	39	0	0	0	0
D8	91	2	4	4	0	0	0	89	0	0	36	0	0	0	0
D10	127	2	4	5	0	0	0	106	0	0	34	3	0	0	0
D12	162	2	4	6	0	0	0	99	0	0	32	0	0	0	0
D1	175	1	5	1	6	0	0	69	44	0	46	5	0	0	0
D3	211	1	5	2	6	0	0	100	17	0	49	3	0	0	0
D5	247	1	5	3	6	0	0	99	6	0	44	3	0	0	0
D8	92	2	5	4	0	0	0	86	0	0	59	0	0	0	0
D10	128	2	5	5	0	0	0	51	6	0	42	6	0	0	0
D12	163	2	5	6	0	0	0	66	0	0	52	4	0	0	0
D1	176	1	6	1	5	0	0	15	0	0	38	0	0	0	0
D3	212	1	6	2	0	0	0	11	0	0	36	0	0	0	0
D5	248	1	6	3	0	0	0	6	0	0	40	0	0	0	0
D8	93	2	6	4	0	0	0	12	0	0	39	0	0	0	0
D10	129	2	6	5	0	0	0	11	0	0	36	0	0	0	0
D12	164	2	6	6	0	0	0	5	0	0	34	0	0	0	0
D1	177	1	7	1	0	0	0	105	0	0	38	0	0	0	0
D3	213	1	7	2	0	0	0	98	0	0	37	0	0	0	0
D5	249	1	7	3	0	0	0	99	0	0	43	0	0	0	0
D8	94	2	7	4	0	0	0	92	0	0	44	0	0	0	0
D10	130	2	7	5	0	0	0	126	0	0	45	0	0	0	0
D12	165	2	7	6	0	0	0	91	0	0	33	0	0	0	0
D1	178	1	8	1	67	0	0	437	0	0	47	0	0	0	0
D3	214	1	8	2	93	0	0	303	0	0	45	0	0	0	0
D5	250	1	8	3	98	0	0	465	0	0	48	0	0	0	0
D8	95	2	8	4	39	0	0	414	0	0	60	0	0	0	0
D10	131	2	8	5	45	0	0	461	0	0	55	0	0	0	0
D12	166	2	8	6	35	0	0	434	0	0	52	0	0	0	0

PAVEDEX, INC. SPOKANE, WA SEPT. 1989
IOWA DEMONSTRATION "D" ROAD DAYTON ROAD SOUTH

SORT	SEG	TAPE	SEG	SORT	ALLIGATOR FEET			LONGITUDINAL FEET			TRANSVERSE #			PATCHES SQ FEET	
#			#	#	L	M	H	L	M	H	L	M	H	P1	P2
B1	D2	1	179	1	116	0	0	353	0	0	54	0	0	0	0
B2	D4	1	215	1	96	0	0	307	0	0	58	0	0	0	0
B3	D6	1	251	1	89	0	0	303	0	0	51	0	0	0	0
B4	D7	2	62	1	27	0	0	344	0	0	62	0	0	0	0
B5	D9	2	96	1	53	0	0	305	0	0	53	0	0	0	0
B6	D11	2	132	1	45	0	0	388	0	0	56	0	0	0	0
B1	D2	1	180	2	135	0	0	283	0	0	60	0	0	0	0
B2	D4	1	216	2	154	0	0	244	0	0	57	0	0	0	0
B3	D6	1	252	2	171	0	0	177	0	0	65	0	0	0	0
B4	D7	2	63	2	47	0	0	494	0	0	71	0	0	0	0
B5	D9	2	97	2	92	0	0	325	0	0	65	0	0	0	0
B6	D11	2	132	2	45	0	0	388	0	0	56	0	0	0	0
B1	D2	1	181	3	11	0	0	167	0	0	48	0	0	0	0
B2	D4	1	217	3	12	0	0	161	0	0	43	0	0	0	0
B3	D6	1	253	3	12	0	0	175	12	0	52	0	0	0	0
B4	D7	2	64	3	5	0	0	201	0	0	49	0	0	0	0
B5	D9	2	98	3	8	0	0	164	0	0	49	0	0	0	0
B6	D11	2	133	3	8	0	0	196	0	0	51	0	0	0	0
B1	D2	1	182	4	79	0	0	226	11	0	61	0	0	0	0
B2	D4	1	218	4	44	0	0	221	19	0	56	1	0	0	0
B3	D6	1	254	4	137	0	0	208	49	0	51	0	0	0	0
B4	D7	2	65	4	28	0	0	300	13	0	66	0	0	0	0
B5	D9	2	99	4	32	0	0	291	23	0	59	0	0	0	0
B6	D11	2	134	4	23	0	0	304	9	0	61	0	0	0	0
B1	D2	1	183	5	100	0	0	173	0	0	32	2	0	0	0
B2	D4	1	219	5	125	0	0	173	34	0	34	1	0	0	0
B3	D6	1	255	5	19	0	0	112	6	0	37	0	0	0	0
B4	D7	2	66	5	56	0	0	199	0	0	38	0	0	0	0
B5	D9	2	100	5	61	0	0	245	0	0	38	0	0	0	0
B6	D11	2	135	5	46	0	0	277	0	0	35	0	0	0	0
B1	D2	1	184	6	63	0	0	177	0	0	57	0	0	0	0
B2	D4	1	220	6	54	0	0	178	0	0	54	0	0	0	0
B3	D6	1	256	6	34	0	0	147	11	0	52	2	0	0	0
B4	D7	2	67	6	16	0	0	197	0	0	53	0	0	0	0
B5	D9	2	101	6	11	0	0	181	0	0	57	0	0	0	0
B6	D11	2	136	6	19	0	0	153	0	0	54	0	0	0	0
B1	D2	1	185	7	17	0	0	108	0	0	54	0	0	0	0
B2	D4	1	221	7	15	0	0	105	0	0	44	0	0	0	0
B3	D6	1	257	7	24	0	0	96	0	0	57	0	0	0	0
B4	D7	2	68	7	11	0	0	166	0	0	50	0	0	0	0
B5	D9	2	102	7	7	0	0	117	0	0	47	0	0	0	0
B6	D11	2	137	7	6	0	0	115	0	0	51	0	0	0	0
B1	D2	1	186	8	67	0	0	202	0	0	47	0	0	0	0
B2	D4	1	222	8	44	0	0	131	7	0	46	0	0	0	0
B3	D6	1	258	8	59	0	0	185	8	0	49	0	0	0	0
B4	D7	2	69	8	21	0	0	201	0	0	51	0	0	0	0
B5	D9	2	103	8	15	0	0	166	0	0	46	0	0	0	0
B6	D11	2	138	8	17	0	0	153	0	0	52	0	0	0	0

PAVEDEX, INC. SPOKANE, WA SEPT 1983
IOWA DEMONSTRATION
"E" ROAD DAYTON ROAD NORTH

SORT #	SORT #	SEG	TAPE	SEG #	CC #	CC %SLABS	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES G SQFT	PATCHES G % AREA	PATCHES F SQFT	PATCHES F %AREA	PATCHES P SQFT	PATCHES P %AREA	TSC #	TSC %SLABS
1	1	E1	1	160	0	0	1	1	2	2	0	0	0	0	0	0.00	0	0	0	0	0	0
11	1	E3	1	197	0	0	0	0	3	3	0	0	0	0	0	0.00	0	0	0	0	0	0
21	1	E5	1	233	0	0	0	0	3	3	0	0	0	0	0	0.00	0	0	0	0	0	0
31	1	E8	2	81A	1	1	0	0	1	1	0	0	0	0	0	0.00	0	0	0	0	0	0
41	1	E10	2	114	0	0	0	0	1	1	0	0	0	0	0	0.00	0	0	0	0	0	0
51	1	E12	2	149	0	0	0	0	2	2	0	0	0	0	0	0.00	0	0	0	0	0	0
2	2	E1	1	161	0	0	0	0	0	0	0	0	0	0	15	0.25	0	0	0	0	0	0
12	2	E3	1	198	0	0	0	0	0	0	0	0	0	0	15	0.27	0	0	0	0	0	0
22	2	E5	1	234	0	0	0	0	0	0	0	0	0	0	15	0.27	0	0	0	0	0	0
32	2	E8	2	81B	0	0	0	0	0	0	0	0	0	0	15	0.27	0	0	0	0	0	0
42	2	E10	2	115	0	0	0	0	0	0	0	0	0	0	15	0.27	0	0	0	0	0	0
52	2	E12	2	150	0	0	0	0	0	0	0	0	0	0	15	0.26	0	0	0	0	0	0
3	3	E1	1	162	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
13	3	E3	1	199	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
23	3	E5	1	235	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
33	3	E8	2	81C	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
43	3	E10	2	116	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
53	3	E12	2	151	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
4	4	E1	1	163	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
14	4	E3	1	200	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
24	4	E5	1	236	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
34	4	E8	2	81D	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
44	4	E10	2	117	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
54	4	E12	2	152	0	0	0	0	1	1	0	0	0	0	0	0.00	0	0	0	0	0	0
5	5	E1	1	164	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
15	5	E3	1	201	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
25	5	E5	1	237	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
35	5	E8	2	82	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
45	5	E10	2	118	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
55	5	E12	2	153	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
6	6	E1	1	165	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
16	6	E3	1	202	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
26	6	E5	1	238	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
36	6	E8	2	83	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
46	6	E10	2	119	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
56	6	E12	2	154	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
7	7	E1	1	166	1	2	1	2	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
17	7	E3	1	203	1	1	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
27	7	E5	1	239	1	1	1	1	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
37	7	E8	2	84	0	0	1	1	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
47	7	E10	2	120	1	1	1	1	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
57	7	E12	2	155	1	1	1	1	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0

"E" ROAD DAYTON ROAD NORTH (CONT)

SORT #	SORT #	SEG	TAPE	SEG #	CC #	CC %SLABS	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES G SQFT	PATCHES G % AREA	PATCHES F SQFT	PATCHES F %AREA	PATCHES P SQFT	PATCHES P %AREA	TSC #	TSC %SLABS
8	8	E1	1	168	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
18	8	E3	1	204	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
28	8	E5	1	240	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
38	8	E8	2	85	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
48	8	E10	2	121	0	0	0	0	0	0	0	0	0	0	0	0.00	3	0	0	0	0	0
58	8	E12	2	156	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
9	9	E1	1	169	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
19	9	E3	1	205	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
29	9	E5	1	241	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
39	9	E8	2	86	0	0	0	0	1	1	0	0	0	0	0	0.00	0	0	0	0	0	0
49	9	E10	2	122	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
59	9	E12	2	157	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
10	10	E1	1	170	0	0	3	2	1	1	1	1	0	0	0	0.00	0	0	0	0	0	0
20	10	E3	1	206	0	0	3	2	1	1	1	1	0	0	0	0.00	0	0	0	0	0	0
30	10	E5	1	242	0	0	3	2	1	1	1	1	0	0	0	0.00	0	0	0	0	0	0
40	10	E8	2	87	0	0	1	1	1	1	2	1	0	0	0	0.00	0	0	0	0	0	0
50	10	E10	2	123	0	0	1	1	0	0	2	2	0	0	0	0.00	0	0	0	0	0	0
60	10	E12	2	158	0	0	3	2	1	1	2	1	0	0	0	0.00	0	0	0	0	0	0

PAVEDEX, INC. SPOKANE, WA SEPT 1989
IOWA DEMONSTRATION
"E" ROAD DAYTON ROAD SOUTH

SURT #	SURT #	SEG	TAPE	SEG #	CC #	CC %SLABS	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES B SOFT	PATCHES B % AREA	PATCHES F SOFT	PATCHES F %AREA	PATCHES P SOFT	PATCHES P %AREA	TSC #	TSC %SLABS
61	1	E2	1	187	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
71	1	E4	1	223	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
81	1	E6	1	259	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
91	1	E7	2	71	1	1	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
101	1	E9	2	104	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
111	1	E11	2	139	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
62	2	E2	1	188	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
72	2	E4	1	224	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
82	2	E6	1	260	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
92	2	E7	2	72	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
102	2	E9	2	105	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
112	2	E11	2	140	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
63	3	E2	1	189	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
73	3	E4	1	225	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
83	3	E6	1	261	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
93	3	E7	2	73	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
103	3	E9	2	105	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
113	3	E11	2	141	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
64	4	E2	1	190	0	0	1	1	0	0	2	2	0	0	0	0.00	0	0	0	0	0	0
74	4	E4	1	226	0	0	1	1	0	0	2	3	0	0	0	0.00	0	0	0	0	0	0
84	4	E6	1	262	0	0	1	1	0	0	1	1	0	0	0	0.00	0	0	0	0	0	0
94	4	E7	2	74	0	0	0	0	0	0	1	1	0	0	0	0.00	0	0	0	0	0	0
104	4	E9	2	107	0	0	1	1	0	0	1	1	0	0	0	0.00	0	0	0	0	0	0
114	4	E11	2	142	0	0	1	1	0	0	2	2	0	0	0	0.00	0	0	0	0	0	0
65	5	E2	1	191	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
75	5	E4	1	227	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
85	5	E6	1	263	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
95	5	E7	2	75	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
105	5	E9	2	108	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
115	5	E11	2	143	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
66	6	E2	1	192	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
76	6	E4	1	228	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
86	6	E6	1	264	2	2	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
96	6	E7	2	76	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
105	6	E9	2	109	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
116	6	E11	2	144	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
67	7	E2	1	193	0	0	0	0	1	1	0	0	0	0	0	0.00	0	0	0	0	0	0
77	7	E4	1	229	0	0	0	0	1	1	0	0	0	0	0	0.00	0	0	0	0	0	0
87	7	E6	1	265	0	0	0	0	1	1	0	0	0	0	0	0.00	0	0	0	0	0	0
97	7	E7	2	77	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
107	7	E9	2	110	0	0	0	0	1	1	0	0	0	0	0	0.00	0	0	0	0	0	0

"E" ROAD DAYTON ROAD SOUTH (CONT)

SORT #	SORT #	SEG	TAPE	SEG #	CC #	CC %SLABS	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES G SQFT	PATCHES G % AREA	PATCHES F SQFT	PATCHES F %AREA	PATCHES P SQFT	PATCHES P %AREA	TSC #	TSC %SLABS
68	8	E2	1	194	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
78	8	E4	1	230	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
88	8	E6	1	266	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
98	8	E7	2	78	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
108	8	E9	2	111	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
118	8	E11	2	146	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
69	9	E2	1	195	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
79	9	E4	1	231	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
89	9	E6	1	267	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
99	9	E7	2	79	0	0	0	0	1	1	0	0	0	0	0	0.00	0	0	0	0	0	0
109	9	E9	2	112	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
119	9	E11	2	147	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
70	10	E2	1	196	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
80	10	E4	1	232	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
90	10	E6	1	268	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
100	10	E7	2	80	0	0	0	0	1	1	0	0	0	0	0	0.00	0	0	0	0	0	0
110	10	E9	2	113	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0
120	10	E11	2	148	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0

PAVEDEX, INC. SPOKANE, WA SEPT. 1989
IOWA DEMONSTRATION
"F" ROAD STORY ROAD E - 41 EAST

SORT #	SORT #	SEG	SEG #	TAPE	ALLIGATOR FEET			LONGITUDINAL FEET			TRANSVERSE #			PATCHES SQ FEET	
					L	M	H	L	M	H	L	M	H	P1	P2
1	1	F1	278	1	X	X	X	X	X	X	X	X	X	X	X
2	1	F3	321	1	X	X	X	X	X	X	X	X	X	X	X
3	1	F5	363	1	0	0	0	80	14	0	59	2	0	0	0
4	1	F7	177	2	0	0	0	93	23	0	53	3	0	0	0
5	1	F9	218	2	0	0	0	95	21	0	60	4	0	0	0
6	1	F11	259	2	0	0	0	81	30	0	50	4	0	0	0
1	2	F1	279	1	0	0	0	94	22	0	50	4	0	0	0
2	2	F3	321	1	X	X	X	X	X	X	X	X	X	X	X
3	2	F5	364	1	0	0	0	65	37	0	52	3	0	0	0
4	2	F7	178	2	0	0	0	83	27	0	55	4	0	0	0
5	2	F9	219	2	0	0	0	93	21	0	57	2	0	0	0
6	2	F11	260	2	0	0	0	121	18	0	60	4	0	0	0
1	3	F1	280	1	0	0	0	65	19	0	50	3	0	0	0
2	3	F3	322	1	0	0	0	75	15	0	53	4	0	0	0
3	3	F5	365	1	0	0	0	46	30	0	52	3	0	0	0
4	3	F7	179	2	0	0	0	102	13	0	56	2	0	0	0
5	3	F9	220	2	0	0	0	68	16	0	50	3	0	0	0
6	3	F11	261	2	0	0	0	72	22	0	52	4	0	0	0
1	4	F1	281	1	0	0	0	152	44	0	57	5	0	0	0
2	4	F3	323	1	0	0	0	199	19	0	60	7	0	0	0
3	4	F5	366	1	0	0	0	165	38	5	59	4	0	0	0
4	4	F7	180	2	0	0	0	200	25	0	66	6	0	0	0
5	4	F9	221	2	0	0	0	171	34	0	59	8	0	0	0
6	4	F11	262	2	0	0	0	164	35	0	57	6	0	0	0
1	5	F1	282	1	0	0	0	281	54	0	60	4	0	0	0
2	5	F3	324	1	0	0	0	313	59	0	70	10	0	0	0
3	5	F5	367	1	0	0	0	242	68	0	68	5	0	0	0
4	5	F7	181	2	0	0	0	286	40	0	71	8	0	0	0
5	5	F9	222	2	0	0	0	329	44	0	71	6	0	0	0
6	5	F11	263	2	0	0	0	301	48	0	67	8	0	0	0
1	6	F1	283	1	0	0	0	399	69	0	62	10	0	0	0
2	6	F3	325	1	0	0	0	344	74	0	59	7	0	0	0
3	6	F5	368	1	0	0	0	446	65	0	72	6	0	0	0
4	6	F7	182	2	0	0	0	487	59	0	70	8	0	0	0
5	6	F9	223	2	0	0	0	512	46	0	68	7	0	0	0
6	6	F11	264	2	0	0	0	495	57	0	71	10	0	0	0
1	7	F1	284	1	0	0	0	412	53	0	55	5	0	0	0
2	7	F3	326	1	0	0	0	407	50	0	58	4	0	0	0
3	7	F5	369	1	0	0	0	456	45	0	59	3	0	0	0
4	7	F7	183	2	0	0	0	614	28	0	62	6	0	0	0
5	7	F9	224	2	0	0	0	538	41	0	61	4	0	0	0
6	7	F11	265	2	0	0	0	528	45	0	61	3	0	0	0

"F" ROAD STORY ROAD E - 41 EAST (CONT)

SORT #	SORT #	SEG	SEG #	TAPE	ALLIGATOR FEET			LONGITUDINAL FEET			TRANSVERSE #			PATCHES SQ FEET	
					L	M	H	L	M	H	L	M	H	P1	P2
1	8	F1	285	1	0	0	0	302	37	0	61	4	0	0	0
2	8	F3	327	1	0	0	0	277	41	0	62	3	0	0	0
3	8	F5	370	1	0	0	0	331	36	0	59	4	0	0	0
4	8	F7	184	2	0	0	0	418	33	0	60	5	0	0	0
5	8	F9	225	2	0	0	0	403	30	0	57	4	0	0	0
6	8	F11	266	2	0	0	0	412	19	0	62	6	0	0	0
1	9	F1	286	1	0	0	0	218	19	0	56	4	0	0	0
2	9	F3	328	1	0	0	0	204	32	0	65	5	0	0	0
3	9	F5	371	1	0	0	0	178	28	0	62	3	0	0	0
4	9	F7	185	2	0	0	0	197	24	0	64	2	0	0	0
5	9	F9	226	2	0	0	0	172	35	0	60	4	0	0	0
6	9	F11	267	2	0	0	0	199	22	0	65	6	0	0	0
1	10	F1	287	1	0	0	0	142	10	0	59	3	0	0	0
2	10	F3	329	1	0	0	0	90	14	0	54	4	0	0	0
3	10	F5	372	1	0	0	0	178	16	0	67	3	0	0	0
4	10	F7	186	2	0	0	0	140	16	0	69	1	0	0	0
5	10	F9	227	2	0	0	0	189	11	0	65	2	0	0	0
6	10	F11	268	2	0	0	0	204	14	0	74	2	0	0	0
1	11	F1	288	1	X	X	X	X	X	X	X	X	X	X	X
2	11	F3	330	1	0	0	0	47	7	0	42	3	0	0	0
3	11	F5	373	1	0	0	0	55	8	0	58	2	0	0	0
4	11	F7	187	2	X	X	X	X	X	X	X	X	X	X	X
5	11	F9	228	2	0	0	0	109	0	0	71	0	0	0	0
6	11	F11	269	2	0	0	0	80	0	0	70	0	0	0	0

PAVEDEX, INC. SPOKANE, WA SEPT. 1989
IOWA DEMONSTRATION
"F" ROAD STORY ROAD E - 41 WEST

SORT #	SORT #	SEG	SEG #	TAPE	ALLIGATOR FEET			LONGITUDINAL FEET			TRANSVERSE #			PATCHES SQ FEET	
					L	M	H	L	M	H	L	M	H	P1	P2
7	1	F2	288	1	0	0	0	125	26	0	58	7	0	0	0
8	1	F4	332	1	0	0	0	88	23	0	52	5	0	0	0
9	1	F6	374	1	0	0	0	119	20	0	53	6	0	0	0
10	1	F8	187	2	0	0	0	73	32	0	46	4	0	0	0
11	1	F10	229	2	0	0	0	70	26	0	47	5	0	0	0
12	1	F12	270	2	0	0	0	75	21	0	68	5	0	0	0
7	2	F2	289	1	0	0	0	87	17	0	52	5	0	0	0
8	2	F4	333	1	0	0	0	74	20	0	48	5	0	0	0
9	2	F6	375	1	0	0	0	75	16	0	50	6	0	0	0
10	2	F8	188	2	0	0	0	62	27	5	55	5	0	0	0
11	2	F10	230	2	0	0	0	43	19	0	55	4	0	0	0
12	2	F12	271	2	0	0	0	81	13	0	70	6	0	0	0
7	3	F2	290	1	0	0	0	336	46	0	57	4	0	0	0
8	3	F4	334	1	0	0	0	358	50	0	59	5	0	0	0
9	3	F6	376	1	0	0	0	346	36	0	56	3	0	0	0
10	3	F8	189	2	0	0	0	304	39	0	50	7	0	0	0
11	3	F10	231	2	0	0	0	311	44	0	53	5	0	0	0
12	3	F12	272	2	0	0	0	309	39	0	58	6	0	0	0
7	4	F2	291	1	0	0	0	165	18	0	49	4	0	0	0
8	4	F4	335	1	0	0	0	169	15	0	52	7	0	0	0
9	4	F6	377	1	0	0	0	179	14	0	51	8	0	0	0
10	4	F8	190	2	0	0	0	125	27	0	47	6	0	0	0
11	4	F10	232	2	0	0	0	144	15	0	53	5	0	0	0
12	4	F12	273	2	0	0	0	116	19	0	54	5	0	0	0
7	5	F2	292	1	0	0	0	191	20	0	49	9	0	0	0
8	5	F4	336	1	0	0	0	191	26	0	53	7	0	0	0
9	5	F6	378	1	0	0	0	271	20	0	51	10	0	0	0
10	5	F8	191	2	0	0	0	216	14	0	45	8	0	0	0
11	5	F10	233	2	0	0	0	214	17	0	49	6	0	0	0
12	5	F12	274	2	0	0	0	178	22	0	55	7	0	0	0
7	6	F2	293	1	0	0	0	57	6	0	43	6	0	0	0
8	6	F4	337	1	0	0	0	48	8	0	41	5	0	0	0
9	6	F6	379	1	0	0	0	41	9	0	41	8	0	0	0
10	6	F8	192	2	0	0	0	29	8	0	38	4	0	0	0
11	6	F10	234	2	0	0	0	10	10	0	40	5	0	0	0
12	6	F12	275	2	0	0	0	9	9	0	45	7	0	0	0
7	7	F2	294	1	0	0	0	0	0	0	26	10	0	0	0
8	7	F4	338	1	0	0	0	7	0	0	27	10	0	0	0
9	7	F6	380	1	0	0	0	0	0	0	39	6	0	0	0
10	7	F8	193	2	0	0	0	0	0	0	35	5	0	0	0
11	7	F10	235	2	0	0	0	0	0	0	27	7	0	0	0
12	7	F12	276	2	0	0	0	0	0	0	33	9	0	0	0

"F" ROAD STORY ROAD E - 41 WEST (CONT

SORT #	SORT #	SEG	SEG #	TAPE	ALLIGATOR FEET			LONGITUDINAL FEET			TRANSVERSE #			PATCHES SQ FEET	
					L	M	H	L	M	H	L	M	H	P1	P2
7	8	F2	295	1	0	0	0	31	0	0	43	10	0	0	0
8	8	F4	339	1	0	0	0	12	0	0	41	6	0	0	0
9	8	F6	381	1	0	0	0	7	0	0	45	5	0	0	0
10	8	F8	194	2	0	0	0	6	0	0	45	6	0	0	0
11	8	F10	236	2	0	0	0	12	0	0	42	8	0	0	0
12	8	F12	277	2	0	0	0	7	0	0	43	9	0	0	0
7	9	F2	296	1	0	0	0	80	5	0	32	5	0	0	0
8	9	F4	340	1	0	0	0	65	6	0	35	8	0	0	0
9	9	F6	382	1	0	0	0	66	6	0	36	6	0	0	0
10	9	F8	195	2	0	0	0	64	9	0	31	5	0	0	0
11	9	F10	237	2	0	0	0	62	16	0	32	6	0	0	0
12	9	F12	278	2	0	0	0	63	5	0	38	8	0	0	0
7	10	F2	297	1	0	0	0	202	9	0	52	4	0	0	0
8	10	F4	341	1	0	0	0	185	7	0	49	5	0	0	0
9	10	F6	383	1	0	0	0	205	10	0	44	9	0	0	0
10	10	F8	196	2	0	0	0	173	6	0	45	4	0	0	0
11	10	F10	238	2	0	0	0	201	5	0	46	5	0	0	0
12	10	F12	279	2	0	0	0	175	7	0	47	6	0	0	0
7	11	F2	298	1	0	0	0	81	5	0	46	4	0	0	0
8	11	F4	342	1	0	0	0	99	0	0	46	6	0	0	0
9	11	F6	384	1	0	0	0	52	0	0	50	3	0	0	0
10	11	F8	197	2	0	0	0	78	6	0	47	4	0	0	0
11	11	F10	239	2	0	0	0	67	6	0	51	5	0	0	0
12	11	F12	280	2	0	0	0	64	0	0	47	3	0	0	0

PAVEDEX, INC. SPOKANE, WA SEPT. 1989
IOWA DEMONSTRATION
ROAD "G" US 69 NORTH

SORT	SORT	SEG	SEG	TAPE	ALLIGATORS FEET			LONGITUDINAL FEET			TRANSVERSE #			PATCHES SQ FEET	
#	#		#		L	M	H	L	M	H	L	M	H	P1	P2
1	7	G2	436	1	44	0	0	622	337	54	97	30	8	0	30
1	8	G4	455	1	41	0	0	655	378	44	97	38	12	0	30
1	9	G6	475	1	40	0	0	566	313	61	106	43	13	0	30
1	10	G8	301	2	37	0	0	724	347	47	120	29	8	0	30
1	11	G10	321	2	30	0	0	601	280	55	141	28	7	0	30
1	12	G12	341	2	24	0	0	700	259	43	106	25	9	0	30
2	7	G2	437	1	11	0	0	663	283	40	98	33	9	0	30
2	8	G4	456	1	18	0	0	648	309	48	98	22	7	0	30
2	9	G6	476	1	17	0	0	558	270	54	115	28	12	0	30
2	10	G8	302	2	13	0	0	577	248	42	97	20	9	0	30
2	11	G10	322	2	13	0	0	644	232	35	117	35	6	0	30
2	12	G12	342	2	13	0	0	655	247	39	87	19	10	0	30
3	7	G2	438	1	32	0	0	643	261	35	99	36	8	0	30
3	8	G4	457	1	18	0	0	657	284	40	86	31	13	0	60
3	9	G6	477	1	26	0	0	628	250	48	115	35	14	0	30
3	10	G8	303	2	20	0	0	577	226	34	80	32	12	0	60
3	11	G10	323	2	19	0	0	591	196	31	102	35	14	0	60
3	12	G12	343	2	13	0	0	605	190	37	95	30	10	0	60
4	7	G2	439	1	26	0	0	563	208	49	102	39	6	0	30
4	8	G4	458	1	0	0	0	601	219	40	83	31	9	0	30
4	9	G6	478	1	24	0	0	668	181	42	96	34	12	0	30
4	10	G8	304	2	13	0	0	650	229	35	100	28	7	0	30
4	11	G10	324	2	14	0	0	666	199	31	114	35	9	0	30
4	12	G12	344	2	26	0	0	626	163	36	79	25	8	0	30
5	7	G2	440	1	53	0	0	616	180	35	91	29	9	0	30
5	8	G4	459	1	30	0	0	596	194	48	74	26	12	0	30
5	9	G6	479	1	25	0	0	621	211	39	97	24	6	0	60
5	10	G8	305	2	31	0	0	572	169	43	71	24	7	0	60
5	11	G10	325	2	28	0	0	602	185	38	102	20	6	0	60
5	12	G12	345	2	29	0	0	563	160	34	88	23	8	0	60
6	7	G2	441	1	40	0	0	588	216	51	99	35	8	0	60
6	8	G4	460	1	22	0	0	552	195	53	86	30	10	0	60
6	9	G6	480	1	32	0	0	595	227	43	108	38	7	0	60
6	10	G8	306	2	25	0	0	568	174	37	79	29	10	0	30
6	11	G10	326	2	36	0	0	631	189	43	105	26	6	0	60
6	12	G12	346	2	23	0	0	605	165	38	82	30	6	0	60

ROAD "G" US 69 NORTH (CONT)

SORT	SORT	SEG	SEG	TAPE	ALLIGATORS FEET			LONGITUDINAL FEET			TRANSVERSE #			PATCHES SQ FEET	
#	#		#		L	M	H	L	M	H	L	M	H	P1	P2
7	7	G2	442	1	26	0	0	565	337	46	107	33	9	0	30
7	8	G4	461	1	29	0	0	472	278	38	99	27	12	0	30
7	9	G6	481	1	13	0	0	524	310	43	102	39	10	0	0
7	10	G8	307	2	13	0	0	508	273	42	92	34	6	0	30
7	11	G10	327	2	12	0	0	609	188	34	106	39	7	0	30
7	12	G12	347	2	14	0	0	666	182	40	91	31	10	0	30
8	7	G2	443	1	23	0	0	649	188	31	82	23	7	0	30
8	8	G4	462	1	12	0	0	614	209	39	72	26	10	0	30
8	9	G6	482	1	13	0	0	638	195	27	76	30	9	0	30
8	10	G8	308	2	13	0	0	569	165	29	66	20	6	0	30
8	11	G10	328	2	13	0	0	571	177	21	85	26	8	0	30
8	12	G12	348	2	0	0	0	638	179	25	72	18	7	0	30
9	7	G2	444	1	0	0	0	215	130	28	36	17	3	0	0
9	8	G4	463	1	0	0	0	256	145	35	19	12	5	0	0
9	9	G6	483	1	0	0	0	162	169	22	16	24	7	0	0
9	10	G8	309	2	0	0	0	229	142	18	28	15	5	0	0
9	11	G10	329	2	0	0	0	186	120	21	10	20	6	0	0
9	12	G12	349	2	0	0	0	217	99	17	15	18	3	0	0
10	7	G2	445	1	0	0	0	0	0	0	0	0	0	0	0
10	8	G4	464	1	0	0	0	0	0	0	0	0	0	0	0
10	9	G6	484	1	0	0	0	0	0	0	0	0	0	0	0
10	10	G8	310	2	0	0	0	0	0	0	0	0	0	0	0
10	11	G10	330	2	0	0	0	0	0	0	0	0	0	0	0
10	12	G12	350	2	0	0	0	0	0	0	0	0	0	0	0

PAVEDEX,INC. SPOKANE,WA WA SEPT. 1989
IOWA DEMONSTRATION
ROAD "G" US 69 SOUTH

SORT #	SORT #	SEG	SEG #	TAPE	ALLIGATORS FEET L	M	H	LONGITUDINAL FEET L	M	H	TRANSVERSE # L	M	H	PATCHES SQ FEET P1	P2
1	1	G1	426	1	7	0	0	501	306	31	77	24	7	0	30
1	2	G3	446	1	14	0	0	526	295	58	97	22	12	0	60
1	3	G5	465	1	19	0	0	379	210	41	59	13	13	0	30
1	4	G7	291	2	7	0	0	410	188	21	77	15	9	0	30
1	5	G9	311	2	7	0	0	428	228	28	69	26	8	0	30
1	6	G11	331	2	17	0	0	382	351	23	78	19	7	0	30
2	1	G1	427	1	0	0	0	643	397	18	89	35	9	0	0
2	2	G3	446	1	15	0	0	484	374	28	102	26	18	0	30
2	3	G5	466	1	0	0	0	632	385	21	68	34	11	0	0
2	4	G7	292	2	0	0	0	588	352	13	97	30	23	0	0
2	5	G9	312	2	0	0	0	606	303	12	104	27	19	0	0
2	6	G11	332	2	0	0	0	599	320	10	113	24	15	0	0
3	1	G1	428	1	49	0	0	450	176	25	114	17	8	0	60
3	2	G3	447	1	36	0	0	508	192	15	95	23	5	0	30
3	3	G5	467	1	19	0	0	483	207	6	87	28	9	0	60
3	4	G7	293	2	25	0	0	409	205	21	116	15	4	0	60
3	5	G9	313	2	34	0	0	397	264	16	122	13	7	0	30
3	6	G11	333	2	31	0	0	391	248	12	110	16	7	0	30
4	1	G1	429	1	11	0	0	425	369	31	76	26	16	0	30
4	2	G3	448	1	13	0	0	452	269	23	64	34	23	0	30
4	3	G5	468	1	12	0	0	466	247	19	71	30	12	0	30
4	4	G7	294	2	11	0	0	505	193	17	80	24	19	0	30
4	5	G9	314	2	11	0	0	430	284	28	81	21	16	0	30
4	6	G11	334	2	12	0	0	425	319	14	77	25	13	0	30
5	1	G1	430	1	12	0	0	558	240	12	83	29	19	0	30
5	2	G3	449	1	26	0	0	494	381	16	89	36	13	0	30
5	3	G5	469	1	12	0	0	505	280	23	80	28	15	0	30
5	4	G7	295	2	12	0	0	450	354	13	86	24	11	0	30
5	5	G9	315	2	12	0	0	520	316	8	98	30	13	0	30
5	6	G11	335	2	14	0	0	566	262	11	101	22	9	0	30
6	1	G1	431	1	30	0	0	418	269	9	78	16	8	0	30
6	2	G3	450	1	35	0	0	362	363	12	70	22	12	0	30
6	3	G5	470	1	21	0	0	467	348	6	82	15	13	0	30
6	4	G7	296	2	24	0	0	396	291	9	98	14	7	0	60
6	5	G9	316	2	24	0	0	493	256	15	91	12	5	0	60
6	6	G11	336	2	18	0	0	420	223	6	86	18	8	0	60

ROAD "G" US 69 SOUTH (CONT)

SORT #	SORT #	SEG	SEG #	TAPE	ALLIGATORS FEET L	M	H	LONGITUDINAL FEET L	M	H	TRANSVERSE # L	M	H	PATCHES SQ FEET P1	P2
7	1	G1	432	1	24	0	0	473	186	19	93	20	6	0	30
7	2	G3	451	1	26	0	0	477	210	24	100	27	4	0	30
7	3	G5	471	1	13	0	0	488	260	28	100	23	10	0	30
7	4	G7	297	2	13	0	0	522	219	20	116	18	6	0	60
7	5	G9	317	2	12	0	0	458	197	22	97	20	3	0	30
7	6	G11	337	2	13	0	0	501	183	18	120	16	7	0	60
8	1	G1	433	1	19	0	0	531	212	29	88	30	9	0	30
8	2	G3	452	1	26	0	0	459	258	40	107	28	6	0	30
8	3	G5	472	1	13	0	0	507	215	28	81	36	7	0	30
8	4	G7	298	2	13	0	0	494	276	21	118	26	13	0	30
8	5	G9	318	2	13	0	0	532	223	26	106	30	11	0	30
8	6	G11	338	2	13	0	0	494	306	28	117	25	8	0	30
9	1	G1	434	1	13	0	0	432	189	21	100	16	6	0	30
9	2	G3	453	1	12	0	0	493	230	24	120	20	8	0	30
9	3	G5	473	1	12	0	0	389	210	18	93	17	8	0	30
9	4	G7	299	2	14	0	0	440	172	27	104	25	7	0	30
9	5	G9	319	2	13	0	0	480	183	17	109	21	4	0	30
9	6	G11	339	2	20	0	0	444	164	19	92	18	6	0	30
10	1	G1	435	1	15	0	0	551	317	35	95	20	8	0	30
10	2	G3	454	1	20	0	0	499	371	44	112	26	6	0	30
10	3	G5	474	1	20	0	0	497	320	30	87	17	10	0	30
10	4	G7	300	2	20	0	0	482	304	31	102	21	7	0	30
10	5	G9	320	2	24	0	0	531	274	31	106	24	4	0	30
10	6	G11	340	2	20	0	0	528	347	27	115	23	8	0	30

PAVEDEX, INC. SPOKANE, WA SEPT. 1989
IOWA DEMONSTRATION
"H" ROAD LINCOLN WAY EAST

SORT #	SORT #	SEG	TAPE	SEG #	CC #	CC %SLABS	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES B SQFT	PATCHES B % AREA	PATCHES F SQFT	PATCHES F %AREA	PATCHES P SQFT	PATCHES P %AREA	TSC #	TSC %SLABS
1	1	H1	1	269	1	1	1	1	0	0	2	3	2	3	0	0.00	0	0.00	0	0.00	0	0
2	1	H3	1	311	0	0	1	1	1	1	2	2	3	4	0	0.00	0	0.00	0	0.00	0	0
3	1	H5	1	353	0	0	1	1	1	1	2	3	3	4	0	0.00	0	0.00	0	0.00	0	0
4	1	H7	2	167	0	0	1	2	0	0	3	6	2	4	0	0.00	0	0.00	0	0.00	0	0
5	1	H9	2	200	0	0	1	1	0	0	3	4	3	4	0	0.00	0	0.00	0	0.00	0	0
6	1	H11	2	249	0	0	1	1	0	0	3	4	3	4	0	0.00	0	0.00	0	0.00	0	0
1	2	H1	1	270	0	0	1	1	0	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
2	2	H3	1	312	0	0	1	1	0	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
3	2	H5	1	354	0	0	1	1	0	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
4	2	H7	2	168	0	0	0	0	0	0	1	2	1	2	0	0.00	0	0.00	0	0.00	0	0
5	2	H9	2	209	0	0	0	0	0	0	1	1	2	2	0	0.00	0	0.00	0	0.00	0	0
6	2	H11	2	250	1	1	0	0	0	0	2	2	1	1	0	0.00	0	0.00	0	0.00	0	0
1	3	H1	1	271	2	2	3	3	2	2	3	3	0	0	0	0.00	0	0.00	0	0.00	0	0
2	3	H3	1	313	3	4	2	2	2	2	3	4	1	1	0	0.00	0	0.00	0	0.00	0	0
3	3	H5	1	355	2	2	2	2	0	0	4	5	2	2	0	0.00	0	0.00	0	0.00	1	1
4	3	H7	2	169	1	2	2	4	1	2	1	2	1	2	0	0.00	0	0.00	0	0.00	1	2
5	3	H9	2	210	1	1	3	4	1	1	1	1	1	1	0	0.00	0	0.00	0	0.00	2	2
6	3	H11	2	251	3	4	3	4	1	1	3	4	0	0	0	0.00	0	0.00	0	0.00	0	0
1	4	H1	1	272	1	1	3	3	1	1	3	3	1	1	30	0.47	0	0.00	0	0.00	4	4
2	4	H3	1	314	0	0	3	4	1	1	3	4	2	2	45	0.71	0	0.00	0	0.00	4	5
3	4	H5	1	356	0	0	2	2	1	1	4	5	1	1	45	0.71	0	0.00	0	0.00	4	5
4	4	H7	2	170	0	0	2	4	0	0	3	5	1	2	30	0.47	0	0.00	0	0.00	3	5
5	4	H9	2	211	1	1	4	5	0	0	3	4	1	1	45	0.71	0	0.00	0	0.00	5	6
6	4	H11	2	252	0	0	5	6	0	0	1	1	1	1	45	0.71	0	0.00	0	0.00	6	7
1	5	H1	1	273	0	0	2	2	1	1	3	3	1	1	0	0.00	0	0.00	1200	18.94	0	0
2	5	H3	1	315	0	0	2	3	3	4	2	3	0	0	0	0.00	0	0.00	1170	18.46	1	1
3	5	H5	1	357	0	0	2	3	2	3	2	3	0	0	0	0.00	0	0.00	1125	17.75	0	0
4	5	H7	2	171	0	0	4	6	3	4	1	1	0	0	0	0.00	0	0.00	1170	18.46	2	3
5	5	H9	2	212	0	0	2	3	2	3	3	4	0	0	0	0.00	0	0.00	1215	19.17	1	1
6	5	H11	2	253	0	0	2	2	2	2	1	1	0	0	0	0.00	0	0.00	1110	17.52	1	1
1	6	H1	1	274	0	0	4	4	1	1	5	5	0	0	0	0.00	0	0.00	720	11.36	8	9
2	6	H3	1	316	0	0	2	2	1	1	5	5	0	0	0	0.00	0	0.00	840	13.26	7	8
3	6	H5	1	358	0	0	1	1	1	1	5	6	0	0	0	0.00	0	0.00	705	11.12	4	5
4	6	H7	2	172	0	0	1	2	1	2	5	8	1	2	0	0.00	0	0.00	855	13.49	6	10
5	6	H9	2	213	0	0	2	2	1	1	3	4	4	5	0	0.00	0	0.00	690	10.89	8	10
6	6	H11	2	254	0	0	0	0	2	3	3	4	1	1	0	0.00	0	0.00	870	13.73	4	5

"H" ROAD LINCOLN WAY EAST (CONT)

SORT #	SORT #	SEG	TYPE	SEG #	CC #	CC %SLABS	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES G SQFT	PATCHES G % AREA	PATCHES F SQFT	PATCHES F %AREA	PATCHES P SQFT	PATCHES P %AREA	TSC #	TSC %SLABS
1	7	H1	1	275	0	0	0	0	1	1	4	4	1	1	0	0.00	0	0.00	0	0.00	4	4
2	7	H3	1	317	0	0	0	0	1	1	5	6	1	1	0	0.00	0	0.00	0	0.00	3	4
3	7	H5	1	359	0	0	0	0	0	0	4	5	1	1	0	0.00	0	0.00	0	0.00	3	4
4	7	H7	2	173	0	0	0	0	1	1	4	6	3	4	0	0.00	0	0.00	0	0.00	2	3
5	7	H9	2	214	0	0	0	0	2	2	2	2	4	5	0	0.00	0	0.00	0	0.00	2	2
6	7	H11	2	255	0	0	1	1	1	1	5	6	1	1	0	0.00	0	0.00	0	0.00	3	2
1	8	H1	1	276	0	0	0	0	0	0	3	3	2	2	0	0.00	0	0.00	0	0.00	0	0
2	8	H3	1	318	0	0	0	0	0	0	1	1	1	1	0	0.00	0	0.00	0	0.00	0	0
3	8	H5	1	360	0	0	0	0	0	0	3	3	2	2	0	0.00	0	0.00	0	0.00	0	0
4	8	H7	2	174	0	0	0	0	0	0	2	3	3	5	0	0.00	0	0.00	0	0.00	0	0
5	8	H9	2	215	0	0	0	0	0	0	1	1	3	3	0	0.00	0	0.00	0	0.00	0	0
6	8	H11	2	256	0	0	0	0	0	0	0	0	3	4	0	0.00	0	0.00	0	0.00	0	0
1	9	H1	1	277	0	0	0	0	0	0	4	4	4	4	0	0.00	0	0.00	0	0.00	0	0
2	9	H3	1	319	0	0	0	0	0	0	4	4	5	5	0	0.00	0	0.00	0	0.00	0	0
3	9	H5	1	361	0	0	0	0	0	0	5	7	6	8	0	0.00	0	0.00	0	0.00	0	0
4	9	H7	2	175	0	0	0	0	0	0	4	7	7	11	0	0.00	0	0.00	0	0.00	0	0
5	9	H9	2	216	0	0	0	0	1	1	6	8	4	5	0	0.00	0	0.00	0	0.00	0	0
6	9	H11	2	257	0	0	0	0	0	0	5	6	6	8	0	0.00	0	0.00	0	0.00	0	0
1	10	H1	1	278	0	0	0	0	1	1	4	5	3	4	0	0.00	0	0.00	0	0.00	0	0
2	10	H3	1	320	0	0	0	0	0	0	5	8	1	2	0	0.00	0	0.00	0	0.00	0	0
3	10	H5	1	362	0	0	0	0	1	1	5	7	2	3	0	0.00	0	0.00	0	0.00	0	0
4	10	H7	2	176	0	0	0	0	2	3	3	5	2	3	0	0.00	0	0.00	0	0.00	0	0
5	10	H9	2	217	0	0	0	0	0	0	3	5	3	5	0	0.00	0	0.00	0	0.00	0	0
6	10	H11	2	258	0	0	0	0	0	0	5	8	1	2	0	0.00	0	0.00	0	0.00	0	0

PAVEDEX, INC. SPOKANE, WA SEPT 1989
IOWA DEMONSTRATION
"H" ROAD LINCOLN WAY WEST

SORT	SORT	SEG	TAPE	SEG	CC		FSC		SPALLING 1		SPALLING 2		SPALLING 3		PATCHES G		PATCHES F		PATCHES P		ISC	
#	#			#	#	%SLABS	#	%SLABS	#	%SLABS	#	%SLABS	#	%SLABS	SQFT	% AREA	SQFT	%AREA	SQFT	%AREA	#	%SLABS
7	1	H2	1	299	0	0	0	0	1	1	2	2	1	1	15	0.24	0	0.00	0	0.00	0	0
8	1	H4	1	343	0	0	0	0	1	1	1	1	2	2	15	0.24	0	0.00	0	0.00	0	0
9	1	H6	1	385	0	0	0	0	2	3	1	1	3	4	15	0.24	0	0.00	0	0.00	0	0
10	1	H8	2	198	0	0	0	0	3	3	2	2	2	2	15	0.24	0	0.00	0	0.00	0	0
11	1	H10	2	240	0	0	1	1	0	0	3	2	3	2	15	0.24	0	0.00	0	0.00	0	0
21	1	H12	2	281	0	0	0	0	0	0	2	2	3	4	15	0.24	0	0.00	0	0.00	0	0
7	2	H2	1	300	1	1	0	0	0	0	1	1	1	1	0	0.00	0	0.00	0	0.00	0	0
8	2	H4	1	344	0	0	0	0	2	3	1	1	2	3	0	0.00	0	0.00	0	0.00	0	0
9	2	H6	1	386	0	0	0	0	0	0	2	3	2	3	0	0.00	0	0.00	0	0.00	0	0
10	2	H8	2	199	0	0	0	0	0	0	2	3	4	6	0	0.00	0	0.00	0	0.00	0	0
11	2	H10	2	241A	0	0	1	1	0	0	3	4	3	4	0	0.00	0	0.00	0	0.00	0	0
21	2	H12	2	282	0	0	0	0	0	0	3	5	3	5	0	0.00	0	0.00	0	0.00	0	0
7	3	H2	1	301	0	0	3	4	1	1	0	0	1	1	0	0.00	0	0.00	0	0.00	0	0
8	3	H4	1	345	0	0	3	3	2	2	1	1	1	1	0	0.00	0	0.00	0	0.00	0	0
9	3	H6	1	387	0	0	2	3	2	3	1	1	1	1	0	0.00	0	0.00	0	0.00	0	0
10	3	H8	2	200	0	0	2	2	1	1	4	5	1	1	0	0.00	0	0.00	0	0.00	0	0
11	3	H10	2	241	1	1	1	1	1	1	2	2	1	1	0	0.00	0	0.00	0	0.00	0	0
21	3	H12	2	283	0	0	2	3	1	1	2	3	1	1	0	0.00	0	0.00	0	0.00	0	0
7	4	H2	1	302	0	0	0	0	1	1	1	1	0	0	0	0.00	0	0.00	0	0.00	1	1
8	4	H4	1	346	0	0	0	0	2	3	1	1	0	0	0	0.00	0	0.00	0	0.00	1	1
9	4	H6	1	388	0	0	1	1	1	1	1	1	0	0	0	0.00	0	0.00	0	0.00	3	4
10	4	H8	2	201	2	2	1	1	1	1	2	2	0	0	0	0.00	0	0.00	0	0.00	2	2
11	4	H10	2	242	0	0	3	4	1	1	2	3	0	0	0	0.00	0	0.00	0	0.00	3	4
21	4	H12	2	284	0	0	2	2	0	0	2	2	0	0	0	0.00	0	0.00	0	0.00	4	4
7	5	H2	1	303	2	2	1	1	0	0	2	2	2	2	0	0.00	0	0.00	2190	34.56	2	2
8	5	H4	1	347	0	0	2	2	0	0	4	5	1	1	0	0.00	0	0.00	2205	34.79	4	5
9	5	H6	1	389	1	1	2	2	0	0	2	2	1	1	0	0.00	0	0.00	2175	34.32	2	2
10	5	H8	2	202	0	0	0	0	0	0	2	2	1	1	0	0.00	0	0.00	2240	35.35	7	7
11	5	H10	2	243	0	0	0	0	0	0	3	4	2	3	0	0.00	0	0.00	2255	35.58	5	7
21	5	H12	2	285	1	1	1	1	0	0	3	4	1	1	0	0.00	0	0.00	2190	34.56	4	5
7	6	H2	1	304	0	0	0	0	1	1	1	1	0	0	30	0.47	0	0.00	0	0.00	0	0
8	6	H4	1	348	0	0	0	0	0	0	2	3	0	0	30	0.47	0	0.00	0	0.00	0	0
9	6	H6	1	390	0	0	0	0	1	1	2	2	0	0	60	0.95	0	0.00	0	0.00	0	0
10	6	H8	2	203	0	0	0	0	1	1	3	3	1	1	60	0.95	0	0.00	0	0.00	2	2
11	6	H10	2	244	0	0	1	1	0	0	2	2	0	0	45	0.71	0	0.00	0	0.00	1	1
21	6	H12	2	286	0	0	1	1	1	1	2	3	0	0	30	0.47	0	0.00	0	0.00	0	0

"H" ROAD LINCOLN WAY WEST (CONT)

SORT #	SORT #	SEG	TAPE	SEG #	CC #	CC %SLABS	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES G SQFT	PATCHES G % AREA	PATCHES F SQFT	PATCHES F %AREA	PATCHES P SQFT	PATCHES P %AREA	TSC #	TSC %SLABS
7	7	H2	1	305	0	0	2	2	0	0	3	3	0	0	30	0.47	0	0.00	0	0.00	2	2
8	7	H4	1	349	0	0	2	2	1	1	2	2	0	0	15	0.24	0	0.00	0	0.00	1	1
9	7	H6	1	391	0	0	2	3	0	0	3	4	0	0	15	0.24	0	0.00	0	0.00	3	4
10	7	H8	2	204	0	0	3	3	0	0	3	3	0	0	30	0.47	0	0.00	0	0.00	2	2
11	7	H10	2	245	0	0	2	2	1	1	3	3	0	0	15	0.24	0	0.00	0	0.00	3	3
21	7	H12	2	287	0	0	4	6	1	1	2	3	0	0	15	0.24	0	0.00	0	0.00	2	3
7	8	H2	1	306	0	0	0	0	2	3	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
8	8	H4	1	350	0	0	0	0	2	3	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
9	8	H6	1	392	0	0	0	0	2	2	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
10	8	H8	2	205	0	0	0	0	2	2	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
11	8	H10	2	246	0	0	0	0	1	1	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
21	8	H12	2	288	0	0	0	0	2	3	2	3	0	0	0	0.00	0	0.00	0	0.00	0	0
7	9	H2	1	307	0	0	0	0	1	1	1	1	0	0	15	0.24	0	0.00	0	0.00	0	0
8	9	H4	1	351	0	0	0	0	1	1	1	1	0	0	15	0.24	0	0.00	0	0.00	0	0
9	9	H6	1	393	0	0	0	0	1	1	1	1	0	0	15	0.24	0	0.00	0	0.00	0	0
10	9	H8	2	206	0	0	0	0	0	0	2	2	0	0	15	0.24	0	0.00	0	0.00	0	0
11	9	H10	2	247	0	0	1	1	2	2	0	0	0	0	15	0.24	0	0.00	0	0.00	0	0
21	9	H12	2	289	0	0	0	0	1	1	1	1	0	0	15	0.24	0	0.00	0	0.00	0	0
7	10	H2	1	308	0	0	0	0	2	3	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
8	10	H4	1	352	0	0	0	0	2	4	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
9	10	H6	1	394	0	0	0	0	2	6	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
10	10	H8	2	207	0	0	0	0	1	1	1	1	0	0	0	0.00	0	0.00	0	0.00	0	0
11	10	H10	2	248	0	0	0	0	2	3	0	0	0	0	0	0.00	0	0.00	0	0.00	0	0
21	10	H12	2	290	0	0	0	0	2	5	1	3	0	0	0	0.00	0	0.00	0	0.00	0	0

PAVEDEX, INC. SPOKANE, WA SEPT 1989
IOWA DEMONSTRATION
"I" ROAD MORTENSON ROAD EAST

SORT #	SORT #	SEG	TAPE	SEG #	CC #	CC %SLABS	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES G SQFT	PATCHES G % AREA	PATCHES F SQFT	PATCHES F %AREA	PATCHES P SQFT	PATCHES P %AREA	TSC #	TSC %SLABS
7	1	I2	1	401	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	1	I4	1	411	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1	I6	1	421	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1	I8	2	356	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	1	I10	2	366	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1	I12	2	376	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	2	I2	1	402	0	0	1	1	1	1	3	3	0	0	0	0	0	0	0	0	0	0
8	2	I4	1	412	0	0	1	1	2	2	2	2	0	0	0	0	0	0	0	0	0	0
9	2	I6	1	422	0	0	1	1	1	1	3	3	0	0	0	0	0	0	0	0	0	0
10	2	I8	2	357	0	0	0	0	0	0	2	2	1	1	0	0	0	0	0	0	0	0
11	2	I10	2	367	0	0	1	1	1	1	2	2	0	0	0	0	0	0	0	0	0	0
12	2	I12	2	377	0	0	1	1	2	2	4	4	0	0	0	0	0	0	0	0	0	0
7	3	I2	1	403	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
8	3	I4	1	413	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
9	3	I6	1	423	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
10	3	I8	2	358	0	0	1	1	0	0	3	3	0	0	0	0	0	0	0	0	0	0
11	3	I10	2	368	0	0	1	1	0	0	2	2	0	0	0	0	0	0	0	0	0	0
12	3	I12	2	378	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
7	4	I2	1	404	0	0	3	3	0	0	2	2	0	0	0	0	0	0	0	0	0	0
8	4	I4	1	414	0	0	3	3	0	0	2	2	0	0	0	0	0	0	0	0	0	0
9	4	I6	1	424	0	0	4	5	0	0	1	1	0	0	0	0	0	0	0	0	0	0
10	4	I8	2	359	0	0	3	3	0	0	1	1	1	1	0	0	0	0	0	0	0	0
11	4	I10	2	369	0	0	4	5	0	0	1	1	0	0	0	0	0	0	0	0	0	0
12	4	I12	2	379	0	0	4	4	1	1	1	1	0	0	0	0	0	0	0	0	0	0
7	5	I2	1	405	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	5	I4	1	415	0	0	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	5	I6	1	425	0	0	3	4	0	0	1	1	0	0	0	0	0	0	0	0	0	0
10	5	I8	2	360	0	0	4	6	0	0	1	2	0	0	0	0	0	0	0	0	0	0
11	5	I10	2	370	0	0	5	6	0	0	2	3	0	0	0	0	0	0	0	0	0	0
12	5	I12	2	380	0	0	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PAVEDEX, INC. SPOKANE, WA SEPT 1989
IOWA DEMONSTRATION
"I" ROAD MORTENSON ROAD WEST

SORT #	SORT #	SEG	TAPE	SEG #	CC #	CC %SLABS	FSC #	FSC %SLABS	SPALLING 1 #	SPALLING 1 %SLABS	SPALLING 2 #	SPALLING 2 %SLABS	SPALLING 3 #	SPALLING 3 %SLABS	PATCHES G SQFT	PATCHES G % AREA	PATCHES F SQFT	PATCHES F %AREA	PATCHES P SQFT	PATCHES P %AREA	TSC #	TSC %SLABS
1	1	11	1	395	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1	13	1	406	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1	15	1	416	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	1	17	2	351	0	0	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
5	1	19	2	361	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	111	2	371	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2	11	1	396	1	1	3	3	4	4	4	4	1	1	0	0	0	0	0	0	0	0
2	2	13	1	407	1	1	4	4	4	4	5	5	1	1	0	0	0	0	0	0	0	0
3	2	15	1	417	1	1	3	3	3	3	3	3	1	1	0	0	0	0	0	0	0	0
4	2	17	2	352	1	1	3	3	3	3	4	4	1	1	0	0	0	0	0	0	0	0
5	2	19	2	362	1	1	4	4	4	4	3	3	1	1	0	0	0	0	0	0	0	0
6	2	111	2	372	1	1	3	3	3	3	5	6	1	1	0	0	0	0	0	0	0	0
1	3	11	1	397	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
2	3	13	1	408	0	0	1	1	0	0	2	2	0	0	0	0	0	0	0	0	0	0
3	3	15	1	418	0	0	1	1	2	2	1	1	0	0	0	0	0	0	0	0	0	0
4	3	17	2	353	0	0	1	1	2	2	1	1	0	0	0	0	0	0	0	0	0	0
5	3	19	2	363	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
6	3	111	2	373	0	0	1	1	0	0	2	2	0	0	0	0	0	0	0	0	0	0
1	4	11	1	398	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	4	13	1	409	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	4	15	1	419	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	4	17	2	354	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4	19	2	364	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	4	111	2	374	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
1	5	11	1	399	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	5	13	1	410	0	0	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	5	15	1	420	0	0	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	5	17	2	355	0	0	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	5	19	2	365	0	0	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	5	111	2	375	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX C: STATISTICAL ANALYSIS RESULTS

STATISTIC CHECK RIGID PAVEMENTS

TEST SECTION	TIME HOURS		CC	FSC	SPALLING 1	SPALLING 2	SPALLING 3	PATCH G	PATCH F	PATCH P	TSC
A NORTH	1400	TOTAL	0	60	0	20	3	360	0	0	47
		MEAN	0	20	0	6.67	1	120	0	0	15.67
		STD DEV.	0	1.73	0	0.58	0	0	0	0	1.53
	1800	TOTAL	0	71	2	31	3	300	0	0	40
		MEAN	0	23.67	0.67	10.33	1	100	0	0	13.33
		STD DEV.	0	3.51	0.58	1.15	0	17.32	0	0	1.15
B NORTH	1300	TOTAL	0	6	0	0	0	0	0	0	0
		MEAN	0	2	0	0	0	0	0	0	0
		STD DEV.	0	0	0	0	0	0	0	0	0
	930	TOTAL	0	6	4	0	0	0	0	0	0
		MEAN	0	2	1.33	0	0	0	0	0	0
		STD DEV.	0	0	1.15	0	0	0	0	0	0
E NORTH	1530	TOTAL	12	12	11	3	0	0	0	0	0
		MEAN	1	4	3.67	1	0	0	0	0	0
		STD DEV.	0	1	0.57	0	0	0	0	0	0
	1045	TOTAL	2	8	7	6	0	0	0	0	0
		MEAN	0.67	2.67	2.33	2	0	0	0	0	0
		STD DEV.	0.58	1.15	1.15	0	0	0	0	0	0

STATISTIC CHECK RIGID PAVEMENTS

TEST SECTION	TIME HOURS		CC	FSC	SPALLING 1	SPALLING 2	SPALLING 3	PATCH G	PATCH F	PATCH P	TSC
E SOUTH	1530	TOTAL	0	3	3	5	0	0	0	0	0
		MEAN	0	1	1	1.67	0	0	0	0	0
		STD DEV.	0	0	0	0.58	0	0	0	0	0
	1045	TOTAL	0	2	3	5	0	0	0	0	0
		MEAN	0	0.67	1	1.67	0	0	0	0	0
		STD DEV.	0	0.58	1	1.15	0	0	0	0	0
H EAST	1645	TOTAL	10	34	22	93	45	120	0	5760	43
		MEAN	3.33	11.33	7.33	31	15	40	0	1920	14.33
		STD DEV.	1.53	2.52	1.53	2.65	1.73	8.66	0	90	2.08
	1130	TOTAL	7	34	21	81	72	120	0	5910	46
		MEAN	2.33	11.33	7	27	24	40	0	1970	15.33
		STD DEV.	1.53	1.15	1	1	6.56	8.66	0	60.62	2.31
	1645	TOTAL	4	20	39	37	18	310	0	6530	22
		MEAN	1.33	6.67	13	12.33	6	103.33	0	2176.67	7.33
		STD DEV.	1.53	0.58	2	1.15	1	36.86	0	27.54	1.15
	1130	TOTAL	4	26	25	59	26	285	0	6645	35
		MEAN	1.33	8.67	8.33	19.67	8.67	95	0	2215	11.67
		STD DEV.	0.58	2.81	0.58	1.53	0.58	22.91	0	56.79	1.53
I WEST	1715	TOTAL	3	28	14	17	3	0	0	0	0
		MEAN	1	10	4.67	5.33	1	0	0	0	0
		STD DEV.	0	1	0.58	1.53	0	0	0	0	0
	1330	TOTAL	3	28	14	17	3	0	0	0	0
		MEAN	1	9.33	4.67	5.67	1	0	0	0	0
		STD DEV.	0	0.58	1.53	2.08	0	0	0	0	0
I EAST	1715	TOTAL	0	25	4	17	0	0	0	0	0
		MEAN	0	8.33	1.33	5.67	0	0	0	0	0
		STD DEV.	0	1.15	0.58	0.58	0	0	0	0	0
	1330	TOTAL	0	30	4	20	2	0	0	0	0
		MEAN	0	10	1.33	6.67	0.67	0	0	0	0
		STD DEV.	0	2	1.53	0.58	1.15	0	0	0	0

CHECK FLEXIBLE PAVEMENTS

TEST SECTION	TIME HOURS	STATISTIC	ALLIG. LOW	LONG. LOW	LONG. MEDIUM	LONG. HIGH	TRANS LOW	TRANS MEDIUM	TRANS HIGH	PATCH 1	PATCH 2
C SOUTH	1150	TOTAL	0	12	0	0	291	0	0	45	90
		MEAN	0	4	0	0	72.75	0	0	15	30
		STD DEV.	0	3.46	0	0	48.86	0	0	0	0
	945	TOTAL	0	18	0	0	288	0	0	45	90
		MEAN	0	6	0	0	96	0	0	15	30
		STD DEV.	0	1	0	0	2	0	0	0	0
D NORTH	1530	TOTAL	299	3140	229	0	1015	30	0	0	0
		MEAN	99.67	1046.67	76.33	0	333.33	10	0	0	0
		STD DEV.	19.86	86.17	36.12	0	8.96	4.36	0	0	0
	1045	TOTAL	119	3077	92	0	1081	13	0	0	0
		MEAN	39.67	1025.67	30.67	0	360.33	4.33	0	0	0
		STD DEV.	5.03	57.35	6.03	0	36.56	4.51	0	0	0
D SOUTH	1530	TOTAL	1677	4618	157	0	1219	6	0	0	0
		MEAN	599	1539.33	52.33	0	406.33	2	0	0	0
		STD DEV.	25.12	146.96	38.08	0	12.42	0	0	0	0
	1045	TOTAL	699	6869	36	0	1270	0	0	0	0
		MEAN	233	2289.67	12	0	423.33	0	0	0	0
		STD DEV.	39.85	441.36	11.53	0	14.47	0	0	0	0
F WEST	1645	TOTAL	0	4012	438	0	1526	207	0	0	0
		MEAN	0	1337.33	146	0	503.67	69	0	0	0
		STD DEV.	0	35.92	13.07	0	6.66	1	0	0	0
	1130	TOTAL	0	3341	460	0	1537	190	0	0	0
		MEAN	0	1113.67	153.33	0	512.33	63.33	0	0	0
		STD DEV.	0	14.36	17.47	0	39.93	6.81	0	0	0
F EAST	1645	TOTAL	0	6085	1023	0	1700	127	0	0	0
		MEAN	0	2028.33	341	0	566.67	42.33	0	0	0
		STD DEV.	0	62.64	38.94	0	87.13	4.51	0	0	0
	1130	TOTAL	0	7956	897	0	1994	142	0	0	0
		MEAN	0	2652	299	0	664.67	47.33	0	0	0
		STD DEV.	0	29.82	11	0	33.86	4.93	0	0	0
G SOUTH	1730	TOTAL	544	14549	8283	734	2758	728	311	0	930
		MEAN	181.33	4849.67	2761	244.67	919.33	242.67	103.67	0	310
		STD DEV.	41.01	118.33	158.07	34.93	98.27	20.55	6.66	0	17.32
	1145	TOTAL	433	14326	7805	564	2986	642	284	0	990
		MEAN	144.33	4775.33	2601.67	188	995.33	214	94.67	0	330
		STD DEV.	13.05	92.21	105.88	18.03	13.05	9.16	9.86	0	30

TEST SECTION	TIME HOURS	STATISTIC	ALLIG. LOW	LONG. LOW	LONG. MEDIUM	CHECK LONG. HIGH	FLEXIBLE TRANS LOW	PAVEMENTS TRANS MEDIUM	TRANS HIGH	PATCH 1	PATCH 2
G NORTH	1730	TOTAL	615	15135	6477	1133	2356	804	246	0	870
		MEAN	205	5045	2159	377.67	785.33	268	82	0	290
		STD DEV.	44.44	82.16	45.57	8.08	62.58	32.07	13	0	17.32
	1145	TOTAL	448	15351	5236	945	2330	716	211	0	960
		MEAN	149.33	5117	1745	315	776.67	238.67	70	0	320
		STD DEV.	27.13	150.63	238.67	10.39	91.66	23.02	2.51	0	17.32

TEST SECTION	TIME HOURS	STATISTIC	ALLIG. LOW	LONGIT. LOW	LONGIT MEDIUM	CHECK TRANSV LOW	SHOULDERS TRANSV MEDIUM	PATCH 1
BB SHLDR.	1330	TOTAL	62	798	18	305	15	0
		MEAN	20.67	266	6	101.67	5	0
		STD DEV.	4.16	7.55	0	1.53	0	0
CC SHLDR.	1345	TOTAL	0	7	0	310	2	391
		MEAN	0	2.33	0	103.33	0.67	130.33
		STD DEV.	0	4.04	0	3.06	1.15	14.74