Effect of Sample Unit Size and Number of Surveyed Distress Types on Pavement Condition Index for Asphalt-Surfaced Roads

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A study was conducted to quantify the effects of altering the sample unit size for performing a distress survey according to the Pavement Condition Index (PCI) method for asphalt surfaced roads. The effect of consolidating distresses into fewer distress types during condition surveys was investigated. The effect of reducing sample unit size was investigated using surface photographs of 24 asphalt-surfaced pavement sections located in Urbana-Champaign, Illinois. Continuous 35-mm strip photographs of each pavement surface were obtained using the PASCO system. The continuous photographs were subdivided into image units, each 3 m (10 ft) long by one lane wide. Standard sample units, each 60 m (200 ft) long by one lane wide, were developed by grouping 20 contiguous images. The PCI of each sample unit was calculated based on observable distresses using Auto PAVER. Pavement image groups were developed by combining varying numbers of contiguous pavement images. The PCI was then calculated for each group using standard deduct curves and PCI calculation methodology. The effect of reducing the number of recorded distresses was investigated using distress data contained in Micro PAVER data bases from several military installations and cities. Comparisons were made between PCI values calculated using standard PCI procedures (19-distress types) and PCI values calculated using modified distress identification procedures developed by the Metropolitan Transportation Commission (7 distress types).

This paper presents the results of a study to quantify the effects of altering the sample unit size for performing a distress survey according to the pavement condition index (PCI) method, for asphalt-surfaced roads. This paper also investigates the effect of consolidating distresses into fewer distress types during condition surveys.

A primary requirement for effective pavement management is the accurate assessment of present and future pavement condition. As such, a pavement distress survey is an important component of any pavement management system. The information collected from these distress surveys is used to document existing pavement condition, to chart past performance history, and to predict future pavement performance. This information is used in determining appropriate maintenance and repair alternatives and their optimal timing.

Methods have been devised by various agencies to standardize distress classifications. The PCI distress identification and survey procedures developed by the U.S. Army Corps of Engineers have been widely used by many highway and airport agencies (*1,2*). PCI is a repeatable index from 0 to 100, with 100 being excellent, that is used to quantify pavement condition based on distress information.

To increase the efficiency of the rating process, various forms of automation have been introduced for the recording, reduction, processing, and/or storage of data. For example, small handheld computers have been used to speed up recording and transfer of data from the field to the office computer. Vehicles that obtain photographs or other visual images of the pavement surface have been developed to accelerate the field data collection time and to provide a permanent visual record of the pavement condition. However, in most applications, human interpretation of the surface condition, either in the field or in an office environment, is necessary to fully quantify all existing distress (*3*).

To increase the efficiency of distress measurements significantly, methods are needed to accelerate data collection and to reduce the time required for data entry. Advancements are continually being made in the development of specially equipped vehicles for pavement distress survey. The direction of current development activities is the use of video imaging to photograph a portion of pavement and, through pattern recognition technology, classify and quantify pavement distress directly without subjective evaluation by human raters.

Auto PAVER is one such method that simplifies the workload of measuring pavement distresses from digitized images and enters the data into the Micro PAVER system (*4*). Pavement sections are photographed and logged into an image-processing system. Auto PAVER employs sophisticated algorithms to fully process the user-defined distresses, including all necessary data entry tasks into Micro PAVER.

EFFECT OF CHANGING SAMPLE UNIT SIZE ON PCI FOR ASPHALT ROADS

For pavement management, a pavement network is divided into uniform sections based on use, pavement structure, construction history, traffic, and other factors. Each pavement section is further divided into inspection or sample units by which each existing distress is identified and quantified. The recorded distress data are used to calculate the PCI of each sample unit inspected; the PCI of the section is determined by averaging all sample unit PCI values.

The PCI procedures for asphalt-surfaced roads are based on an assumed sample unit size of 230 m^2 (2,500 ft^2). The sample unit size was selected for convenience by the developers of the PCI. For example, the 230 m^2 for asphalt roads is two highway lanes wide (8 m) by 30 m (100 ft) long. Occasionally, it is inconvenient or impossible to obtain a sample unit of that size. For example, the section length is not always divisible into 30-m (100-ft) units.

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The effect of altering sample unit size has never been quantified. The rule of thumb has been that a sample unit size should be within ±40 percent of the recommended size, 230 m^2 ± 90 m^2 (2,500 ft^2 ±1,000 ft^2), for which there was no proven basis. As such, one objective of this study was to determine the effect of varying sample unit size on the PCI value for roads and streets.

This study was limited to asphalt-surfaced pavements. Twenty-four different pavement sections located in Urbana-Champaign, Illinois, including conventional flexible pavement and composite pavement construction, were used. The test sections were surveyed using the PASCO (*5*) photographic system. A continuous set of photographic prints was produced for each lane. Digitized images of one-lane width by 3 m in length (approximately 10 m^2) were developed from the prints. Therefore, sample units of different sizes could be produced by grouping the distress information from several images. For example, a recommended sample unit size of approximately 230 m^2 (2,500 ft^2) is produced by grouping 20 consecutive images, while a sample unit half this size is produced by grouping 10 images.

Distress identification was performed on each digitized image using Auto PAVER V1.0 (*4,6*). Auto PAVER is a mouse-driven computer system that automates distress quantity calculation and creates an image distress file. An additional software program was written to perform PCI calculation on different groups of images. The groups comprised 1, 2, 4, 5, 10, 20, and 40 images. Therefore, the sample unit sizes created ranged from 5 percent to 200 percent of the recommended sample unit size, which would consist of 20 images.

The results of the PCI calculations are provided in Tables 1 and 2. The PCI values shown are outlined as follows:

TABLE 1 Calculated PCI Values for Inspected Sample Units

Pavement ID	Street Name	Number of Sample Units	Sample Unit PCI Value	Rating per Sample Unit
Champ/00002/02E	Newmark Drive	3	47 73 76	Fair Very Good Very Good
Champ/00002/02W		3	60 72 49	Good Very Good Fair
Champ/0005/05N	Curtis Road	3	31 33 12	Poor Poor Very Poor
Champ/00005/05S		3	13 34 30	Very Poor Poor Poor
Champ/00006/06E	First Street	3	21 20 16	Very Poor Very Poor Very Poor
Champ/00006/06W		3	25 34 42	Very Poor Poor Fair
Champ/00008/08N	Logan Road	1	50	Fair
Champ/00008/08S		1	56	Good
Champ/00009/09E	Fourth Street	1	35	Poor
Champ/00009/09W		1	40	Poor
Champ/00010/10N	Chalmers Street	2	34 59	Poor Good
Champ/00010/10S		2	39 51	Poor Fair

(*continued on next page*)

1. A sample unit consisting of 20 consecutive images was first defined. The distress data from the 20 images were added and the regular sample unit PCI calculated (Column 1).

2. The PCI for each of the 20 individual images was calculated, and the average of the 20 image PCI values was reported as the 5 percent sample unit PCI (Column 2).

3. The distress data for each pair of two consecutive images were combined and the PCI of each pair calculated. The average PCI of the 10 image pairs was reported as the 10 percent sample unit PCI (Column 3).

4. Steps 1 through 3 were repeated for different image groups to obtain the PCI values in the remaining columns.

Figure 1 provides a plot of the results for the 10 percent sample unit size. A constrained least square technique was used to fit a fourth-degree polynomial through the data. Similar analyses were completed for the remaining sample unit sizes with the results illustrated in Figure 2. The average change in PCI for each of the sample unit sizes investigated is plotted in Figure 3. As indicated in Tables 3 and 4, the change in PCI is less than a few PCI points for sample unit sizes of ±40 percent of the recommended size.

EFFECT OF REDUCING NUMBER OF DISTRESS TYPES ON PCI FOR ASPHALT ROADS

The PCI is used for pavement evaluation and determination of maintenance and rehabilitation requirements. The PCI is also used to project pavement performance and to establish maintenance and rehabilitation strategies. Therefore, it is imperative that the PCI be repeatable with a reasonable degree of accuracy.

The PCI procedure uses 19 distress types for asphalt-surfaced roads and streets to provide adequate information in all geographical areas. Some users have expressed interest in reducing the num-

TABLE 1 *(continued)*

Champ/00011/11E	Broadway Road	2	50 33	Fair Poor
Champ/00011/11W		2	38 29	Poor Poor
Champ/00012/12E	Broadway Road	3	37 44 42	Poor Fair Fair
Champ/00012/12W		3	42 43 44	Fair Fair Fair
Champ/00013/13E	Lincoln Avenue	5	20 36 33	Very Poor Poor Poor
Champ/00013/13W		5	18 20 24	Very Poor Poor Poor
Champ/00014/14N	Pennsylvania Avenue	2	46 47	Fair Fair
Champ/00014/14S		2	41 52	Fair Fair
Champ/00015/15E	Mattis Avenue	3	56 41 31	Good Fair Poor
Champ/00015/15W		3	26 26 47	Poor Poor Fair
Champ/00016/16N	Bloomington Road	3	33 16 26	Poor Very Poor Poor
Champ/00016/16S		2	36 22	Poor Very Poor

TABLE 2 PCI Values and Standard Deviations per Group

Pvmt. ID	Group Size 1 mean	Group Size 1 s	Group Size 2 mean	Group Size 2 s	Group Size 4 mean	Group Size 4 s	Group Size 5 mean	Group Size 10 mean	Group Size 20 (Normal Sample Unit)	Group Size 40 mean
	Group Condition Index (GCI)									
02E	68.98	14.83	64.80	16.18	60.40	18.76	59.25	54.50	47	
	78.4	10.58	75.4	5.80	74.2	3.96	73.75	74.0	73	54
	78.95	8.06	77.9	6.05	76.6	2.41	76.75	76.5	76	
02W	73.65	12.36	70.30	12.98	67.4	12.20	66.5	64.5	60	
	78.35	9.49	76.9	7.43	75.8	6.76	75.25	74.5	72	60
	70.1	19.13	68.6	18.88	63.2	16.07	64	56.5	49	
	49.6	11.67	45.7	7.79	39.8	6.42	38.75	33.5	31	
05N	53.9	17.65	49.7	18.04	41.4	15.18	40	37.0	33	34
	29.15	16.82	26.7	17.12	16.2	8.76	12.5	13.5	12	
05S	33.85	14.49	29.8	14.60	22.0	10.0	21.25	17.5	13	
	48.5	13.86	43.7	12.18	36.8	8.93	37	34.0	34	19
	42.45	11.08	38.3	10.25	34.0	11.66	31.25	30	30	
06E	50.35	18.49	43.8	21.36	33.0	18.26	28.00	26.5	21	
	36.8	12.54	34.8	10.22	28.6	11.72	30.75	27.0	20	20
	41.15	13.70	34.5	13.63	30.4	15.61	27.25	21.0	16	
06W	49.1	15.50	43.7	17.97	38.6	15.47	36.25	33.5	25	
	48.45	8.38	44.9	7.82	39.8	8.58	39.75	37.5	34	29
	57.1	14.09	52.9	8.72	51	8.37	49.75	46.0	42	
08N	65.4	12.68	62.3	12.76	58.8	8.02	56.25	53.0	50	53
08S	72.05	18.58	66.6	15.81	63.0	14.63	63.5	58.5	56	
09E	56.05	16.97	53.3	16.64	47.0	17.0	42.75	39.5	35	38
09W	55.25	10.43	51.4	10.69	47.0	10.51	46.0	43.5	40	
10N	62.3	17.74	56.7	17.22	48.4	13.87	49.75	41.0	34	
	72.15	6.28	70.2	6.48	68.2	6.53	68.25	65.0	59	42
10S	57.1	15.97	53.9	16.49	48.8	18.57	47.0	42.5	39	
	62.3	9.02	59	8.45	57.0	7.04	58.0	56.0	51	40
11E	72.9	16.69	69.9	16.19	64.8	12.81	64.0	57.5	50	
	52.45	10.20	47.7	11.68	40.2	6.11	38.25	34.5	33	39

(*continued on next page*)

TABLE 2 (*continued*)

Group Condition Index (GCI)											
Pvmt. ID	Group Size 1 mean	s	Group Size 2 mean	s	Group Size 4 mean	s	Group Size 5 mean	Group Size 10 mean	Group Size 20 (Normal Sample Unit)	Group Size 40 mean	
11W	66.8	22.04	64.4	24.87	60.4	26.73	59.25	56.5	38		
	51.8	12.48	45.8	12.06	40.4	12.92	39.25	33.5	29	35	
12E	58.3	22.38	52.5	18.40	47.4	13.30	46.0	39.0	37		
	64.45	17.64	59.6	17.00	55.6	17.27	54.25	49.0	44	39	
	60.75	21.39	56.5	15.18	54	7.87	53.75	49.0	42		
12W	61.0	17.29	55.8	14.56	52.4	17.11	49.0	46.5	42		
	55.65	24.11	51.2	14.78	47.0	12.94	45.25	43.5	43	39	
	57.75	20.23	53.5	15.39	49.6	12.94	48.0	47.0	44		
13E	43.9	19.41	38.5	16.30	30.6	13.96	29..5	24.0	20		
	56.55	6.63	53.5	6.26	47.8	5.22	47.0	41.5	36	29	
	50.75	16.42	45.9	13.12	42.2	10.06	41.75	35.5	33		
	49.95	11.18	45	13.67	40.4	12.26	39.75	37.0	35	34	
	52.45	8.42	50.1	12.14	44.6	15.37	43.0	40.0	37		
13W	53.25	24.37	48.6	26.81	26.2	18.27	24.5	18.0	18		
	47.1	19.21	38.4	18.95	25.6	9.76	26.25	23.5	20	14	
	43.55	15.51	37.7	14.46	37.7	13.67	29.5	24.5	24		
	47.9	10.78	42.2	12.44	35.2	5.45	35.75	38.0	29	28	
	54.75	12.41	52.5	13.68	45.2	11.34	44.0	40.0	35		
14N	68.75	17.71	63.8	16.67	61.0	18.56	59.0	55.0	46		
	68.55	13.56	62.9	9.63	58.8	7.33	58.0	54.0	47	42	
14S	53.8	10.44	51.2	8.77	48.2	10.96	47.5	45.0	41		
	62.75	9.96	61.8	8.24	60.6	7.06	59.5	59.0	52	39	
15E	68.1	20.0	64.6	18.48	64.2	15.90	59.75	59.5	56		
	61.2	21.56	56.1	18.83	49.4	7.73	50.0	46.0	41	43	
	57	24.70	50.0	22.52	41.6	19.65	40.75	30.0	31		
15W	43.95	23.41	38.8	22.91	31.2	18.75	29.5	27.0	26		
	39.6	19.70	33.6	16.47	33.0	15.84	32.25	28.0	26	26.0	
	64.7	21.92	57.1	13.86	50.8	7.01	51.75	48.0	47		
16N	59.6	26.83	56.2	27.47	51.2	26.06	48.5	45.0	33		
	44.75	20.54	37.7	17.36	31.2	22.59	30	19.5	16	17	
	49.55	17.79	40.7	11.67	31.8	6.76	30.75	28.0	26		
16S	52.2	14.86	49.9	14.60	44.4	13.90	43.5	42.5	36		
	42.5	14.24	39.9	14.86	34.0	10.05	32	26.5	22	29	

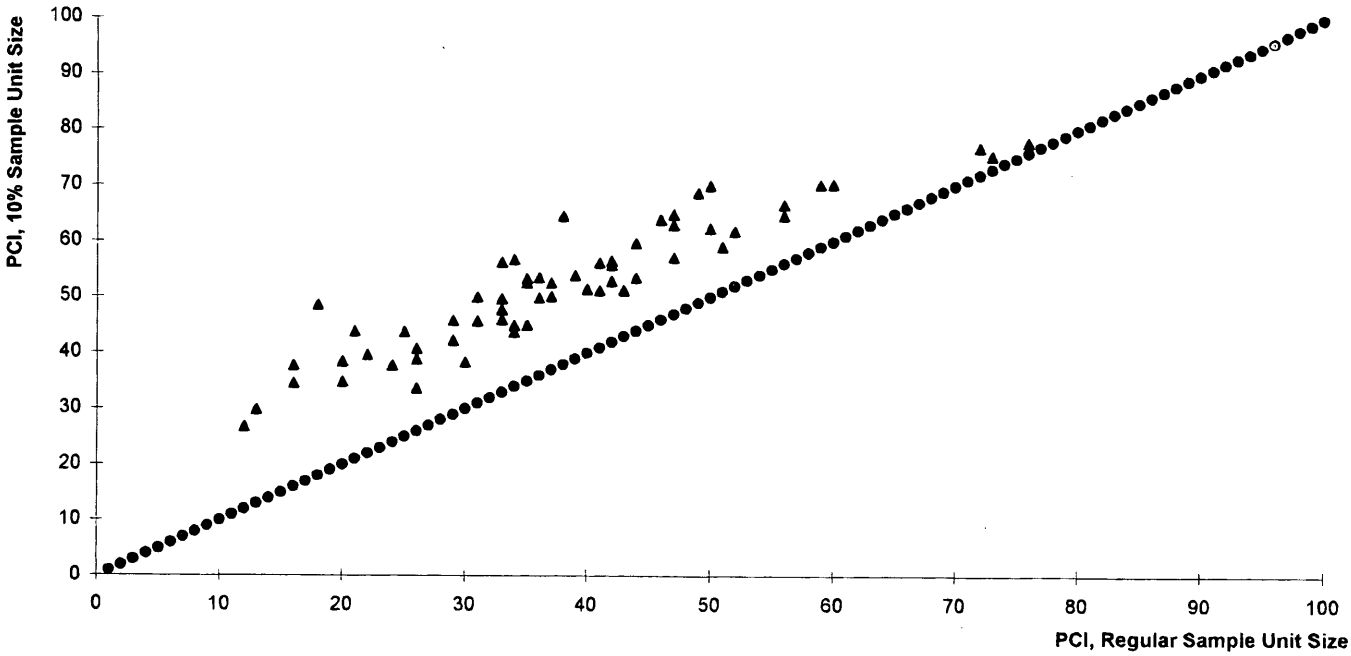

FIGURE 1 **PCI of regular sample unit size versus 10 percent sample unit size.**

ber of distresses used in the PCI procedure to expedite field inspection. This section presents an analysis of the effect of reducing the number of distresses on the PCI values. This study was limited to comparison of the standard PCI method to a modified PCI method used by the Metropolitan Transportation Commission (MTC), Oakland, California, in its pavement management system implementation. The MTC is the transportation planning agency for the 103 cities and counties in the San Francisco Bay Area.

Development of MTC-Modified PCI Procedure

The major objectives of MTC were to expedite the pavement condition survey process and minimize the time required for training the agency staff who will do the survey, while providing adequate information to make reasonable maintenance and rehabilitation decisions. These objectives are addressed by Smith (*7*):

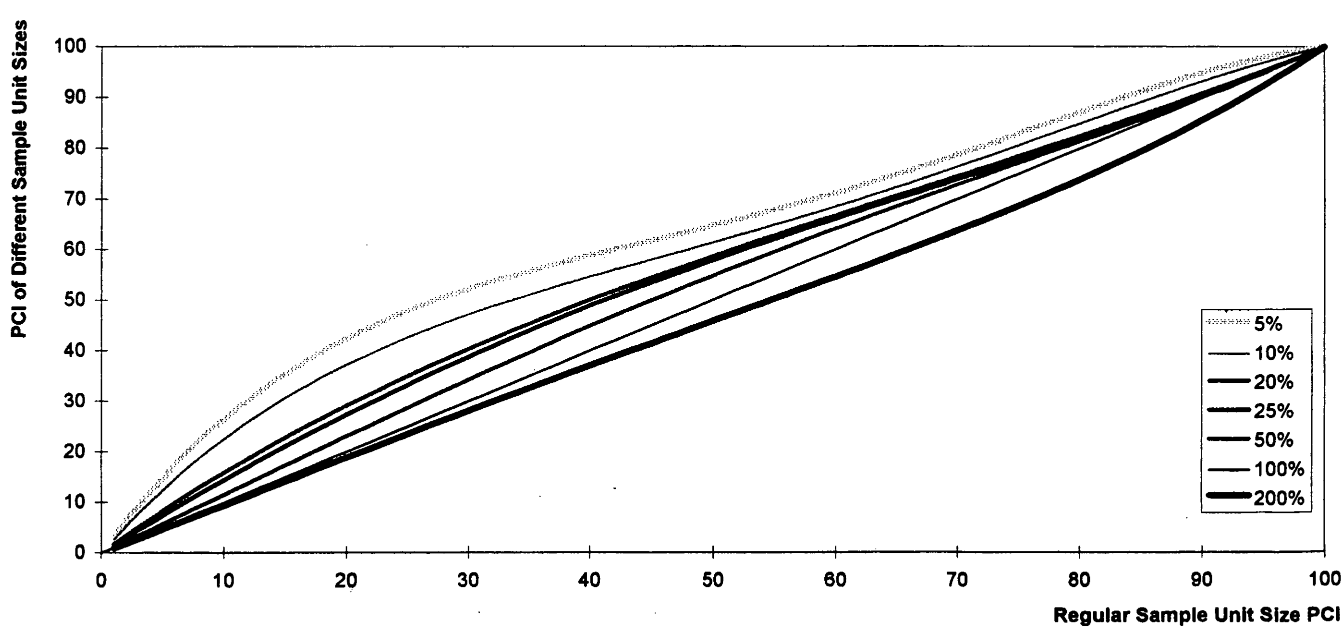

FIGURE 2 **Effect of sample unit size on PCI.**

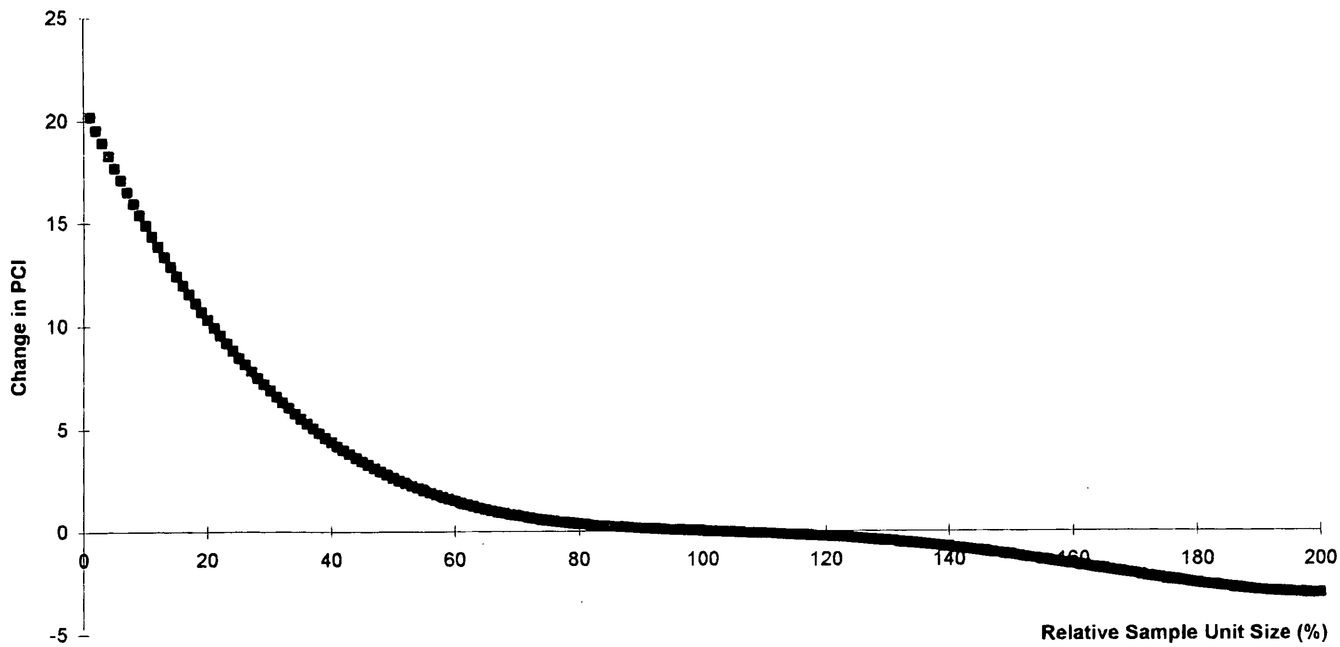

FIGURE 3 Change in PCI versus percent sample unit size.

1. Limiting the distress types in the condition survey procedure to only those usually found in the area of study or implementation site;
2. Limiting the distress types in the condition survey procedure to only those used to identify maintenance and rehabilitation needs in the area of study or implementation site;
3. Combining less common distress types based on distress causation and maintenance requirements; and
4. Developing a sampling technique to expedite the inspection process.

Since more than 95 percent of pavements maintained by cities and counties in the MTC area have bituminous surfaces (*8*), only flexible surfaced pavements were initially included in the system. An analysis of the prevailing distress types occurring in the MTC cities resulted in the compilation of seven key distresses to be used for PCI calculation. These distress types were identified as those that are useful in determining maintenance and rehabilitation needs at the network and project levels. The MTC-modified PCI procedure preserves the rating scale of 0 to 100 and the distress deduct curves used in the conventional PCI procedure. Table 5 presents a list of distress conversions and deduct curves used.

Comparing Modified MTC PCI and Standard PCI Procedure

A software program was developed to recalculate each PCI in a given Micro PAVER data base according to the MTC procedure. The distress types in each sample unit were converted to one of the seven MTC distresses. The program was used with several Micro PAVER data bases from military installations and cities. Table 6 shows summary statistics for several of the data bases. Figures 4 and 5 illustrate the PCI differences for sample units and for entire sections, respectively.

CONCLUSIONS AND RECOMMENDATIONS

The two main objectives of this study were (a) to determine the effect of sample unit size on the PCI value and (b) to determine the impact of PCI value when distress types are consolidated.

Previously completed pavement condition surveys (limited to asphalt-surfaced roads), using pavement surface photography analyzed for distress with the Auto PAVER image-processing software, were used in this study. The PCI was calculated for 61 sample units inspected (approximately 1,220 images). Figure 3 depicts the average effect of sample unit size on the PCI value; however, it should be noted that the effect of sample unit size on the PCI is also a function of the PCI value of the pavement as indicated in Figure 2. Currently, the guidance is to use a sample unit size equal to 230 m^2 (2,500 ft^2) $\pm$ 40 percent. This guidance is acceptable and will provide a PCI value that is $\pm$ two points of the recommended sample unit PCI. It is important to recognize that the comparison was based on digitized images. These results may be different if the comparison was based on traditional visual surveys.

The effect of consolidating distress types on the PCI is summarized in Table 6 for several data bases. The difference in PCI is very dependent on the data base and the types of distresses that exist in any specific site or region. It is evident from Table 6 that there is deviation from the true PCI when reducing the number of distresses. Each agency will have to assess the benefit of reducing the number of distresses versus the deviation from the true PCI.

TABLE 3 PCI for Different Sample Unit Sizes

	Group Size 1	Group Size 2	Group Size 4	Group Size 5	Group Size 10	Group Size 20	Group Size 40
Regular Sample Unit PCI	5%	10%	20%	25%	50%	100%	200%
12	29.15	26.7	16.2	12.5	13.5	12	
13	33.85	29.8	22	21.25	17.5	13	
14						14	14
16	44.75	37.7	31.2	30	19.5	16	
16	41.15	34.5	30.4	27.25	21.0	16	
17						17	
18	53.25	48.6	26.2	24.5	18.0	18	
19						19	14
20	47.1	38.4	25.6	26.25	23.5	20	
20	43.9	38.5	30.6	29.5	24.0	20	
20	36.8	34.8	28.6	30.75	27.0	20	
21	50.35	43.8	33	28	26.5	21	20
22	42.5	39.6	34	32	26.5	22	
24	43.55	37.7	37.7	29.5	24.5	24	19
25	49.1	43.7	38.6	36.25	33.5	25	17
26	43.95	38.8	31.2	29.5	27.0	26	24
26	49.55	40.7	31.8	30.75	28.0	26	
26	39.6	33.6	33	32.25	28.0	26	
27						27	28
28						28	29
29						29	25
29	51.8	45.8	40.4	39.25	33.5	29	
29	47.9	42.2	35.2	35.75	31.0	29	29
30						30	30
30	42.45	38.3	34	31.25	30.0	30	28
31	49.6	45.7	39.8	38.75	33.5	31	
31	57	50	41.6	40.75	30.0	31	
32						32	34
33	53.9	49.7	41.4	40	37.0	33	
33	59.6	56.2	51.2	48.5	45.0	33	
33	52.45	47.7	40.6	38.25	34.5	33	
33	50.75	45.9	42.2	41.75	35.5	33	
34	48.5	43.7	36.8	37	34.0	34	33
34	48.45	44.9	39.8	39.75	37.5	34	
34	62.3	56.7	48.4	49.75	41.0	34	35
35	56.05	53.3	47	42.75	39.5	35	
35	54.75	52.5	45.2	44	38.0	35	
35	49.95	45	40.4	39.75	37.0	35	
36	52.2	49.9	44.4	43.5	42.5	36	
36	56.55	53.5	47.8	47	41.5	36	
37	58.3	52.5	47.4	46	39.0	37	
37	52.45	50.1	44.6	43	40.0	37	38
38	66.8	64.4	60.4	59.25	56.5	38	
39	57.1	53.9	48.8	47	42.5	39	36
40	55.25	51.4	47	46	43.5	40	39
41	53.8	51.2	48.2	47.5	45.0	41	40
41	61.2	56.1	49.4	50	46.0	41	39
42	57.1	52.9	51	49.75	46.0	42	
42	60.75	56.5	54	53.75	49.0	42	40
42	61	55.8	52.4	49	46.5	42	
43						43	38
43	55.65	51.2	47	45.25	43.5	43	39
44	57.75	53.5	49.6	48	47.0	44	
44	64.45	59.6	55.6	54.25	49.0	44	
45						45	40
46	68.75	63.8	61	59	55.0	46	42
47	68.55	62.9	58.8	58	54.0	47	42
47	68.95	64.8	60.4	59.25	54.5	47	
47	64.7	57.1	50.8	51.75	48.0	47	39
49	70.1	68.6	63.2	64	56.5	49	43
50	72.9	69.9	64.8	64	57.5	50	
50	65.4	62.3	58.8	56.25	53.0	50	
51	62.3	59	57	58	56.0	51	
52	62.75	61.8	60.6	59.5	59.0	52	
53						53	43
56	72.05	66.6	63	63.5	58.5	56	53
56	68.1	64.6	64.2	59.75	59.5	56	
59	72.15	70.2	68.2	68.25	65.0	59	
60	73.65	70.3	67.4	66.5	64.5	60	54
66						66	60
70						70	67
72	78.35	76.9	75.8	75.25	74.5	72	
73	78.4	75.4	74.2	73.75	74	73	
76	78.95	77.9	76.6	76.75	76.5	76	

TABLE 4 Change in PCI for Different Sample Unit Sizes

	Group Size 1	Group Size 2	Group Size 4	Group Size 5	Group Size 10	Group Size 20	Group Size 40
Regular Sample Unit PCI	**5%**	**10%**	**20%**	**25%**	**50%**	**100%**	**200%**
12	17.15	14.7	4.2	0.5	1.5	0	
13	20.85	16.8	9	8.25	4.5	0	
14						0	0
16	28.75	21.7	15.2	14	3.5	0	
16	25.15	18.5	14.4	11.25	5	0	
17						0	
18	35.25	30.6	8.2	6.5	0	0	
19						0	-5
20	27.1	18.4	5.6	6.25	3.5	0	
20	23.9	18.5	10.6	9.5	4	0	
20	16.8	14.8	8.6	10.75	7	0	
21	29.35	22.8	12	7	5.5	0	-1
22	20.5	17.6	12	10	4.5	0	
24	19.55	13.7	13.7	5.5	0.5	0	-5
25	24.1	18.7	13.6	11.25	8.5	0	-8
26	17.95	12.8	5.2	3.5	1	0	-2
26	23.55	14.7	5.8	4.75	2	0	
26	13.6	7.6	7	6.25	2	0	
27						0	1
28						0	1
29						0	-4
29	22.8	16.8	11.4	10.25	4.5	0	
29	18.9	13.2	6.2	6.75	2	0	0
30						0	0
30	12.45	8.3	4	1.25	0	0	-2
31	18.6	14.7	8.8	7.75	2.5	0	
31	26	19	10.6	9.75	-1	0	
32						0	2
33	20.9	16.7	8.4	7	4	0	
33	26.6	23.2	18.2	15.5	12	0	
33	19.45	14.7	7.6	5.25	1.5	0	
33	17.75	12.9	9.2	8.75	2.5	0	
34	14.5	9.7	2.8	3	0	0	-1
34	14.45	10.9	5.8	5.75	3.5	0	
34	28.3	22.7	14.4	15.75	7	0	1
35	21.05	18.3	12	7.75	4.5	0	
35	19.75	17.5	10.2	9	3	0	
35	14.95	10	5.4	4.75	2	0	
36	16.2	13.9	8.4	7.5	6.5	0	
36	20.55	17.5	11.8	11	5.5	0	
37	21.3	15.5	10.4	9	2	0	
37	15.45	13.1	7.6	6	3	0	1
38	28.8	26.4	22.4	21.25	18.5	0	
39	18.1	14.9	9.8	8	3.5	0	-3
40	15.25	11.4	7	6	3.5	0	-1
41	12.8	10.2	7.2	6.5	4	0	-1
41	20.2	15.1	8.4	9	5	0	-2
42	15.1	10.9	9	7.75	4	0	
42	18.75	14.5	12	11.75	7	0	-2
42	19	13.8	10.4	7	4.5	0	
43						0	-5
43	12.65	8.2	4	2.25	0.5	0	-4
44	13.75	9.5	5.6	4	3	0	
44	20.45	15.6	11.6	10.25	5	0	
45						0	-5
46	22.75	17.8	15	13	9	0	-4
47	21.55	15.9	11.8	11	7	0	-5
47	21.95	17.8	13.4	12.25	7.5	0	
47	17.7	10.1	3.8	4.75	1	0	-8
49	21.1	19.6	14.2	15	7.5	0	-6
50	22.9	19.9	14.8	14	7.5	0	
50	15.4	12.3	8.8	6.25	3	0	
51	11.3	8	6	7	5	0	
52	10.75	9.8	8.6	7.5	7	0	
53						0	-10
56	16.05	10.6	7	7.5	2.5	0	-3
56	12.1	8.6	8.2	3.75	3.5	0	
59	13.15	11.2	9.2	9.25	6	0	
60	13.65	10.3	7.4	6.5	4.5	0	-6
66						0	-6
70						0	-3
72	6.35	4.9	3.8	3.25	2.5	0	
73	5.4	2.4	1.2	0.75	1	0	
76	2.95	1.9	0.6	0.75	0.5	0	
Average	**18.74**	**14.46**	**9.17**	**7.92**	**4.12**	**0.00**	**-2.91**

TABLE 5 Distress Conversion

Reduced List	*Micro PAVER Distresses*	*Deduct Curves Used*
Alligator Cracking	Alligator Cracking Potholes Slippage Cracking Edge Cracking (High Severity)	Alligator Cracking
Block Cracking	Block Cracking	Block Cracking
Distortions	Corrugations Bumps and Sags Shoving Swell	Corrugations
Longitudinal & Transverse Cracking	Longitudinal & Transverse Cracking Edge Cracking (Low and Med. Severity) Joint Reflection Cracking	Longitudinal & Transverse Cracking
Patching (& Utility Cut Patching)	Patching (& Utility Cut Patching)	Patching
Rutting & Depressions	Rutting & Depressions	Rutting
Weathering & Raveling	Weathering & Raveling	Weathering & Raveling
Not Counted	Bleeding Lane/Shoulder Drop-Off Polished Aggregate Railroad Crossing	

TABLE 6 Summary of Statistics Between Standard PCI and MTC PCI (Consolidated Distress PCI)

Database	Difference, Absolute Mean	Difference, Arithmetic Mean	Difference, Standard Deviation
Fort Lee, VA	3.97	0.61	6.27
Oakdale	4.23	2.56	4.98
USACERL	4.67	3.98	4.63
Fort Leonard Wood, MO	6.78	7.17	6.28
Pinellas Park, FL	1.00	0.23	3.19
Rockland, NY	2.79	0.46	4.86

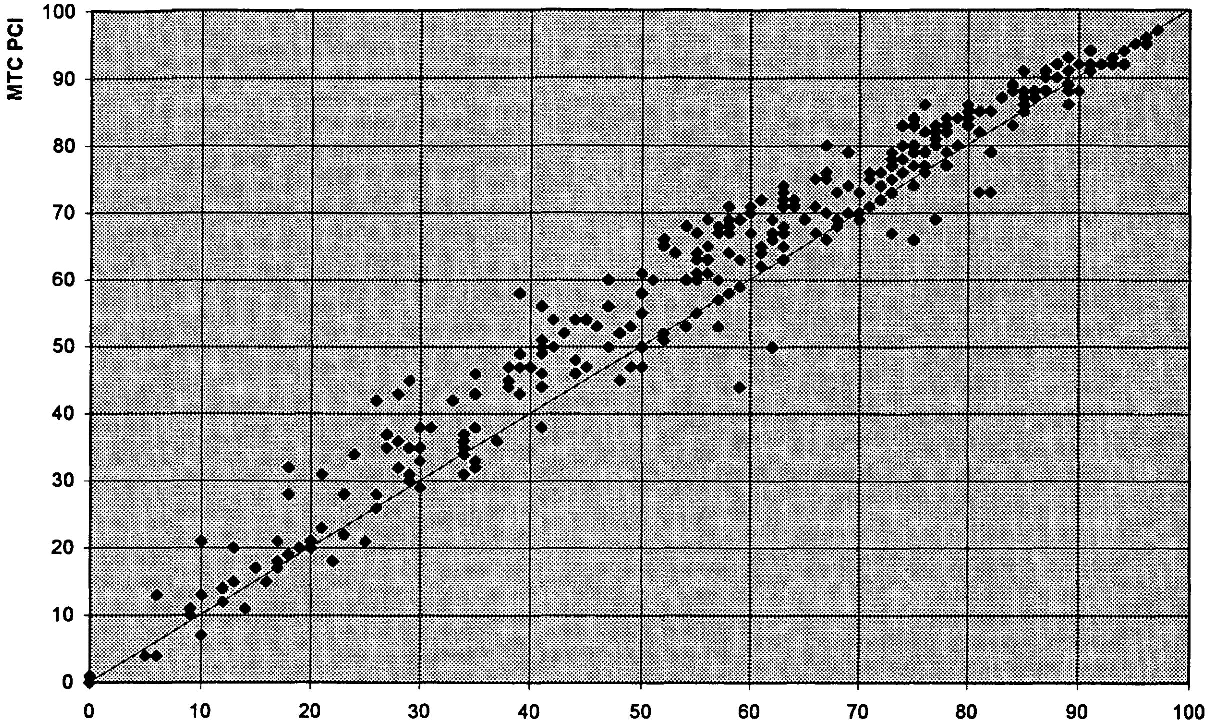

FIGURE 4 Consolidated distress PCI (sample unit).

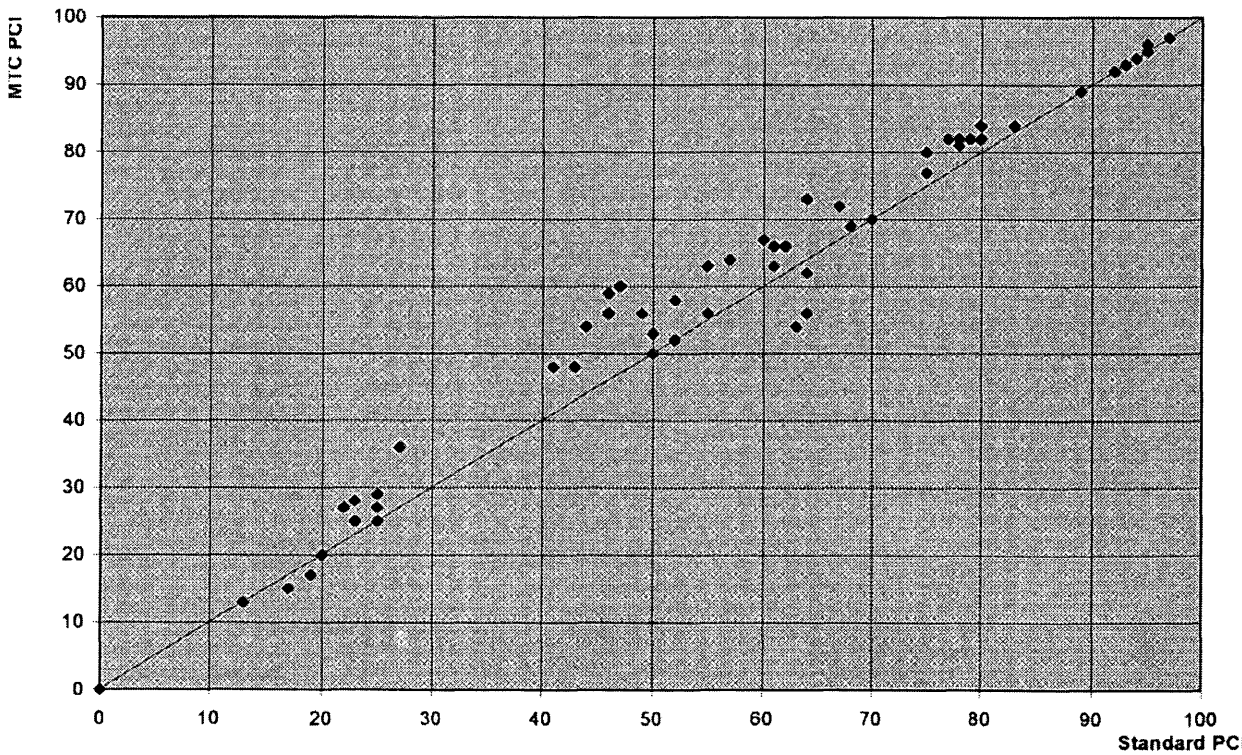

FIGURE 5 Consolidated distress PCI (section).

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The views of the authors do not purport to reflect the position of the Department of the Army or the Department of Defense.