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2

Development of a Pavement Maintenance Management System

LEVEL III

Volume V: Proposed Revision of Chapter 3, AFR 93-5

CONSTRUCTION ENGINEERING RESEARCH LABORATORY
CHAMPAIGN, ILLINOIS 61820

OCTOBER 1977

CEEDO

FINAL REPORT FOR PERIOD JULY 1976-SEPTEMBER 1977

Approved for public release; distribution unlimited

CIVIL AND ENVIRONMENTAL
ENGINEERING DEVELOPMENT OFFICE
(AIR FORCE SYSTEMS COMMAND)
TYNDALL AIR FORCE BASE
FLORIDA 32403

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The Air Force has for several years been actively engaged in the development of a Pavement Maintenance Management System. The first accomplishment of this study was the development of improved procedures for determining the relative condition of airfield pavements. These improved procedures are presented in detail in this report. These procedures were developed during FY 75 and 76 and validated by field tests during FY 76 and 77. Two conferences, attended by Command Pavement Engineers from all Major Commands, have been held at Tyndall AFB, Florida (30 Nov -

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2 Dec 1976, 18 - 20 October 1977), to discuss and revise these procedures. It was the consensus of the attendees at these conferences that these procedures provided vastly improved methods for determining the relative condition of airfield pavements. Thus, CEEDO was requested, during the conference held in October 1977, to publish, in some form, instructions for the use of these procedures as soon as possible. As a result this technical report is being published in the same format as that used for Chapter 3, "Airfield Pavement Condition Survey Report," AFR 93-5. The Air Force Civil Engineering Center (AFCEC), at Tyndall AFB, Florida, has the responsibility for revising AFR 93-5. It is recommended that the information presented in this report be used as a basis for revision of Chapter 3, AFR 93-5.

PREFACE

This report documents work accomplished between July 1976 and September 1977 by the U.S. Army Construction Engineering Research Laboratory, under Project Order No. 77-014 from the Air Force Civil Engineering Center (AFCEC), Tyndall AFB, Florida. Mr. Donald N. Brown was Project Engineer for the Civil Engineering Center.

On April 8, 1977, AFCEC divided into two organizations. AFCEC became part of the Air Force Engineering and Services Agency (AFESA). The Research and Development function remains under Air Force Systems Command as Det 1 (Civil and Environmental Engineering Development Office (CEEDO) ADTC). Mr. Donald N. Brown remains as the Project Engineer. Both units remain at Tyndall AFB, Florida 32403.

This report has been reviewed by the Information Center Officer (IO) and is releasable to the National Technical Information Services (NTIS). At NTIS it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

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INTRODUCTION

The Air Force has for several years been actively engaged in the development of a Pavement Maintenance Management System. The first accomplishment in this study was the development of improved procedures for determining the relative condition of airfield pavements. These improved procedures are presented in detail in this report. These procedures were developed during FY 75 and 76 and validated by field tests during FY 76 and 77. Two conferences, attended by Command Pavement Engineers from all Major Commands, have been held at Tyndall AFB, Florida (30 Nov-2 Dec 1976, 18-20 Oct 1977), to discuss and revise these procedures. It was the consensus of the attendees at these conferences that these procedures provided vastly improved methods for determining the relative condition of airfield pavements. Thus, CEEDO was requested, during the conference held in October 1977, to publish, in some form, instructions for the use of these procedures as soon as possible. As a result this technical report is being published in the same format as that used for Chapter 3, "Airfield Pavement Condition Survey Report," AFR 93-5. The Air Force Civil Engineering Center (AFCEC), at Tyndall AFB, Florida, has the responsibility for revising AFR 93-5. It is recommended that the information presented in this report be used as a basis for revision of Chapter 3, AFR 93-5.

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AIRFIELD PAVEMENT CONDITION SURVEY
(Proposed Revision of Chapter 3, AFR 93-5)

3-1. Scope. This chapter describes the procedures for performing an airfield pavement condition survey and determining the pavement condition index (PCI) based on data obtained from the survey. Outlines of methods and data requirements for preparing condition survey reports are also presented.

3-2. Objectives. The condition survey and determination of the PCI fulfill the following objectives:

a. Indicates the present condition of the pavement in terms of structural integrity and operational surface condition.

b. Provides the Base Civil Engineer (BCE) with an objective and rational basis for determining maintenance and repair needs and priorities. The PCI obtained over a period of years will also establish the rate of pavement deterioration which serves as a warning system for early identification and/or projection of major repair requirements.

c. Provides the major commands with a common index for comparing the condition and performance of pavements at all operational bases within their jurisdictions, and also provides a rational justification for major repair projects and for requesting in-depth pavement evaluation.

d. Provides HQ USAF with a rational basis for assigning priority for in-depth pavement evaluations.

e. Provides feedback on pavement performance for validation or improvement of current pavement design and maintenance procedures.

3-3. General.

a. The airfield pavement condition survey and the determination of the PCI by the base pavement engineer are the primary means of obtaining and recording vital airfield pavement performance data.

b. The condition survey for both jointed concrete and asphalt- or tar-surfaced pavement features consists principally of a visual inspection of the pavement surfaces for signs of pavement distress resulting from the influence of aircraft traffic and environment.

c. The overall airfield pavement must first be divided into features based on the pavement's design, construction history, and traffic area. A designated pavement feature therefore (1) has consistent structural thickness and materials, (2) was constructed at one time, and (3) is located in one traffic area. The features should be outlined and identified on the airfield layout plan.

3-4. Procedure. The steps for performing the condition survey and determining the PCI for a pavement feature are shown in Figure 3-1 and are briefly described below.

a. The pavement feature is first divided into sample units. A sample unit for concrete pavement is approximately 20 slabs; a sample unit for asphalt is an area of approximately 5000 square feet.

b. The sample units are inspected, and distress types and their severity levels and densities are recorded. Attachment A provides a comprehensive guide for identification of the different distress types and their severity levels. The criteria in Attachment A must be used in identifying and recording the distress types and severity levels in order to obtain an accurate PCI.

c. For each distress type, density, and severity level within a sample unit, a deduct value is determined from the appropriate curve. These curves are presented in Section 3-4-1 for jointed concrete and Section 3-4-2 for asphalt- or tar-surfaced pavements.

d. The total deduct value (TDV) for each sample unit is determined by adding all deduct values for each distress condition observed.

e. A corrected deduct value (CDV) is determined from Section 3-4-1 for jointed concrete and Section 3-4-2 for asphalt- or tar-surfaced pavements. The CDV is the TDV adjusted for the number of distress conditions observed with individual deduct values of more than five points.

f. The PCI for each sample unit inspected is calculated as follows:

$$PCI = 100 - CDV$$

If the CDV for a sample unit is less than the highest individual distress deduct value, the highest value should be used in lieu of the CDV in the above equation.

g. The PCI of the entire feature is the average of the PCIs from all sample units inspected.

h. The feature's pavement condition rating is determined from Figure 3-1, Step 8, which presents verbal descriptions of pavement condition as a function of PCI value.

3-4-1. Jointed Concrete Pavement Condition Survey. Figure 3-2 illustrates the division of a jointed concrete feature into sample units. Each sample unit (approximately 20 slabs in size) is numbered so it can be relocated for future inspections, maintenance needs, or random sampling purposes.

Each sample unit of the feature is inspected (or see Section 3-5 for sampling). The actual inspection is performed by walking over each slab of the sample unit being surveyed and recording distress(es) existing in the slab on the jointed concrete pavement-condition survey data sheet for sample unit (Figure 3-3). One data sheet is used for each sample unit. A sketch is made of the sample unit, using the dots as joint intersections. The appropriate number code for each distress found in the slab is placed in the square representing the slab. The letter L (low), M (medium), or H (high) is included along with the distress number code to indicate the severity level of the distress. For example, 15L indicates that low severity corner spalling exists in the slab.

A summary of the distresses and the severities of each distress contained in the sample unit is compiled on the survey data sheet. These data are used to compute the PCI for the sample unit by following the steps presented in Section 3-2. Figure 3-4 presents the deduct curves for each distress type and Figure 3-5 gives the corrected deduct curves. Figure 3-3 shows the summary of the distress densities and severities and the computed PCI for the sample unit.

The PCIs for all the sample units are compiled into a feature summary, as shown in Figure 3-6. The mean PCI for the feature is determined by averaging the PCIs from each sample unit. The overall condition rating of the feature is determined by using the mean PCI and Figure 3-1 (i.e., Excellent, Good, Poor, etc.).

3-4-2. Asphalt- or Tar-Surfaced Pavement Condition Survey. Figure 3-7 shows an example of dividing a feature into sample units. Each sample unit (approximately 5000 square feet in size) is numbered so it can be relocated for future inspections, maintenance needs, or random sampling purposes.

Each sample unit of the feature is inspected (or see Section 3-5 for sampling). The distress inspection is conducted by walking over the sample unit, measuring each distress type and severity according to Attachment A, and recording the data on the asphalt- or tar-surfaced pavement-condition survey data sheet for sample unit (Figure 3-8). One data sheet is used for each sample unit. A hand odometer is very helpful for measuring the distress lengths and areas. A 10-foot straightedge and a 12-inch scale must be available for measuring the depth of ruts or depressions. Each column on the data sheet is used to represent a distress type, and the amount.and severity of each distress located are listed in the column. For example, distress No. 5 (depression) is recorded as 6x4L, which indicates that the depression is 6 feet by 4 feet and of low severity. Distress type No. 8 (longitudinal and transverse cracking) is measured in linear feet; thus, 10L indicates 10 feet of light cracking, 5M indicates 5 feet of medium cracking, etc. This format is very convenient for recording data in the field.

The total distress data are used to compute the PCI for the sample unit by following the steps presented in Figure 3-1. Figure 3-9 gives the deduct curves for each distress type, and Figure 3-10 presents the corrected deduct curves. A summary of the distress densities and severities and the computed PCI for the sample unit are given in Figure 3-8.

The PCIs for each sample unit are compiled into a feature summary as shown in Figure 3-11. The mean PCI for the feature is determined by averaging the PCIs from each sample unit. The overall condition rating of the feature is determined using the mean PCI and Figure 3-1.

3-4-3. Remarks.

a. For both types of pavement (3-4-1, 3-4-2), it is important that each sample unit be identified adequately so that it can be relocated for additional inspections to verify distress data, or for comparison with future inspections.

b. Based on significant variation of sample unit PCI along a feature and/or significant variation in distress types among sample units, one feature should be divided into two or more features for future inspections and maintenance purposes.

3-5. Condition Survey by Sampling. Inspection of an entire feature may require considerable effort, especially if the feature is very large. This is particularly true for asphalt- or tar-surfaced pavements containing much distress. Because of the time and effort involved, frequent surveys of the entire feature may be beyond available manpower, funds, and time; for example, closing a heavily used runway for any extended time period is difficult. A sampling plan has therefore been developed so that an adequate estimate of the PCI can be determined by inspecting only a portion of the sample units in a feature. Use of the statistical sampling plan described here will considerably reduce the time required to inspect a feature without significant loss of accuracy. However, inspection of the entire feature may be desired for contractual maintenance work. The MAJCOM pavements engineer will specify whether or not sampling may be used.

a. Number of Sample Units to Be Inspected. The minimum number of sample units that must be surveyed to obtain an adequate estimate of the PCI of the feature depends on:

(1) How large an error can be tolerated in the estimate of the feature PCI (denoted by e).

(2) The desired probability that the feature PCI estimate will be within this limit of error (usually set fairly high, such as 95 percent).

(3) The estimate of the variation of the PCI (or standard deviation) from one sample unit to another within the feature (denoted by σ).

(4) The total number of sample units in the feature (denoted by N).

For 95 percent confidence that the error in estimating the mean feature PCI is no greater than $\pm e$, the minimum number of sample units to be inspected, n, is calculated from the following equation.

$$n = \frac{N\sigma^2}{(\frac{e^2}{4})(N-1) + \sigma^2} \qquad (3\text{-}1)$$

For example, an asphalt-surfaced taxiway feature 50 feet wide and 2500 feet long must be inspected and the mean PCI determined. Convenient sample units of 50x100 feet are selected; 25 units result. Determining the true PCI of the feature within ± 5 points, with a confidence level of 95 percent, is desired. A standard deviation of 10 points is selected based on data obtained from many asphalt features. The parameters are therefore:

$N = 25$

$e = 5$ points

$\sigma = 10$ points

$$n = \frac{25\ (10^2)}{\frac{(5)^2}{4}\ (25-1) + (10)^2} = 10.$$

Therefore, a minimum of 10 sample units must be selected at random and inspected; the PCI of each unit and the mean PCI of the feature are then computed based on the inspection data.

Plots which permit the number of required samples to be readily obtained were developed using Equation (3-1). These graphs, shown in Figures 3-12 and 3-13, can be used to select the minimum number of sample units that must be inspected to provide a reasonable estimate of the true mean PCI of the feature. This estimate will be within ± 5 points approximately 95 percent of the time.

b. Selection of Sample Units to Be Inspected. Sample units must be selected randomly to insure an unbiased estimate of the pavement feature's PCI. If the total number of sample units in a feature is 10 or more, stratifying the feature is recommended This involves dividing the feature into a number of parts called strata. An equal number of sample units are randomly selected from each stratum, and the sample mean is computed by averaging the PCI of all surveyed sample units.

The following example illustrates the procedure of stratified random sampling. The feature to be inspected (Figure 3-7) contains 25 sample units. The required minimum number of sample units, as previously calculated, is 10. The sample units are numbered from 1 to 25 beginning at one end. Strata can be selected in several ways, such as dividing the feature into five strata:

Stratum 1	Sample units 1 through 5
Stratum 2	Sample units 6 through 10
Stratum 3	Sample units 11 through 15
Stratum 4	Sample units 16 through 20
Stratum 5	Sample units 21 through 25

Two sample units are selected at random from each stratum using a random number table such as Table 3-1. For the example, the units could be selected by starting at columns 05 and 06, and row 10, and proceeding down the page, selecting two numbers from 1 to 5 (03 from row 16 and 01 from row 25), then 6 to 10, etc. Since the required units are not obtained when the bottom of the column has been reached, the additional units can be obtained by proceeding upward from row 49 in columns 20 and 21. The sample units selected for the example using this procedure are:

Strata	Sample Units
Stratum 1 (1-5)	01, 03
Stratum 2 (6-10)	09, 10
Stratum 3 (11-15)	12, 13
Stratum 4 (16-20)	16, 17
Stratum 5 (21-25)	21, 23

Each of these sample units must be inspected and its PCI determined. The mean PCI of the taxiway feature is then estimated as the mean of the 10 sample units. Using the data in Figure 3-11, the PCI of the feature determined using the sample option is as shown in Figure 3-14. The PCI of the 10 sample units is 38, which is close to the true mean of 36, as given in Figure 3-11.

One of the major objectives to random sampling that engineers sometimes express is the problem of not including a very poor or excellent sample unit(s) which may exist in the feature. However, one or more additional samples may be selected by the engineer if desired; but the following equation must then be used to compute the mean PCI:

$$PCI_f = \frac{(N - C)}{N} \overline{PCI}_1 + \frac{C}{N} \overline{PCI}_2 \qquad (3\text{-}2)$$

where PCI_f = mean PCI of feature

N = total number of sample units in the feature

C = number of additional sample units

$\overline{PCI}_1$ = arithmetic mean of PCI for random units

$\overline{PCI}_2$ = arithmetic mean of PCI for the additional sample units.

For example, if the mean PCI of the 10 sample units previously discussed was 38, and one additional section, which was inspected because it had serious distress, had a PCI of 10, the final PCI_f of the feature would be computed as:

$$PCI_f = \frac{(25-1)}{25}(38) + \frac{1}{25}(10) = 37.$$

3-6. Pavement Condition Index (PCI) Computer Program. A computer program to compute the PCIs of any number of sample units and features is included in Attachment B. This program provides a rapid means of computing the PCIs when many sample units and/or features are surveyed, and a convenient summary of distress data, sample unit PCI values, and feature PCIs.

3-7. Basic Airfield Data. A considerable amount of basic airfield data are incorporated into the condition survey report. Most of this information is contained in construction and maintenance records, and in previous pavement condition survey reports which are usually available in the BCE files. To facilitate report preparation, the basic data should be accumulated and maintained by the base pavement engineer in a format similar to the condition survey information items. These items should be compiled at base level for subsequent use in the survey reports as follows:

a. Construction History. The history of maintenance, repair, and reconstruction from original construction of the primary airfield pavement system to the present should be maintained. The data should reflect airfield pavement projects and airfield change projects accomplished by the construction agent, contract services, and BCE work forces.

b. Traffic History. The frequency of full stop landings and takeoffs for each aircraft should be obtained from base operations. The data should be cumulative from earliest records.

c. Weather and Precipitation Data. Annual temperature ranges and precipitation data in the form of a weather summary should be obtained from the base weather office.

d. Plans and cross-sections of all major airfield components should be included in the report. These should be updated to reflect new construction, reconstruction, or overlays upon completion of projects.

e. The Base Comprehensive Plan should be supplemented as necessary to show subsurface drainage systems under the airfield pavements.

f. Grades. Longitudinal and transverse grades should be indicated on runway and taxiway profile and cross-section drawings.

g. Frost Action. If applicable, records of pavement behavior during freezing periods and subsequent thaws should be obtained.

h. Distress Data. All data collected during the condition survey should be stored for future use. A knowledge of the development of distress over time is helpful in determining maintenance and repair needs.

i. Photographs. Photographs depicting both general and specific airfield conditions should be included to illustrate specific pavement conditions. Include an aerial photograph of minimum scale 1:800, current within 3 years.

j. Pavement Condition Survey Reports. All previous pavement condition survey reports should be on hand and maintained in chronological order and referenced in the current report.

3-8. Airfield Pavement Condition Survey Reports. The format for reporting the findings of the airfield condition survey has been designed to preclude the necessity of extensive drafting and typing. The pavement distress data and PCI computations can be presented as directly obtained from the computer program, or manual calculations. Basic airfield data and load-carrying capacity evaluation will primarily reflect changes in airfield pavement systems which have occurred since the last condition survey report. The report should be prepared by the base pavement engineer on a recurring cycle at intervals not to exceed 5 years and should be reviewed by the major command pavement engineer. The PCI condition survey should be performed annually for all the features. The results (preferably the PCI program computer output) should be submitted to the major command engineer for evaluation and further action. If significant changes in the PCI have occurred, the condition survey report should be updated. The update should include Sections 4, 5, 6, and 7 of the report. The condition survey report format is shown in Figure 3-15. The major command engineer should make sure that the format is used to insure that the completed reports are standardized.

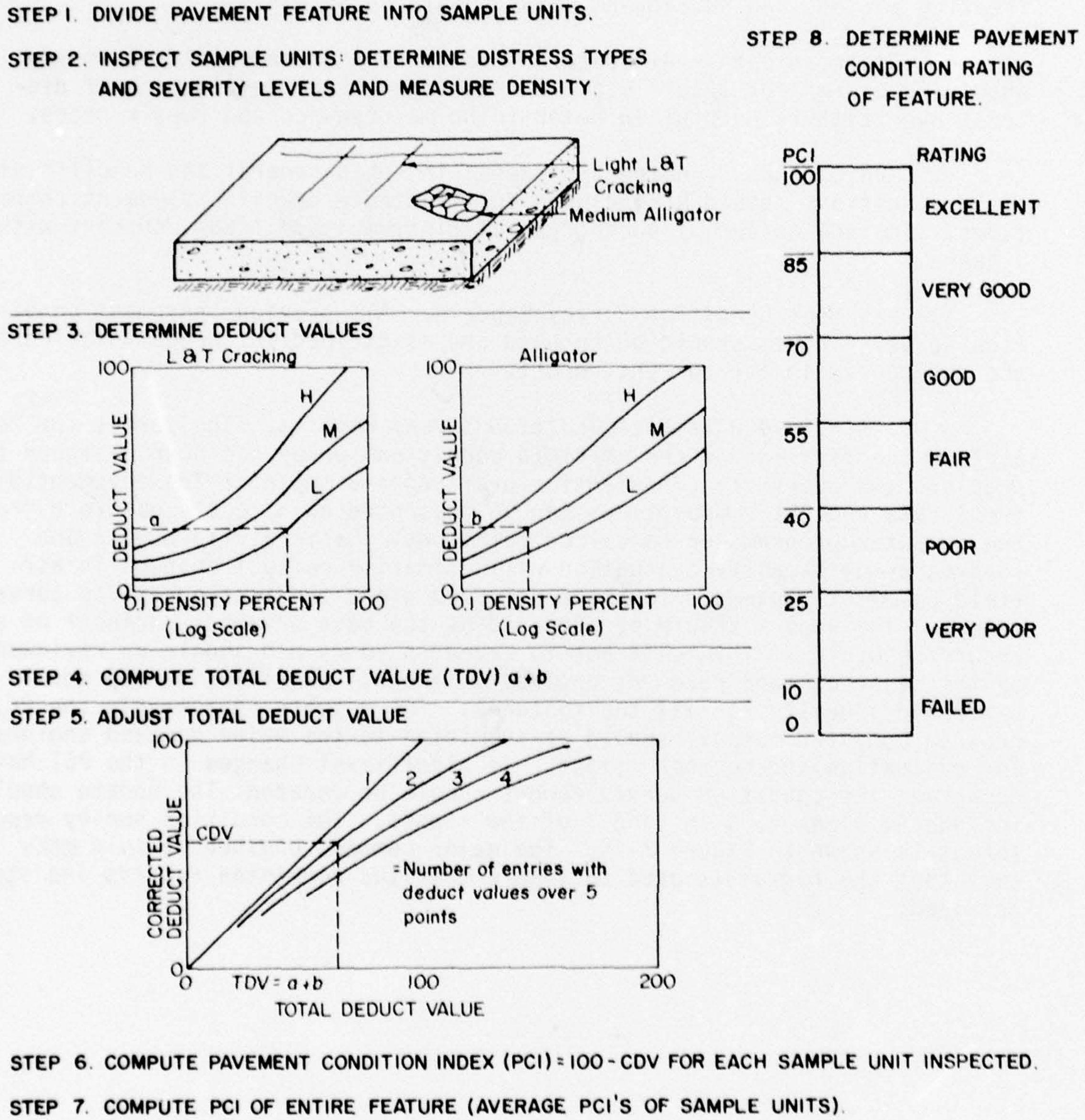


Figure 3-1. Steps for Determining PCI of a Pavement Feature

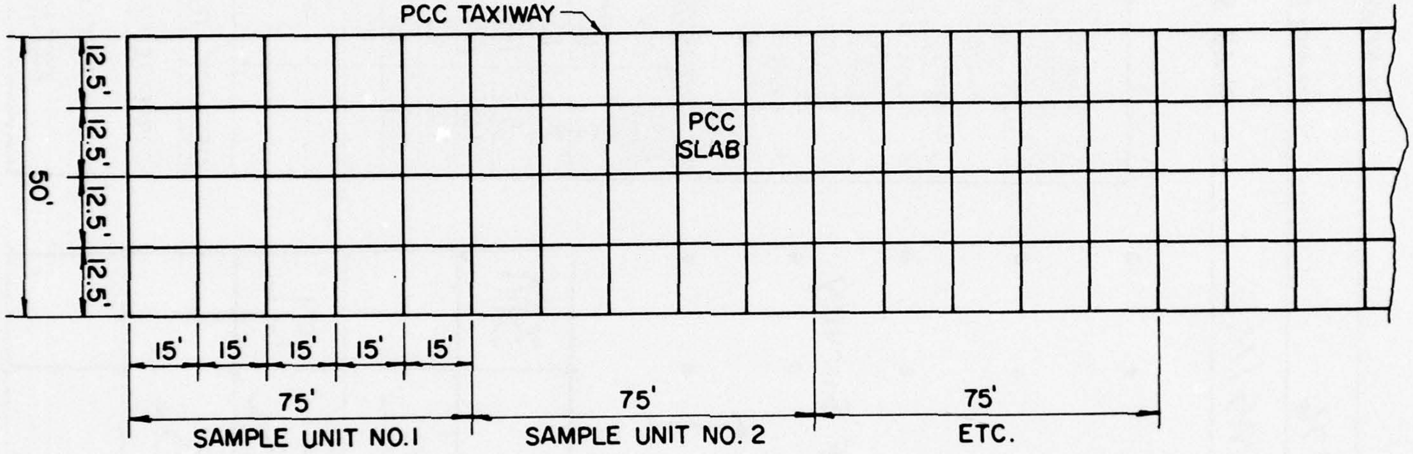


Figure 3-2. Illustration of Division of a Jointed Concrete Pavement Feature Into Sample Units of 20 Slabs

JOINTED CONCRETE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRFIELD Z

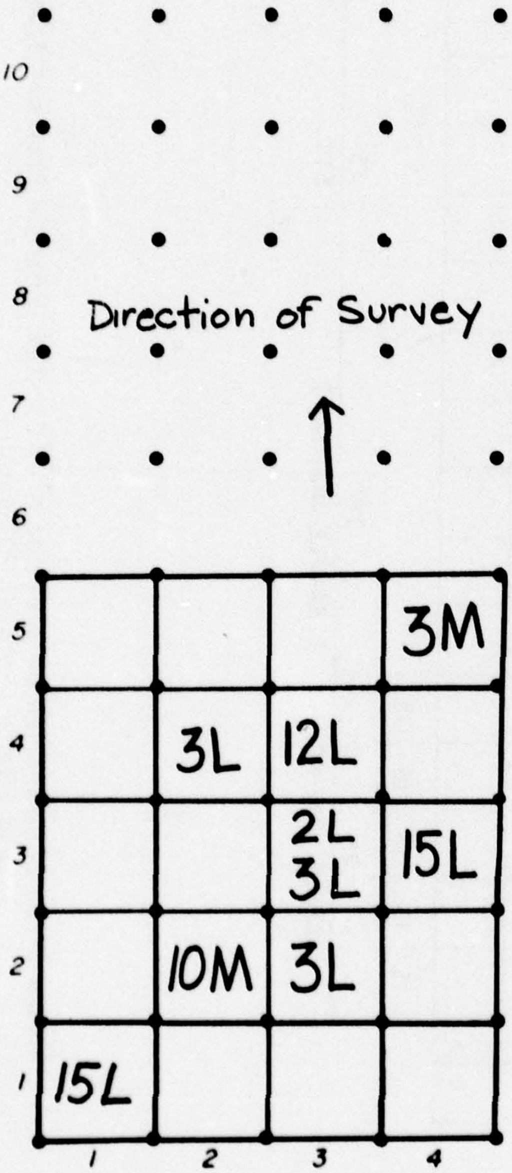
FEATURE TW1

DATE 3/28/76

SAMPLE UNIT No. 1

SURVEYED BY MS/MD

SLAB SIZE 12.5 x 15 ft
20 SLABS



1. Blow-Up
2. Corner Break
3. Longitudinal/ Transverse/ Diagonal Crack
4. "D" Crack
5. Joint Seal Damage
6. Patching, < 5 ft^2
7. Patching/ Utility Cut
8. Popouts
9. Pumping
10. Scaling/Map Crack/Crazing
11. Settlement/ Fault
12. Shattered Slab
13. Shrinkage Crack
14. Spalling -- Joints
15. Spalling -- Corner

DIST. TYPE	SEV.	NO. SLABS	% SLABS	DEDUCT VALUE
2	L	1	5	4
3	L	3	15	11
3	M	1	5	11
10	M	1	5	7
12	L	1	5	10
15	L	2	10	3

DEDUCT TOTAL 46

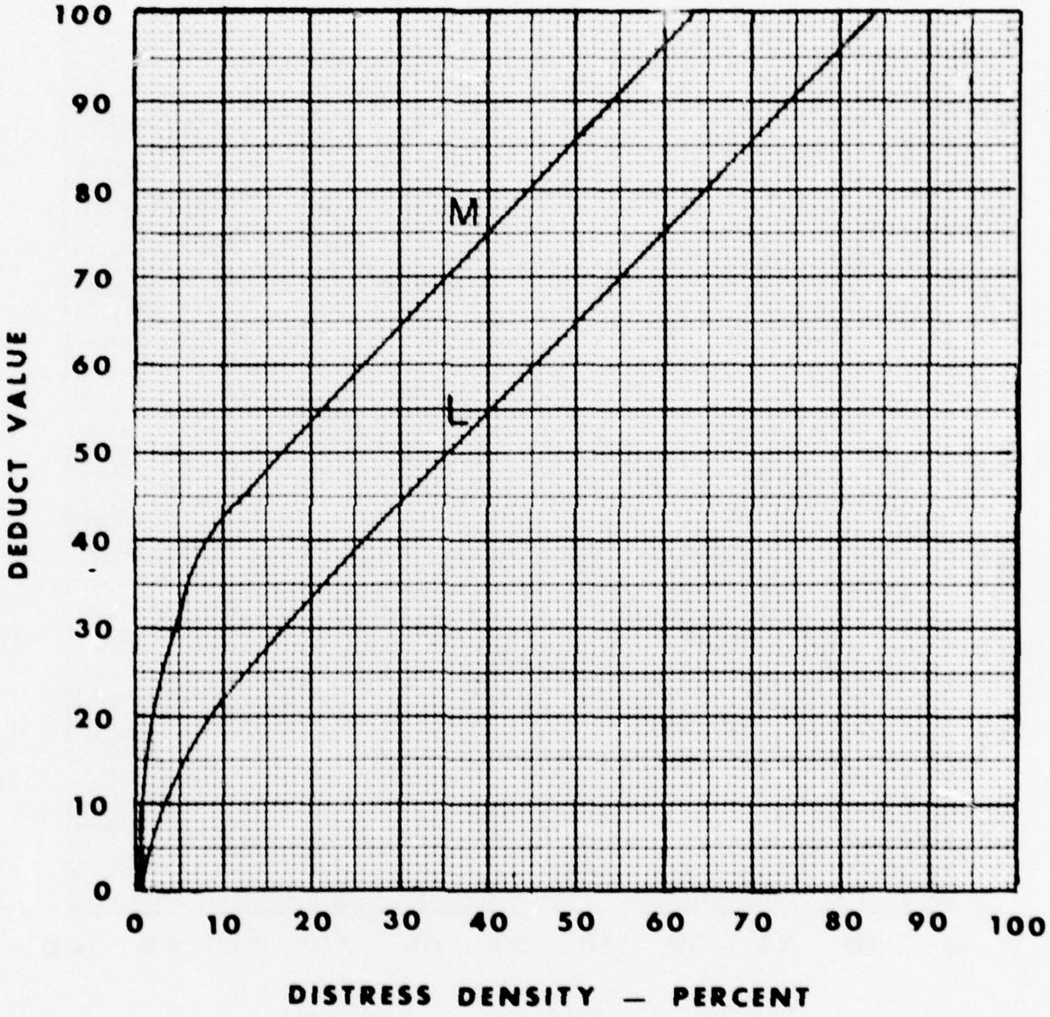
CORRECTED DEDUCT VALUE (CDV) 32

PCI = 100 − CDV = 68

RATING = GOOD

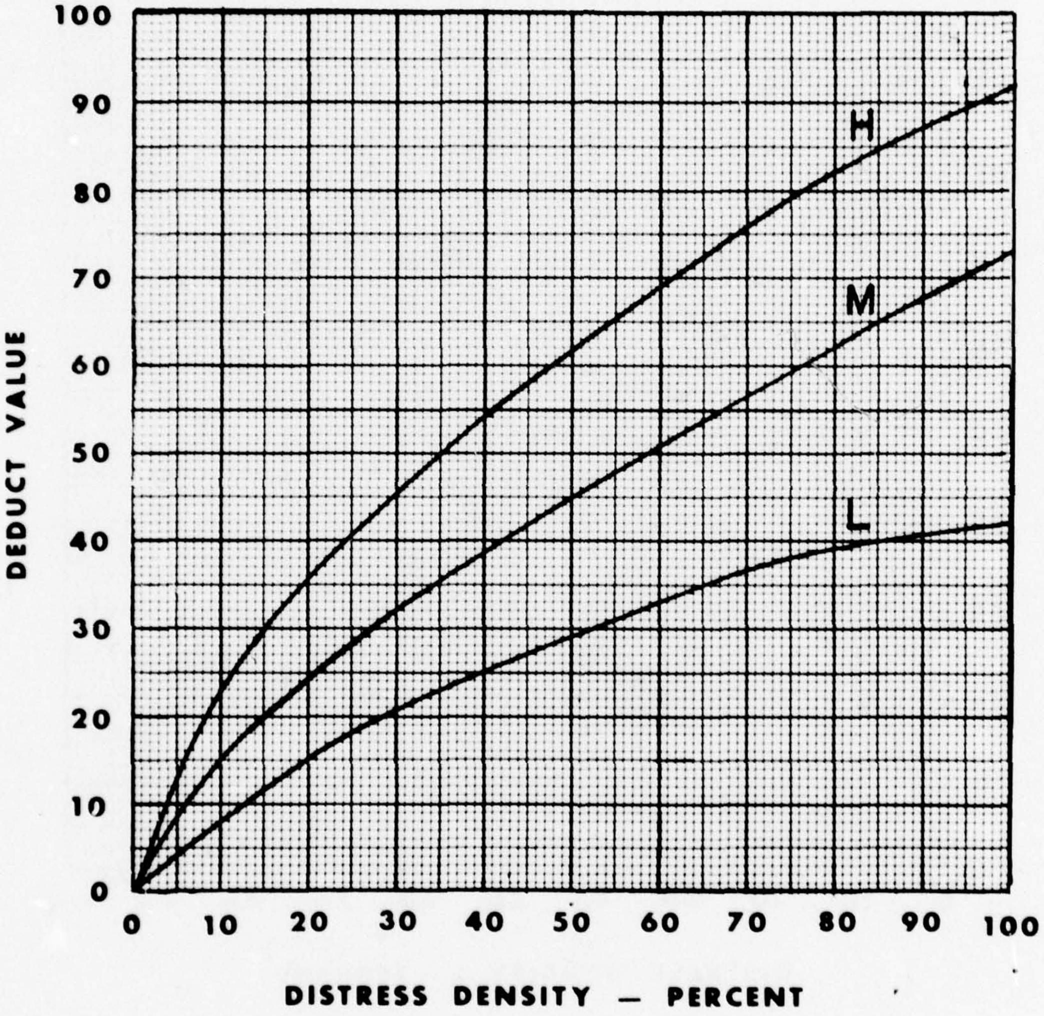
Figure 3-3. Jointed Concrete Pavements - Condition Survey Data Sheet

NOTE: High severity blow-up renders the pavement inoperative, therefore a deduct value of 100 should be used regardless of density.



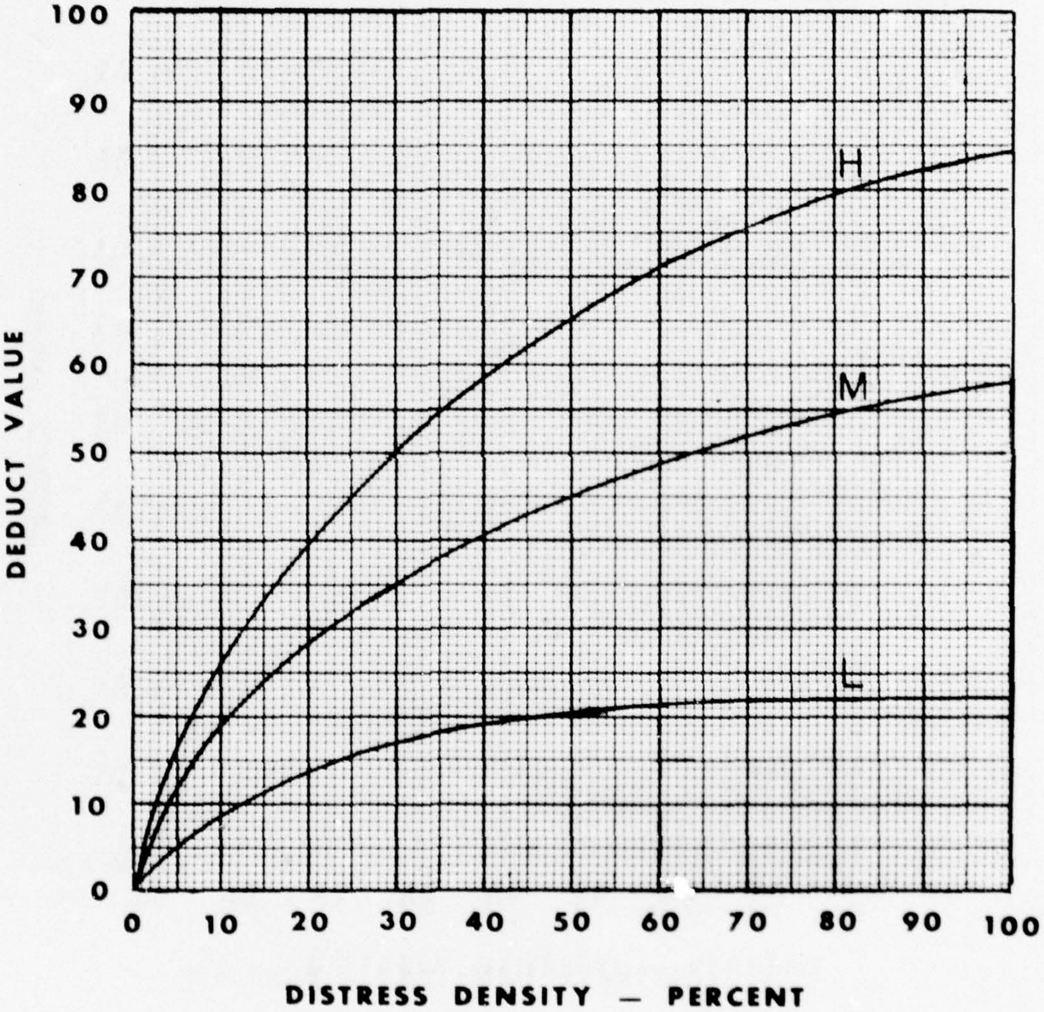
1. Blow-up.

Figure 3-4. Jointed Concrete Distress Deduct Values



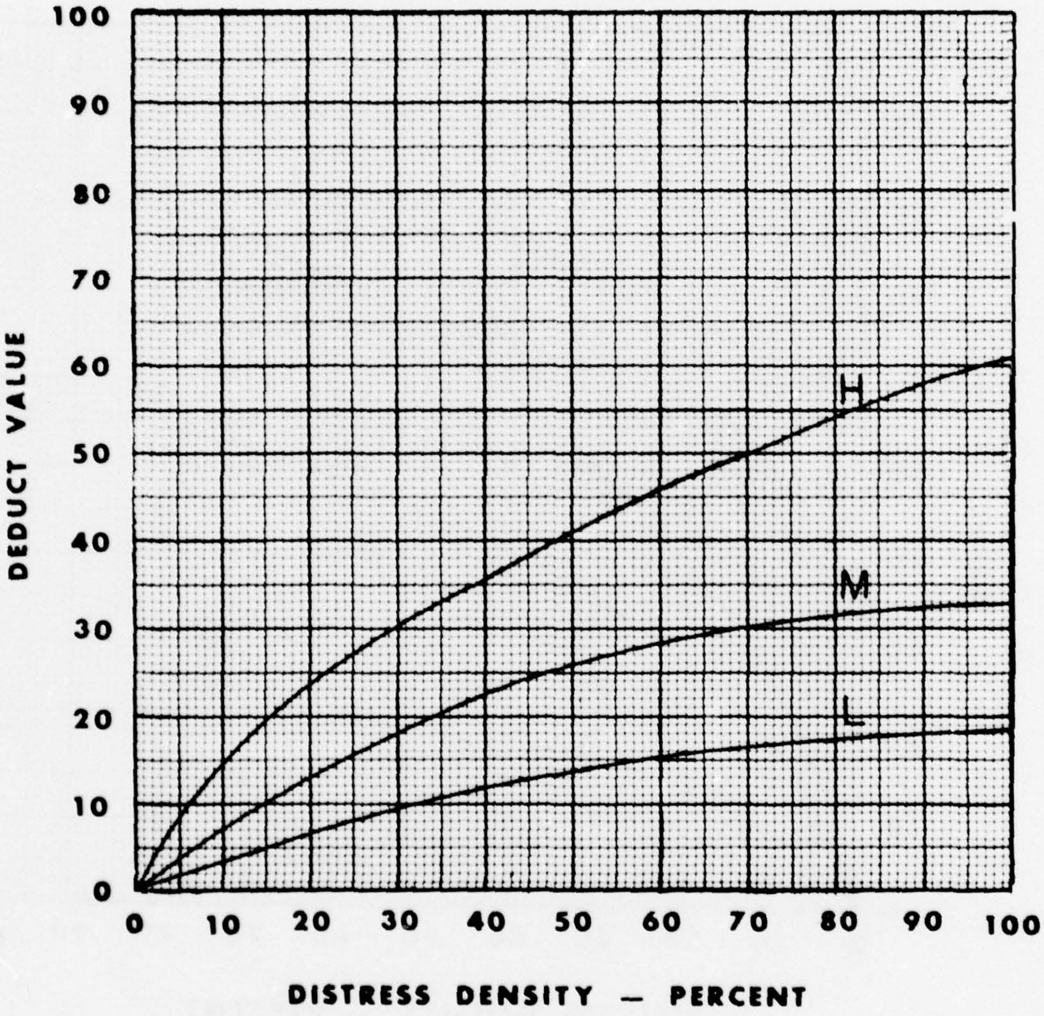
2. Corner break.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



3. Longitudinal/transverse/diagonal cracking.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



4. Durability cracking.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)

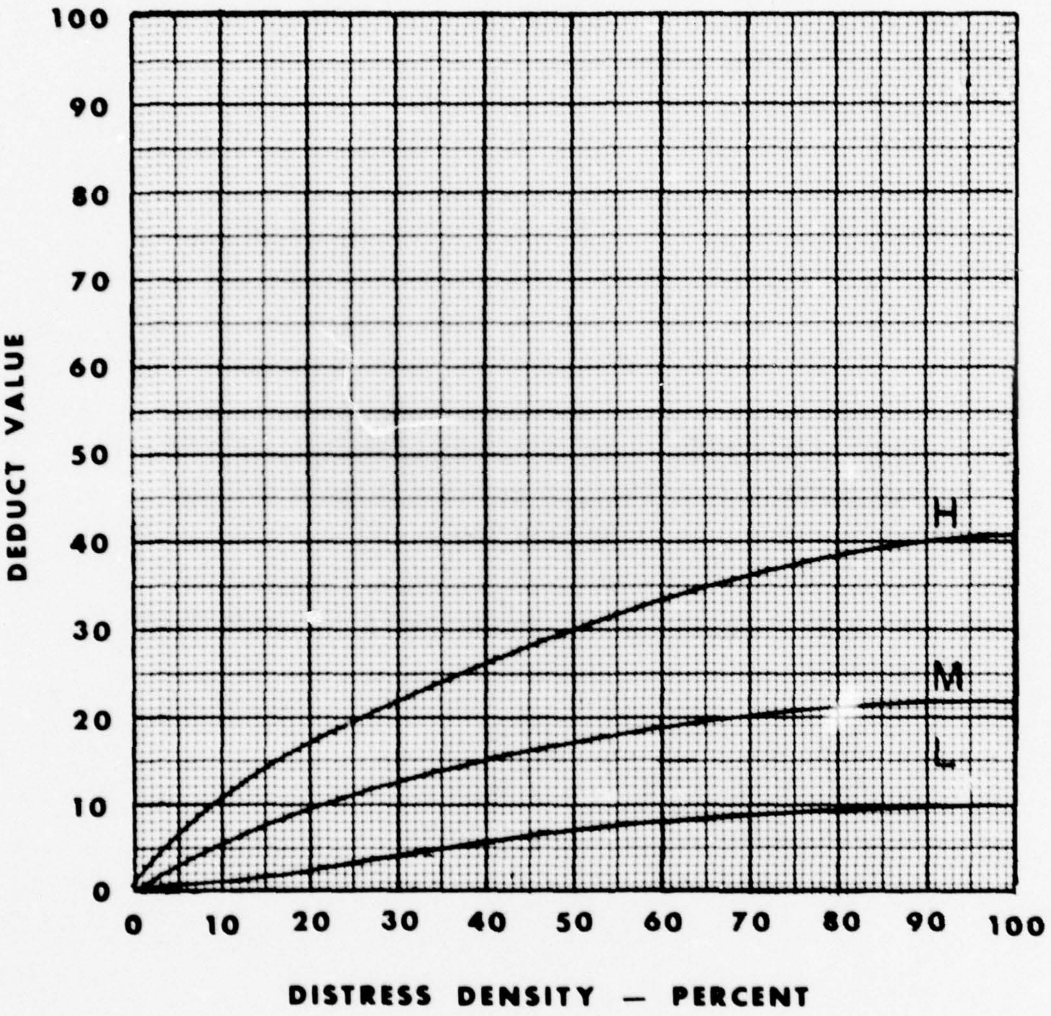
JOINT SEAL DAMAGE IS NOT RATED BY DENSITY. THE SEVERITY OF THE DISTRESS IS DETERMINED BY THE SEALANT'S OVERALL CONDITION FOR A PARTICULAR SECTION.

THE DEDUCT VALUES FOR THE THREE LEVELS OF SEVERITY ARE AS FOLLOWS:

1. HIGH SEVERITY - 12 POINTS
2. MEDIUM SEVERITY - 7 POINTS
3. LOW SEVERITY - 2 POINTS

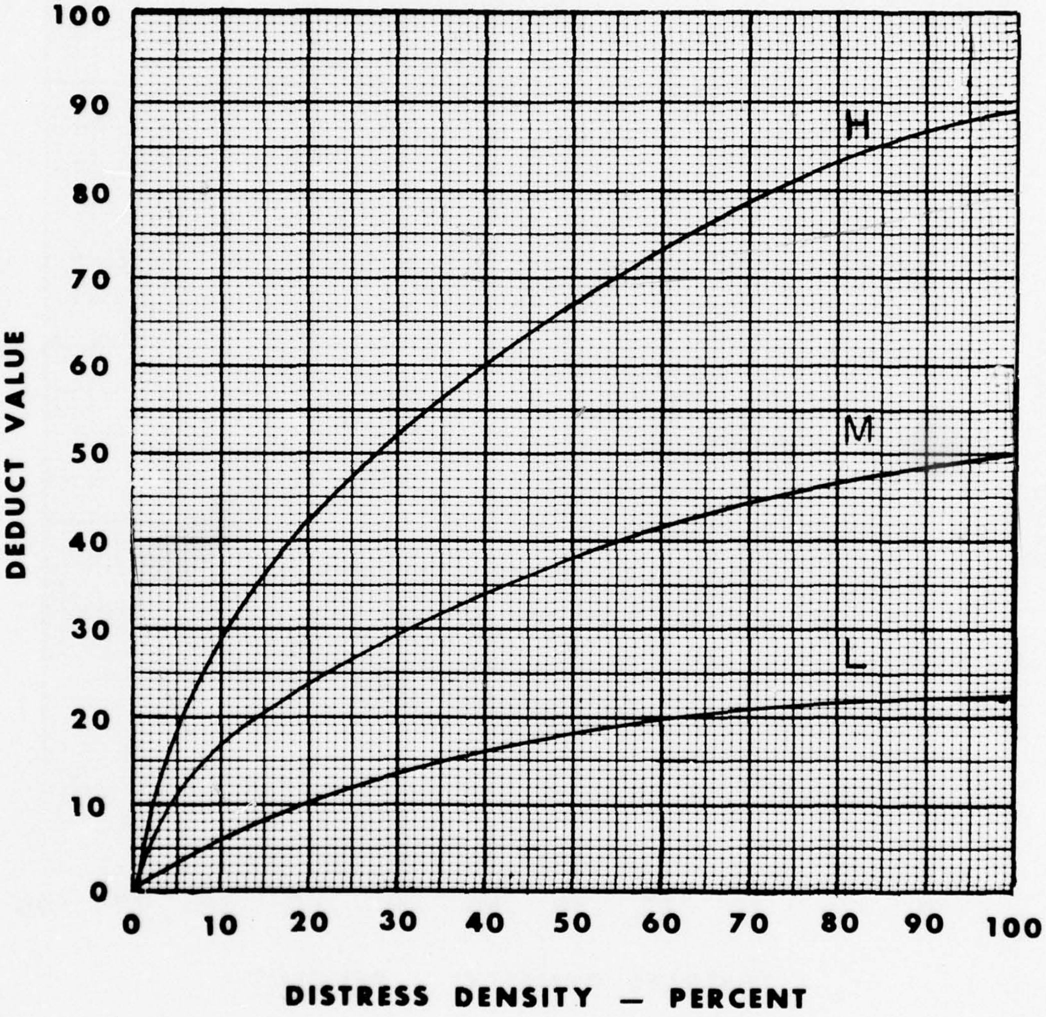
5. Joint seal damage.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



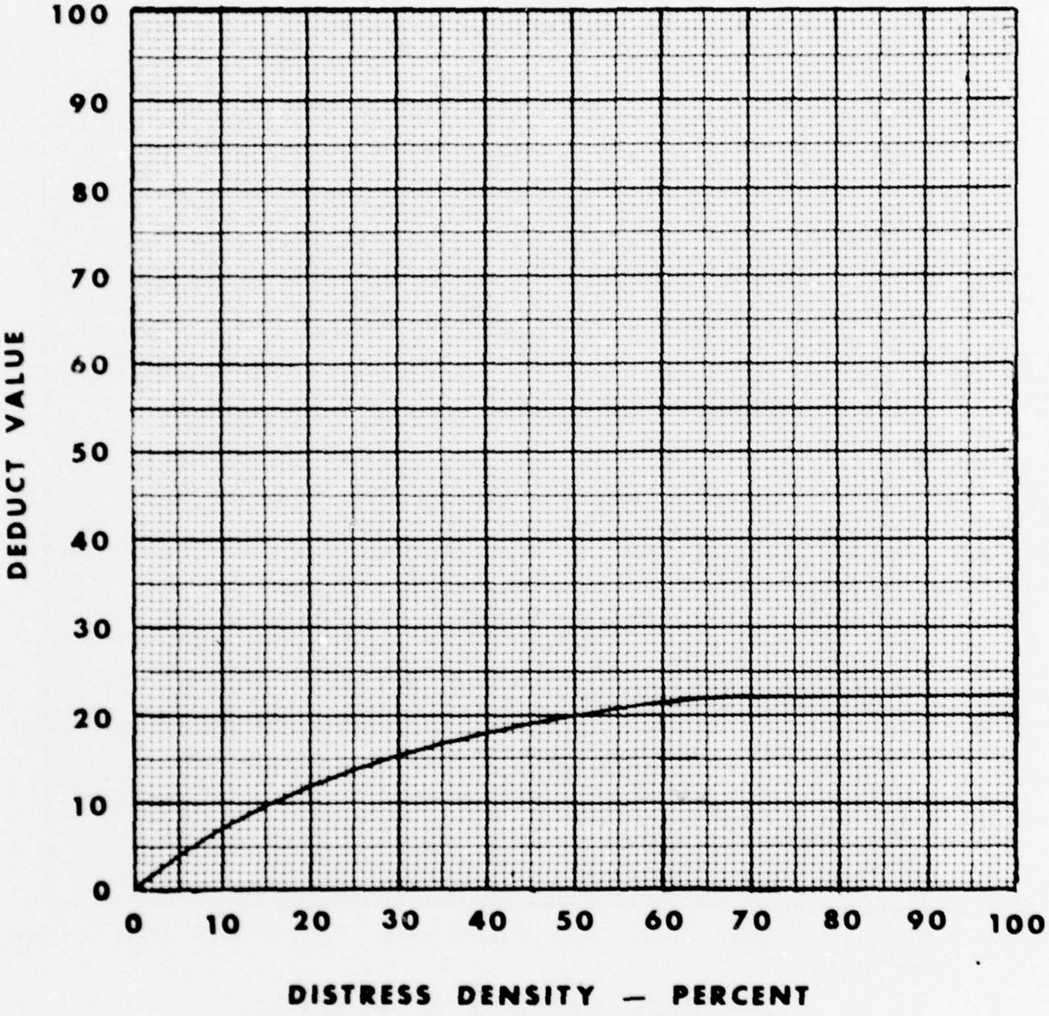
6. Small patch.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



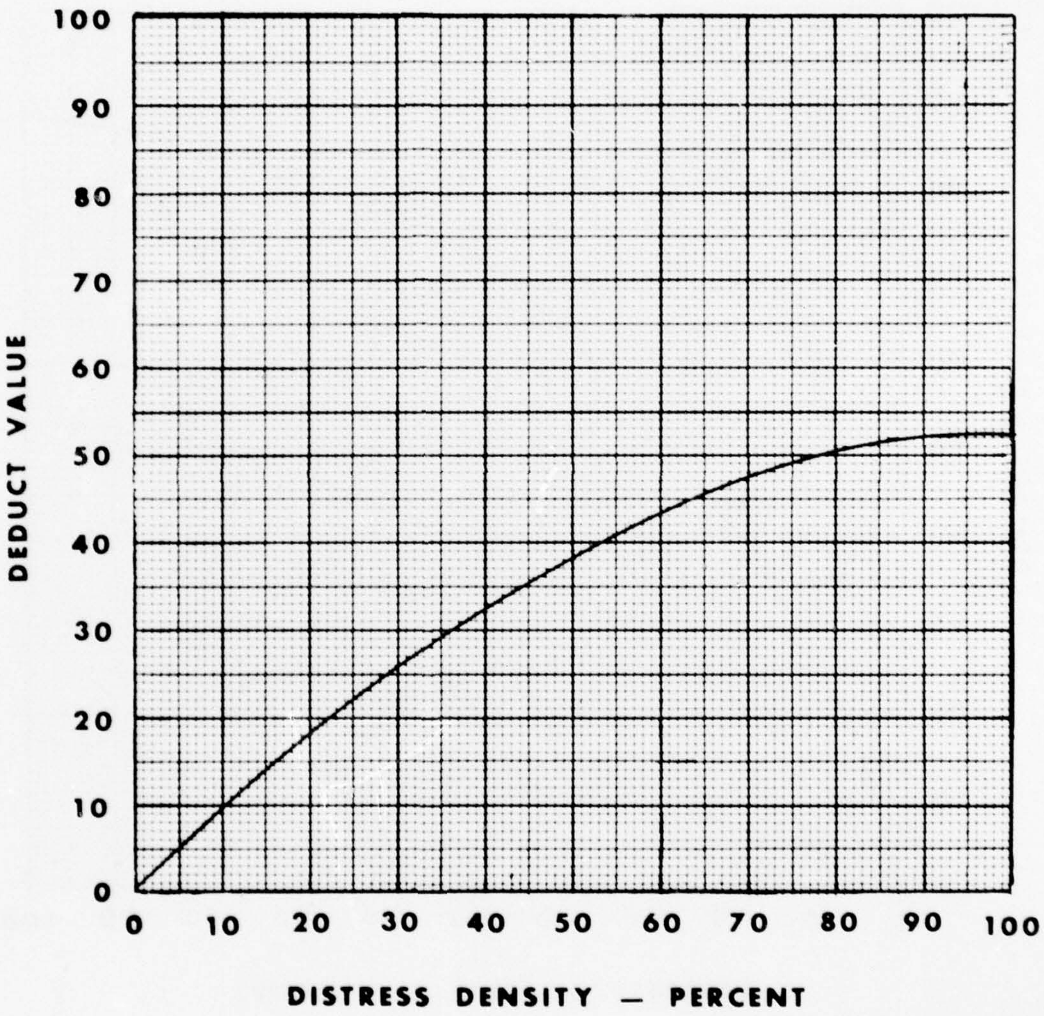
7. Patching/utility cut defect.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



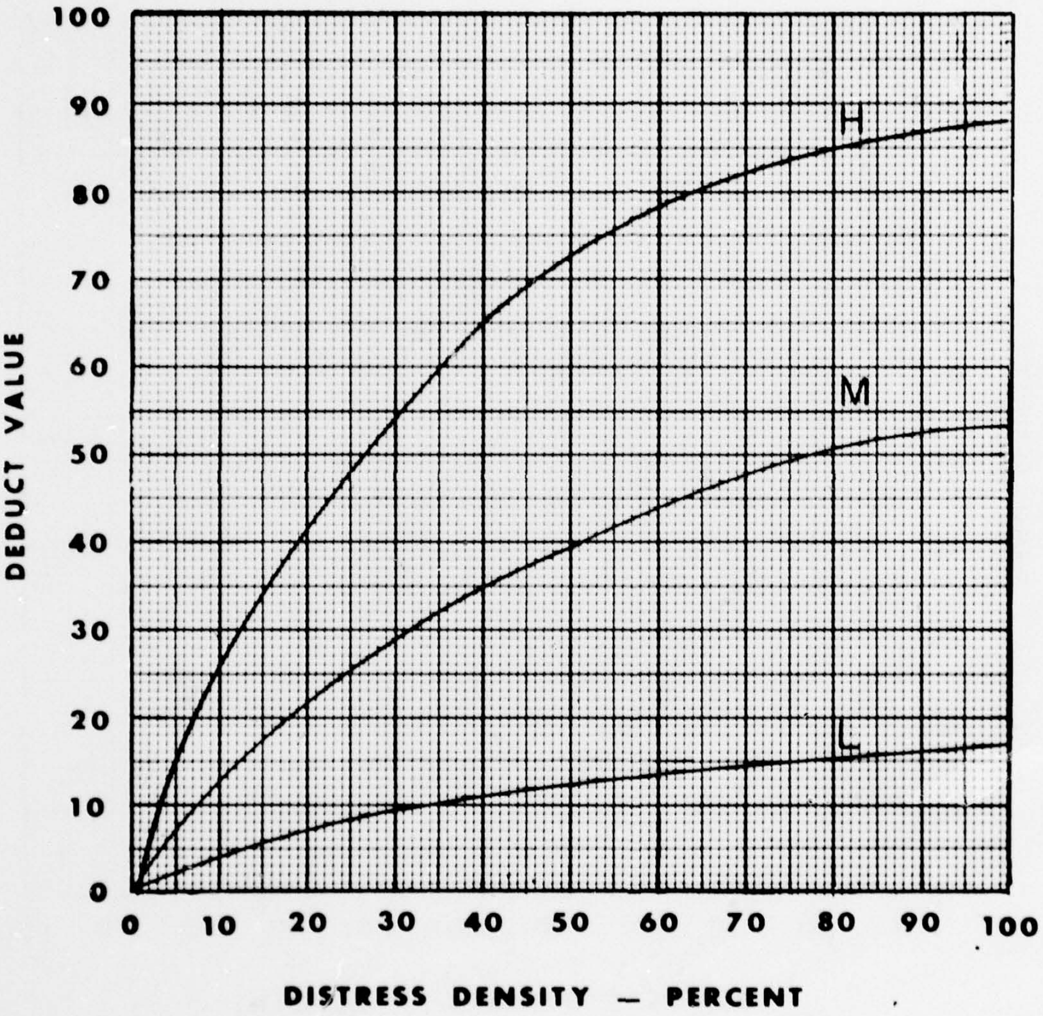
8. Popouts.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



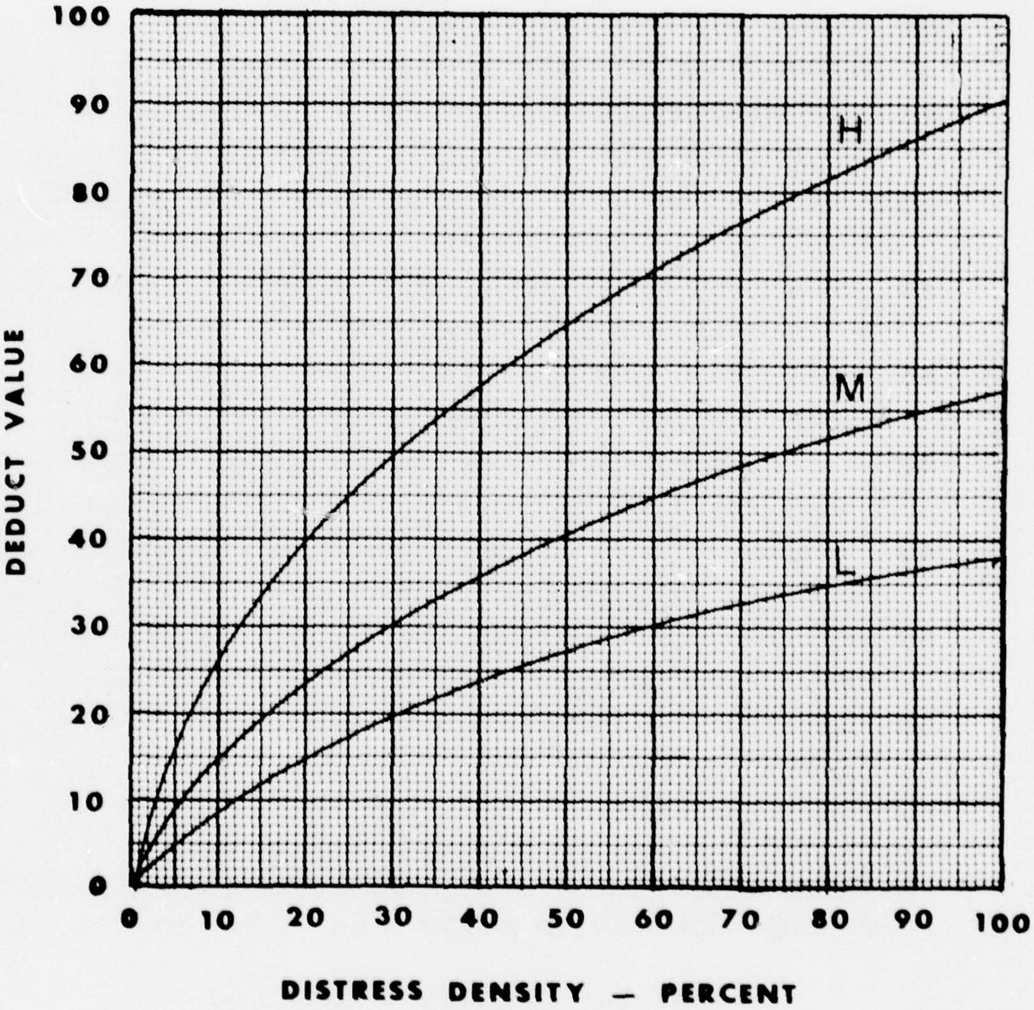
9. Pumping.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



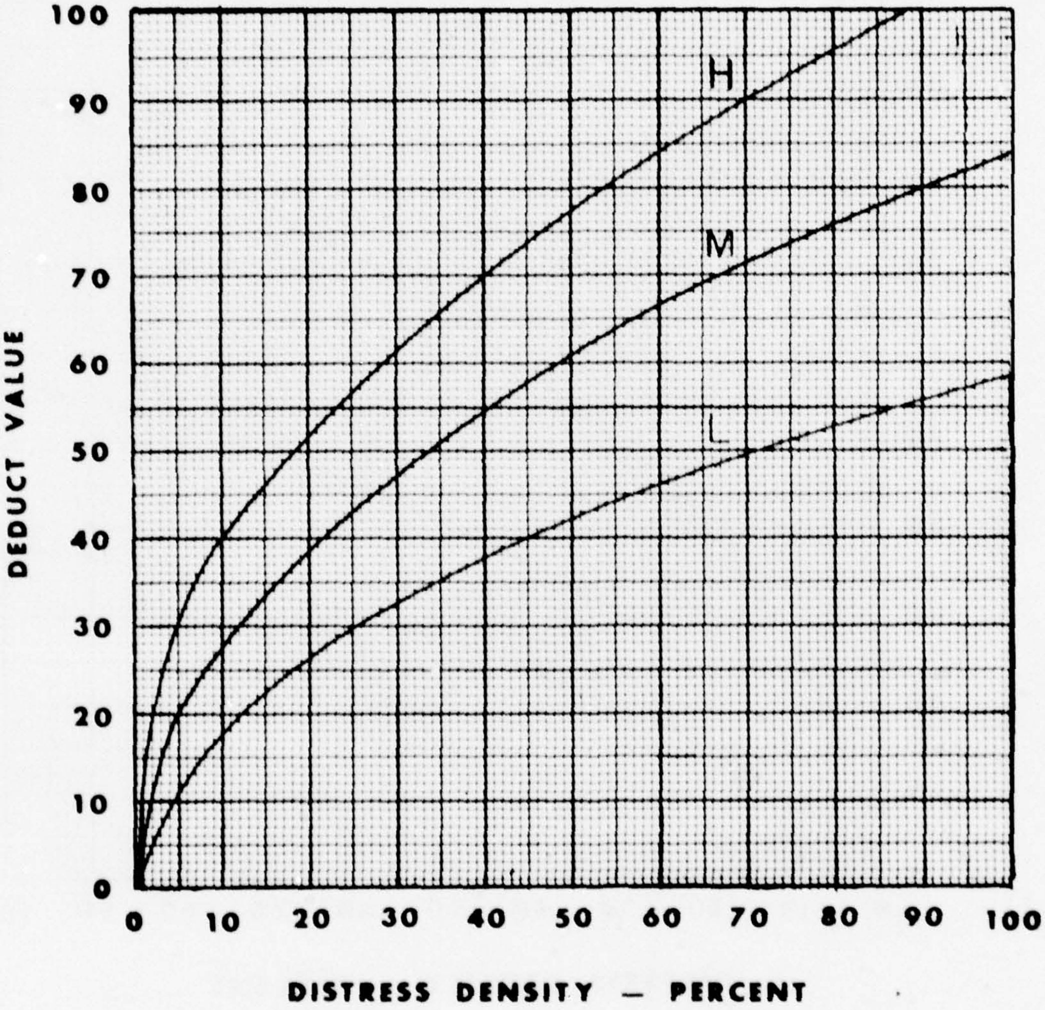
10. Scaling.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



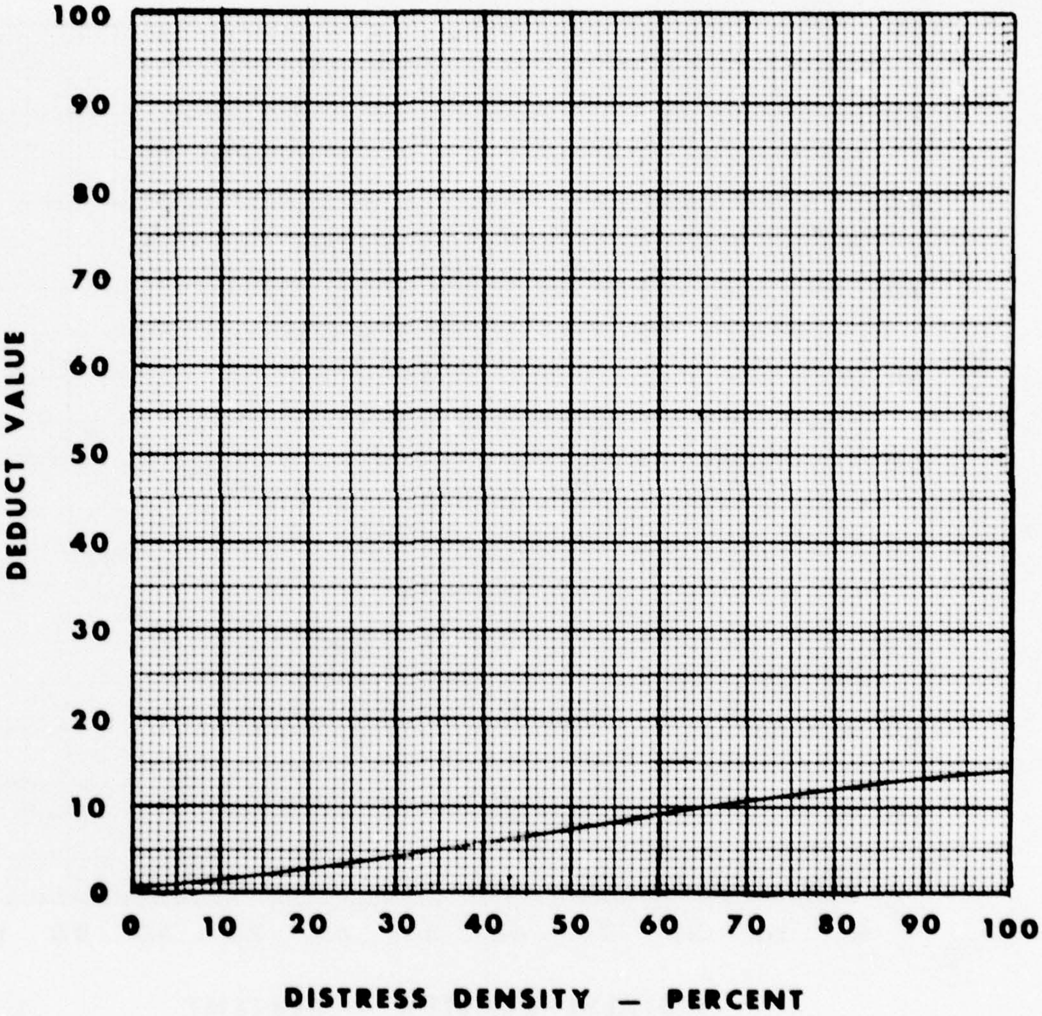
11. Settlement.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



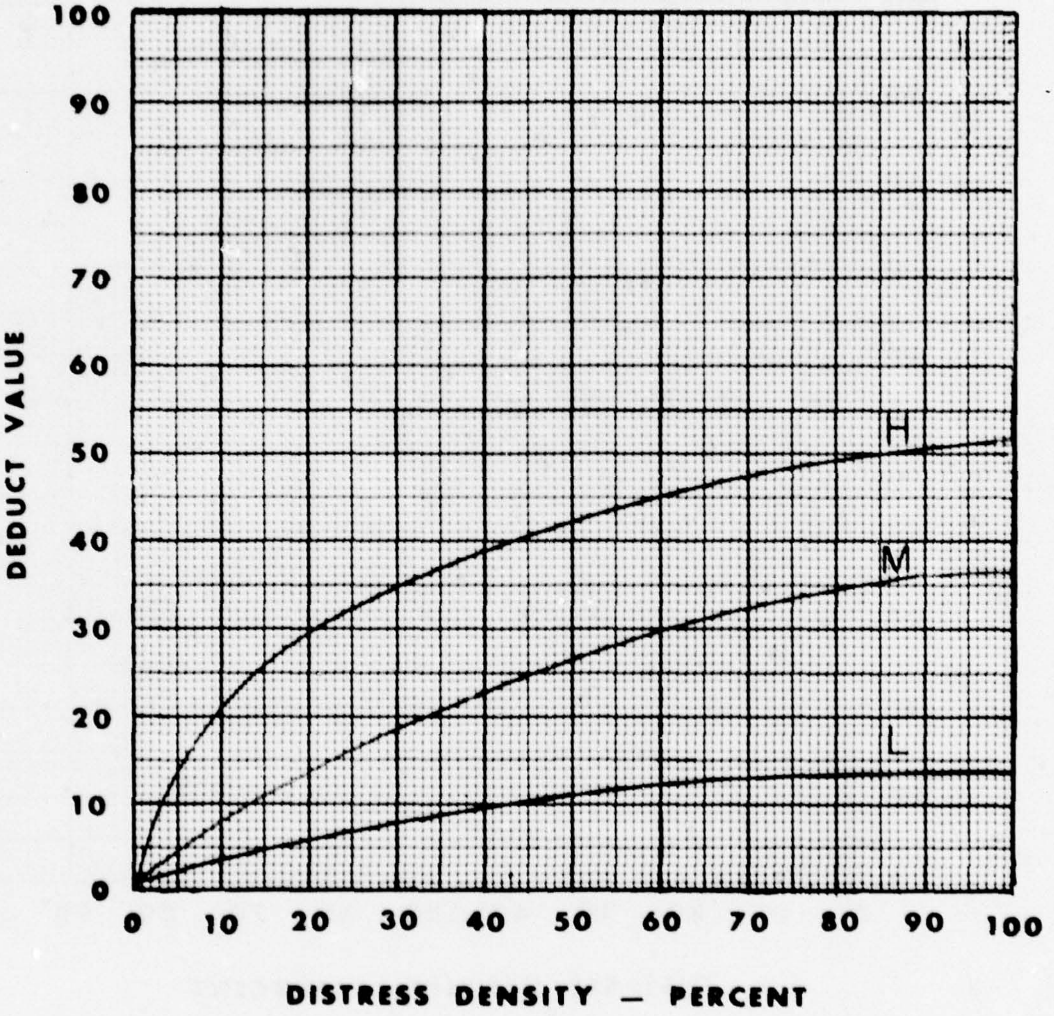
12. Shattered slab.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



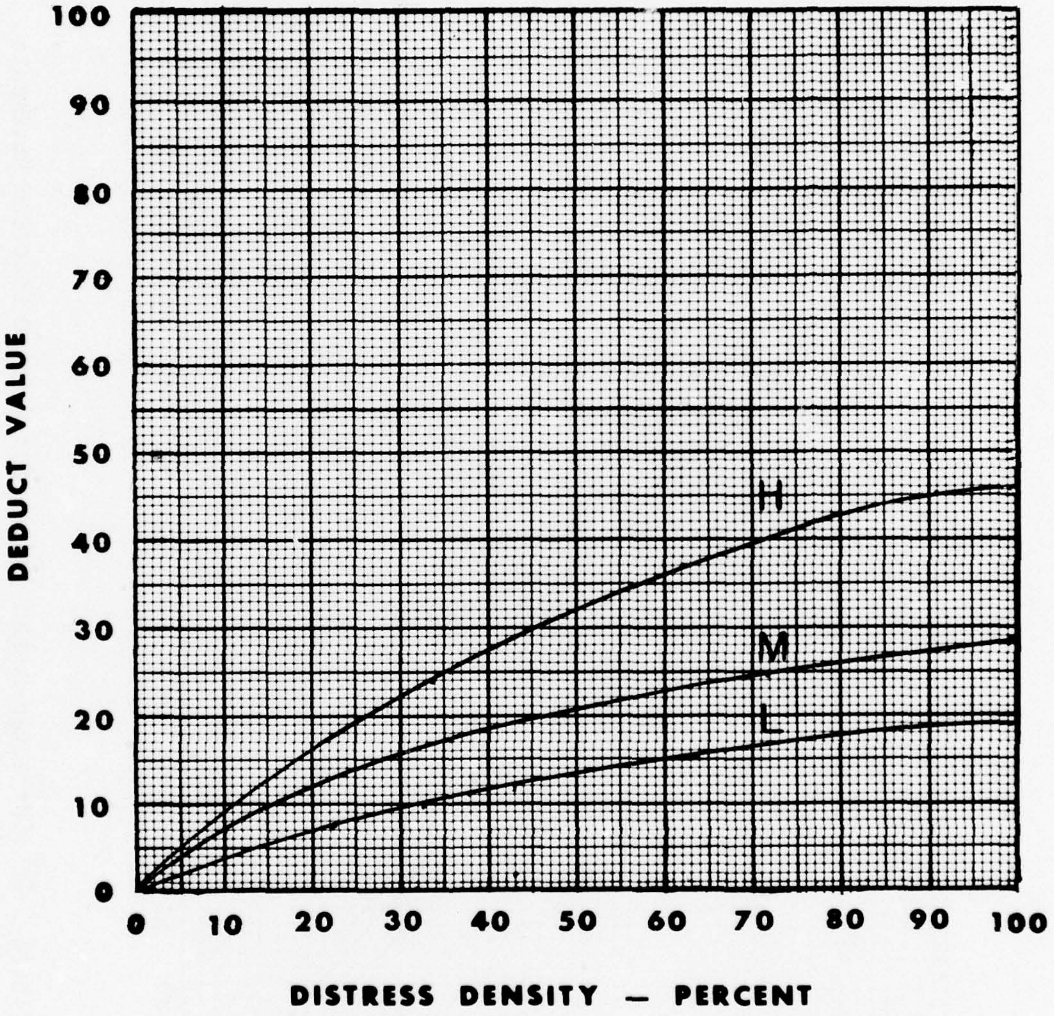
13. Shrinkage cracks.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



14. Spalling along the joints.

Figure 3-4. Jointed Concrete Distress Deduct Values (continued)



15. Spalling corner.

Figure 3-4. Jointed Concrete Distress Deduct Values (concluded)

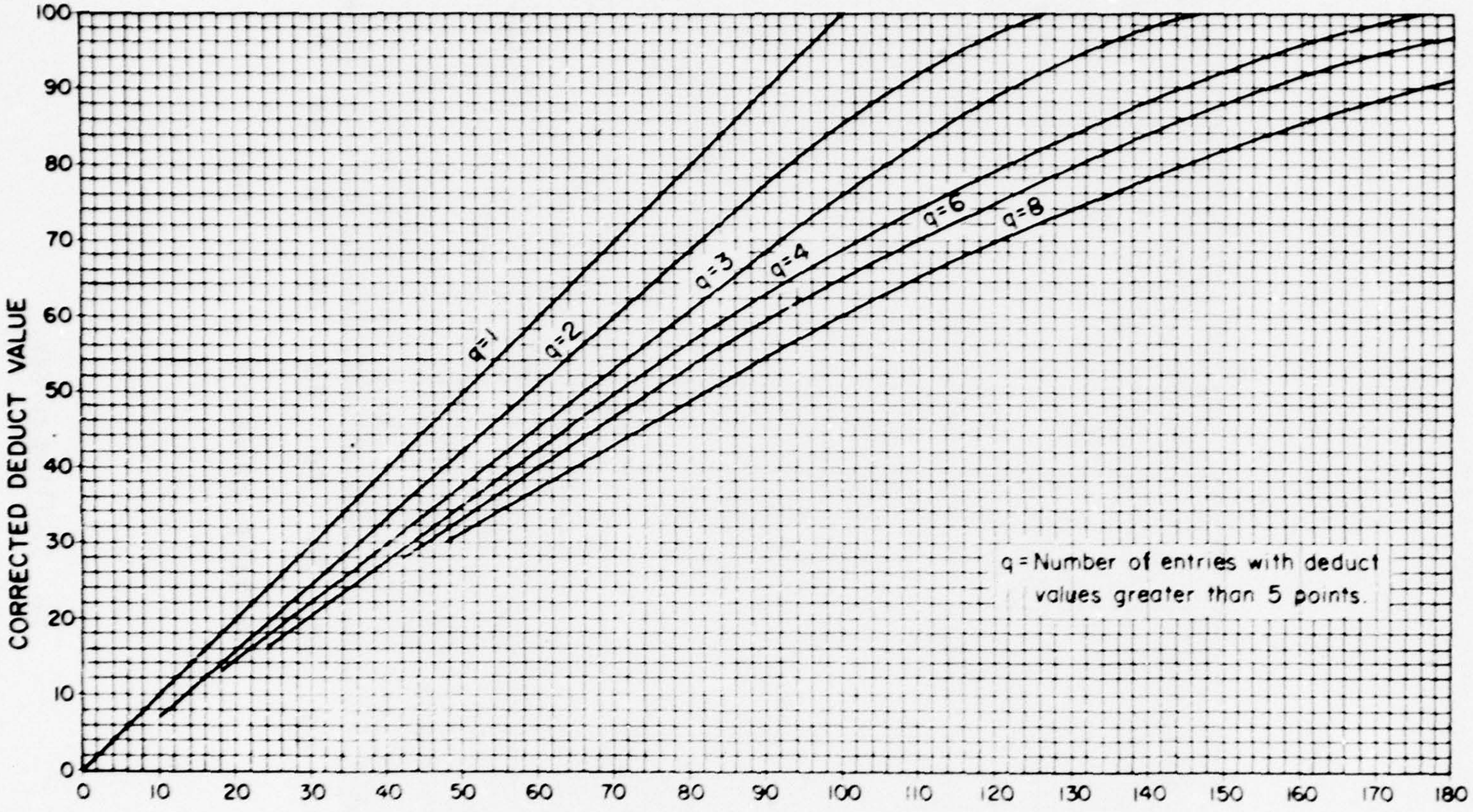


Figure 3-5. Corrected Deduct Values for Jointed Concrete Pavements

Pavement Feature: Taxiway 1

Total No. of Units: 5

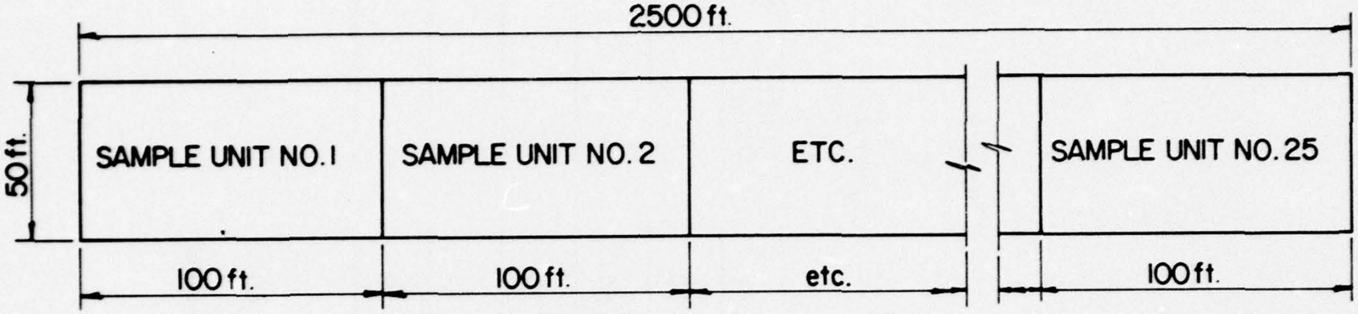
Date of Survey: 3/28/76

Unit No.	No. of Slabs	Slab Size	PCI	Unit No.	No. of Slabs	Slab Size	PCI
1	20	12.5x15	60				
2	20	12.5x15	64				
3	20	12.5x15	74				
4	20	12.5x15	74				
5	20	12.5x15	28				

Average PCI for feature: 60

Condition rating: Good

Figure 3-6. Feature Summary - Jointed Concrete Pavement

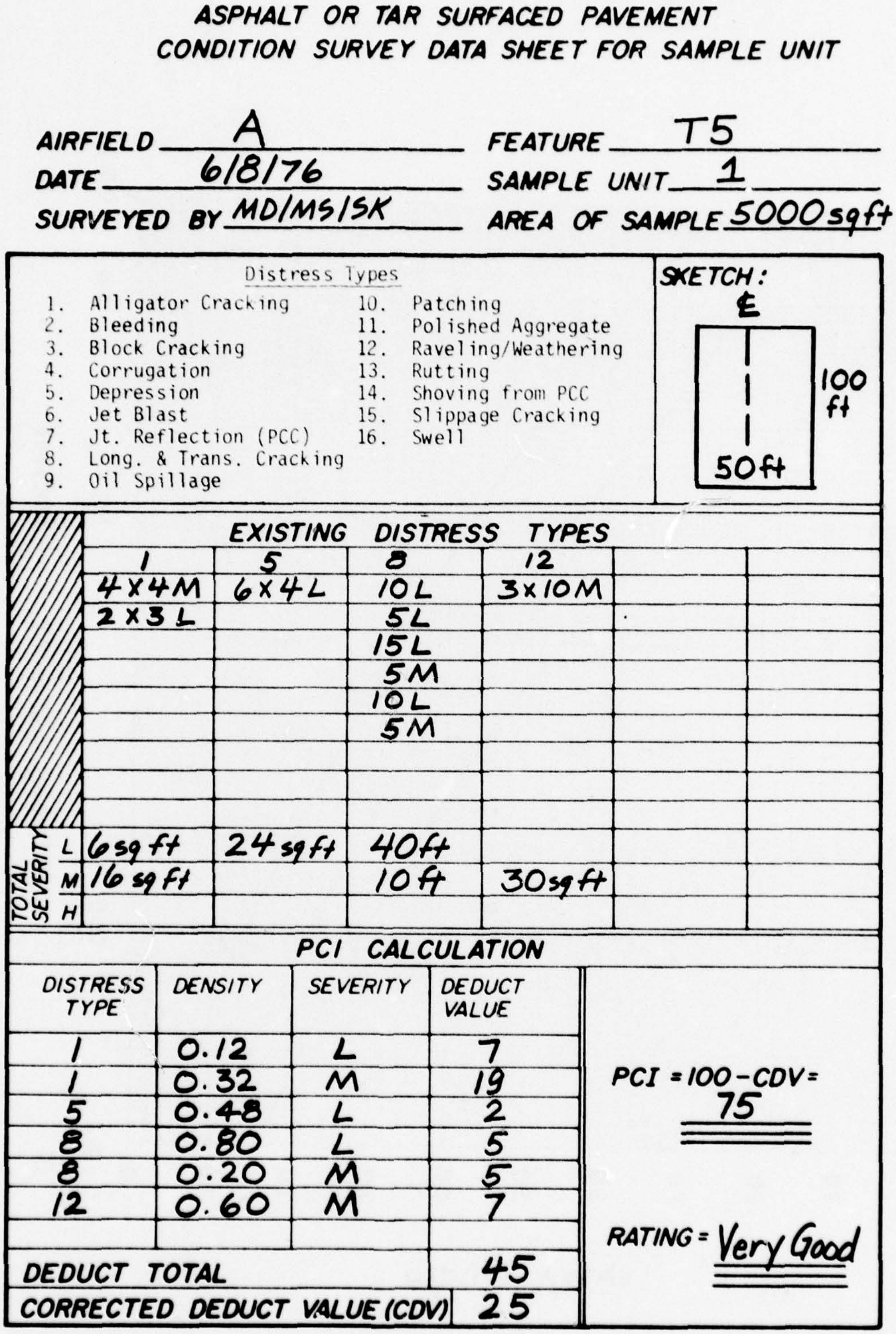


Feature Dimension = 50 x 2500 ft.

Sample Unit = 50 x 100 ft.

Number of Sample Units = 25

Figure 3-7. Example Division of Asphalt- or Tar-Surfaced Pavement Feature Into Sample Units



ASPHALT OR TAR SURFACED PAVEMENT CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRFIELD A
FEATURE T5
DATE 6/8/76
SAMPLE UNIT 1
SURVEYED BY MD/MS/SK
AREA OF SAMPLE 5000 sq ft

Distress Types

1. Alligator Cracking
2. Bleeding
3. Block Cracking
4. Corrugation
5. Depression
6. Jet Blast
7. Jt. Reflection (PCC)
8. Long. & Trans. Cracking
9. Oil Spillage
10. Patching
11. Polished Aggregate
12. Raveling/Weathering
13. Rutting
14. Shoving from PCC
15. Slippage Cracking
16. Swell

SKETCH:

EXISTING DISTRESS TYPES

	1	5	8	12		
	4 X 4 M	6 X 4 L	10 L	3 X 10 M		
	2 X 3 L		5 L			
			15 L			
			5 M			
			10 L			
			5 M			
TOTAL SEVERITY L	6 sq ft	24 sq ft	40 ft			
TOTAL SEVERITY M	16 sq ft		10 ft	30 sq ft		
TOTAL SEVERITY H						

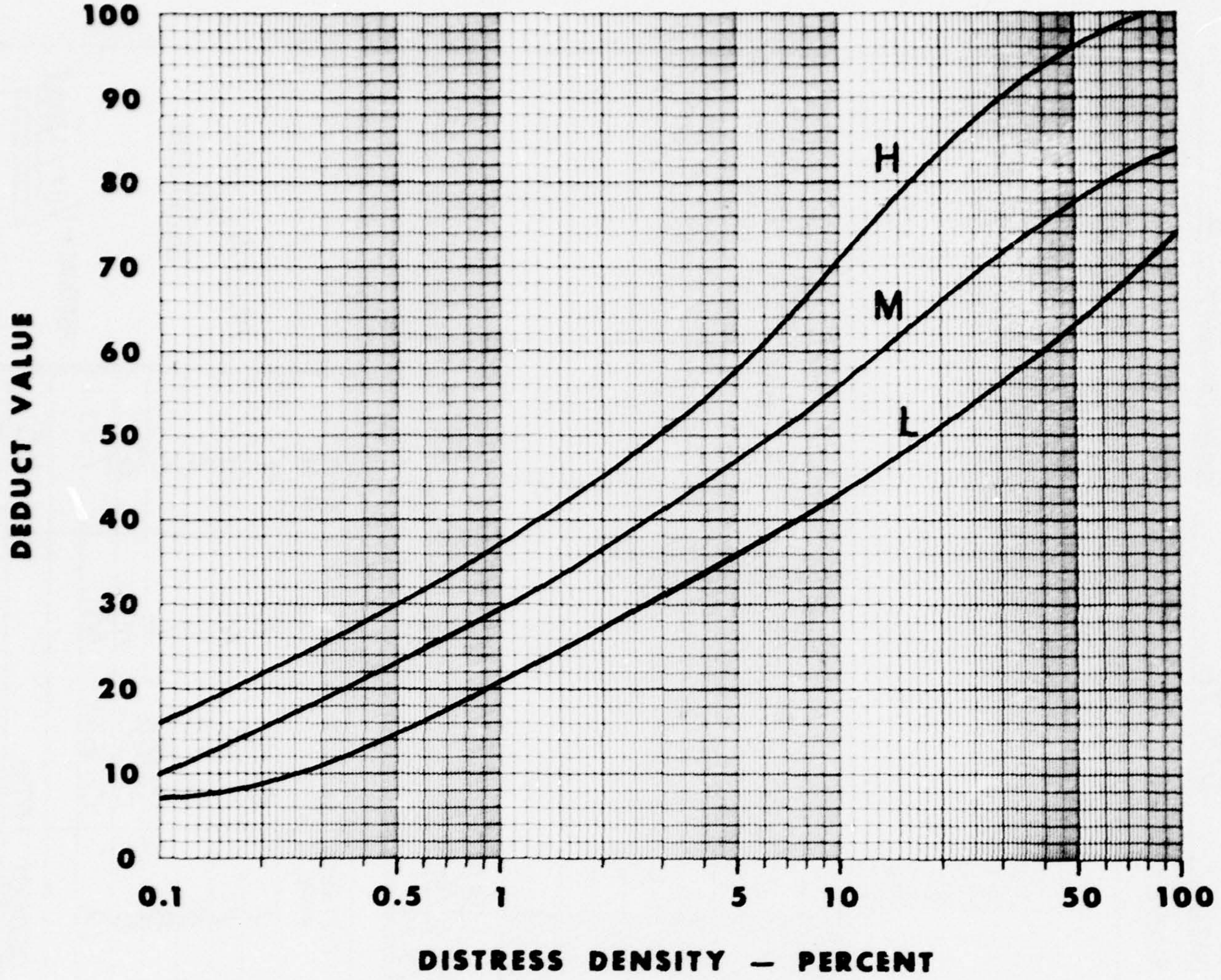
PCI CALCULATION

DISTRESS TYPE	DENSITY	SEVERITY	DEDUCT VALUE
1	0.12	L	7
1	0.32	M	19
5	0.48	L	2
8	0.80	L	5
8	0.20	M	5
12	0.60	M	7
DEDUCT TOTAL			45
CORRECTED DEDUCT VALUE (CDV)			25

PCI = 100 - CDV = 75

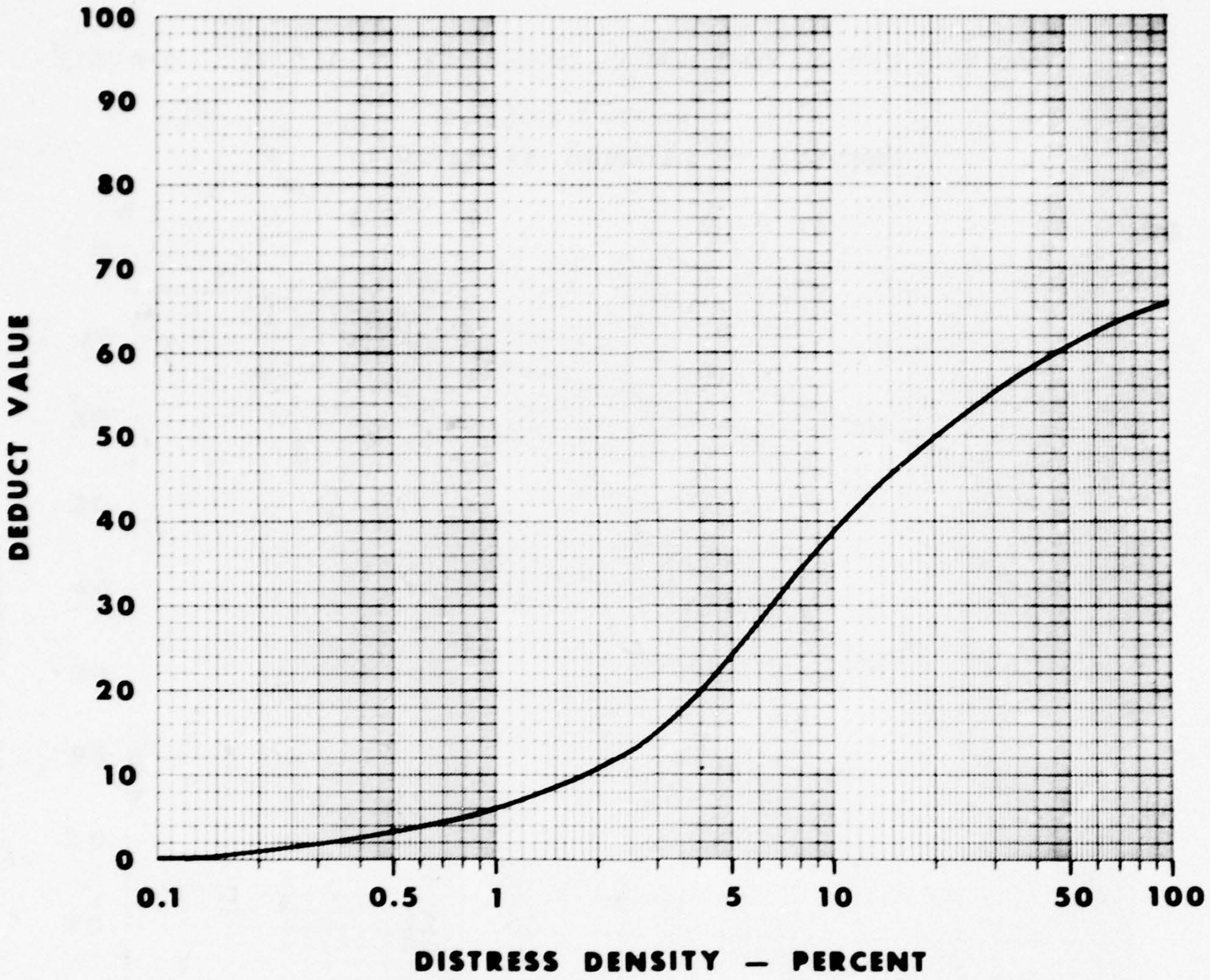
RATING = Very Good

Figure 3-8. Asphalt- or Tar-Surfaced Pavements - Condition Survey Data Sheet



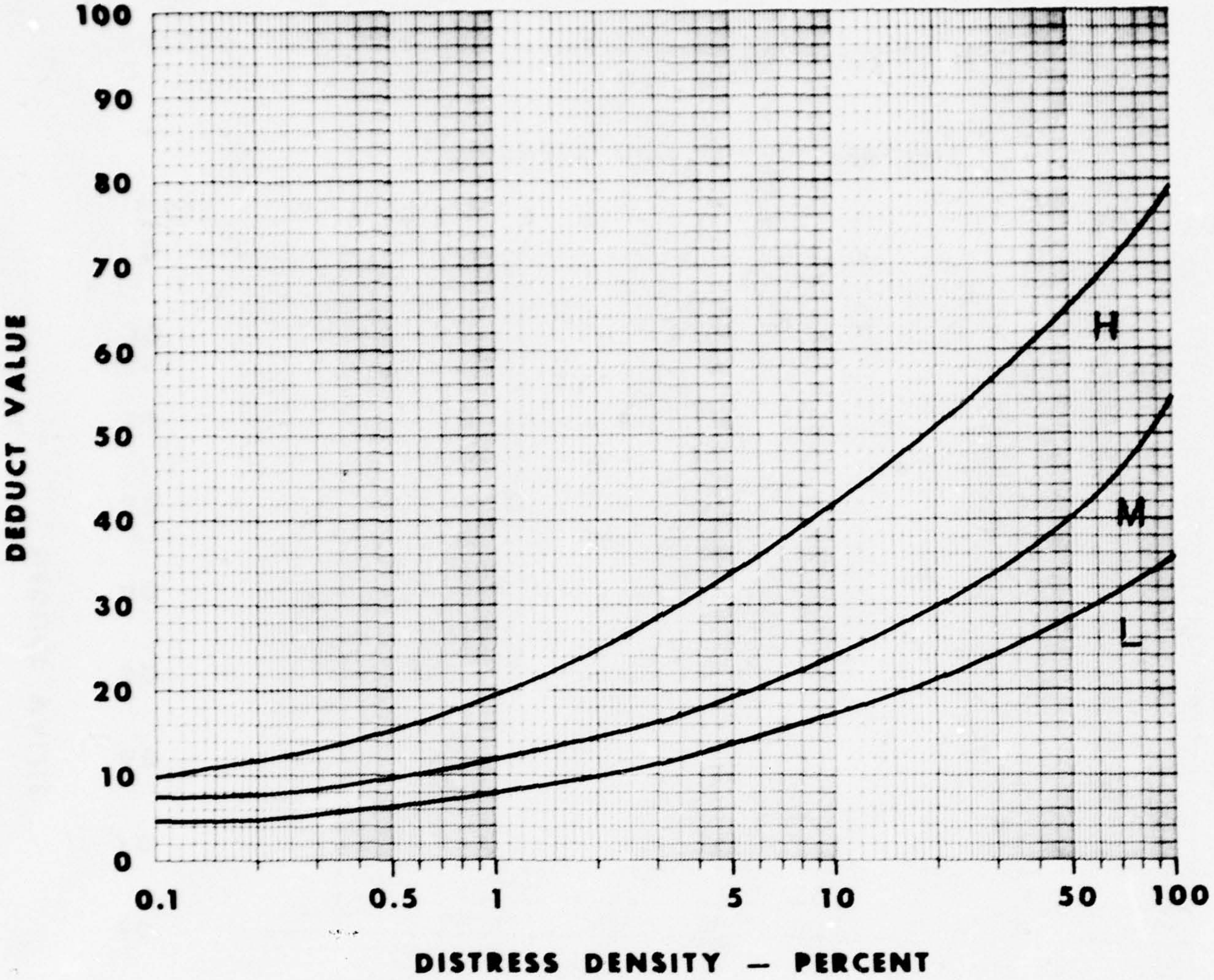
1. Alligator cracking.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values



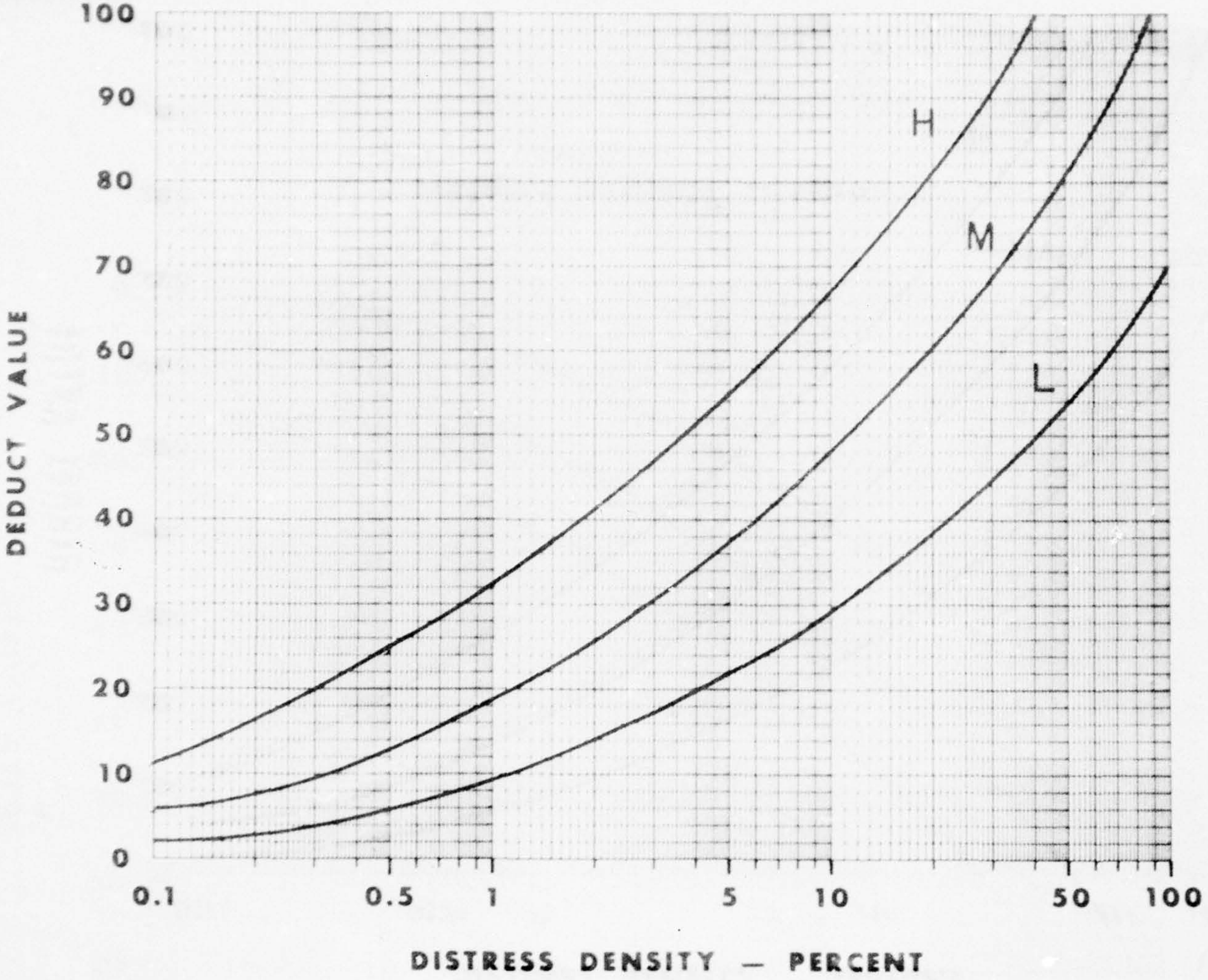
2. Bleeding.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



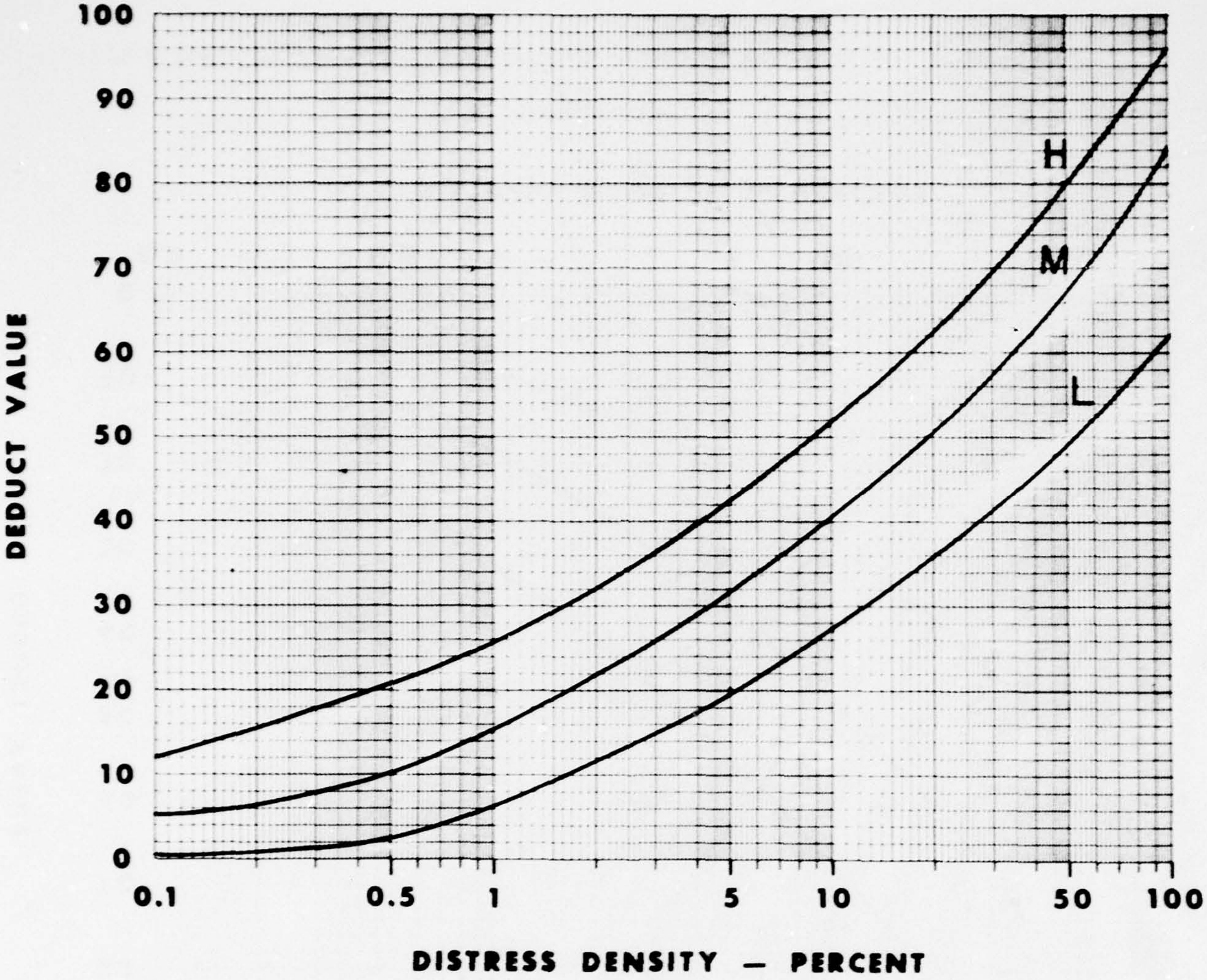
3. Block cracking.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



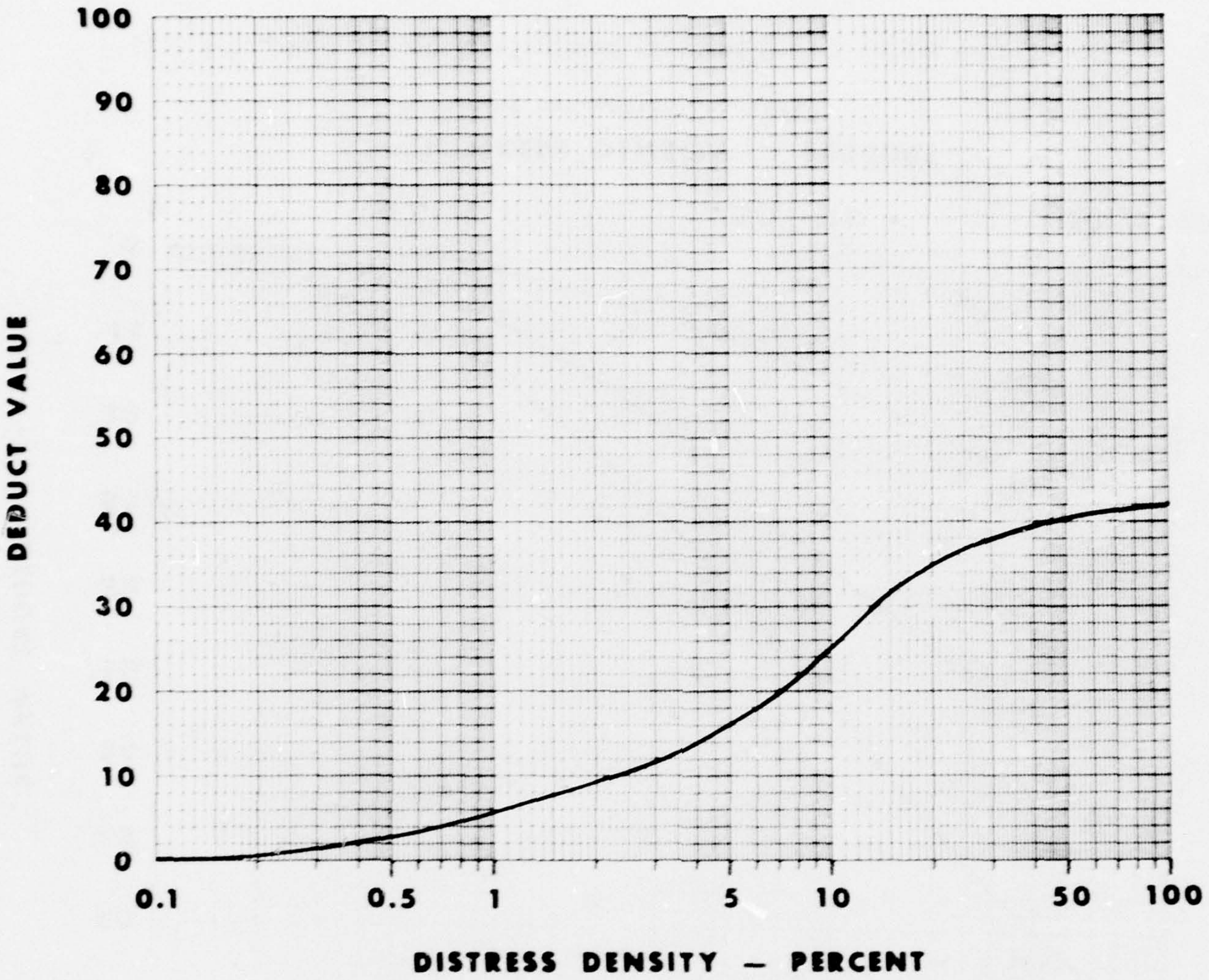
4. Corrugation.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



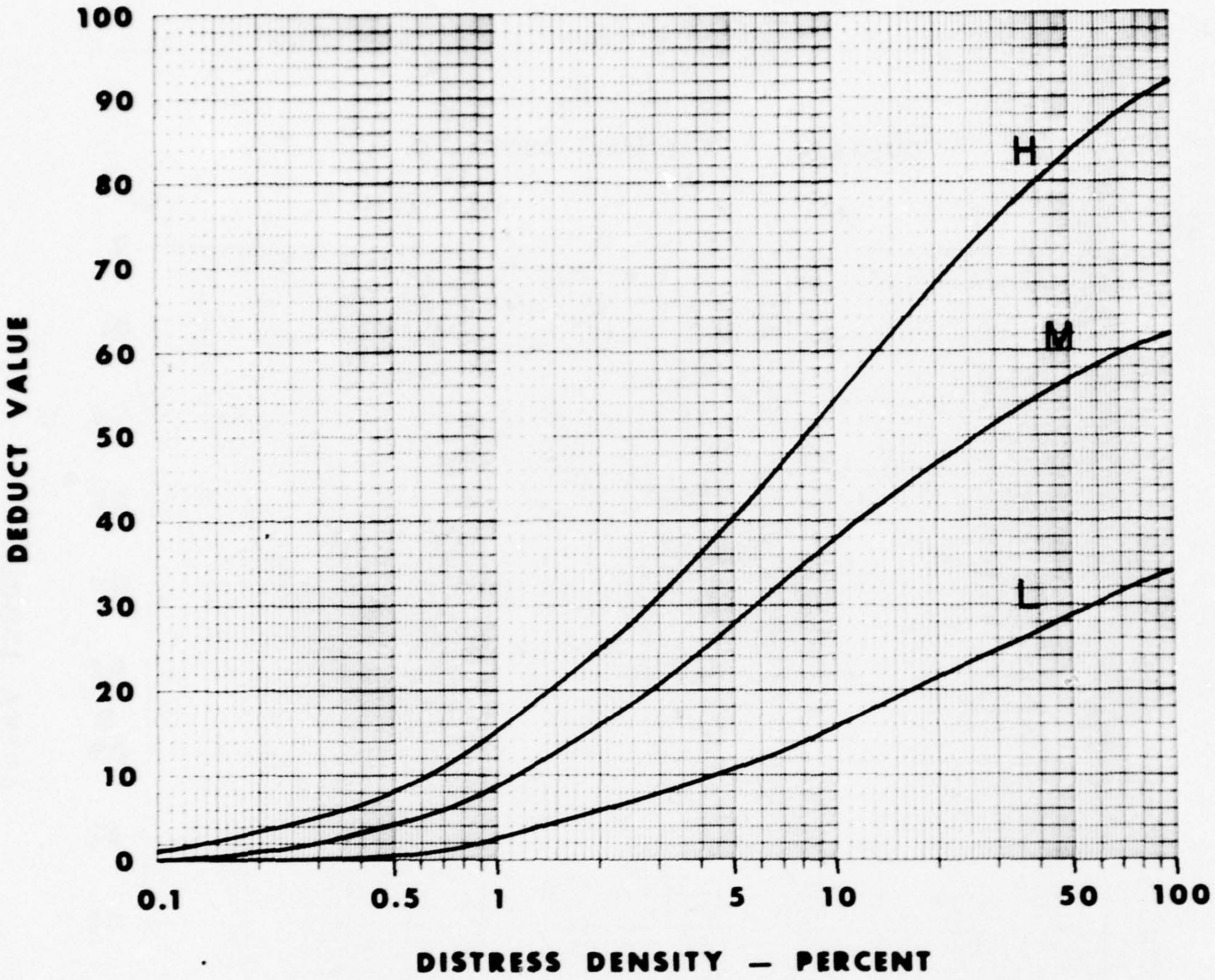
5. Depression.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



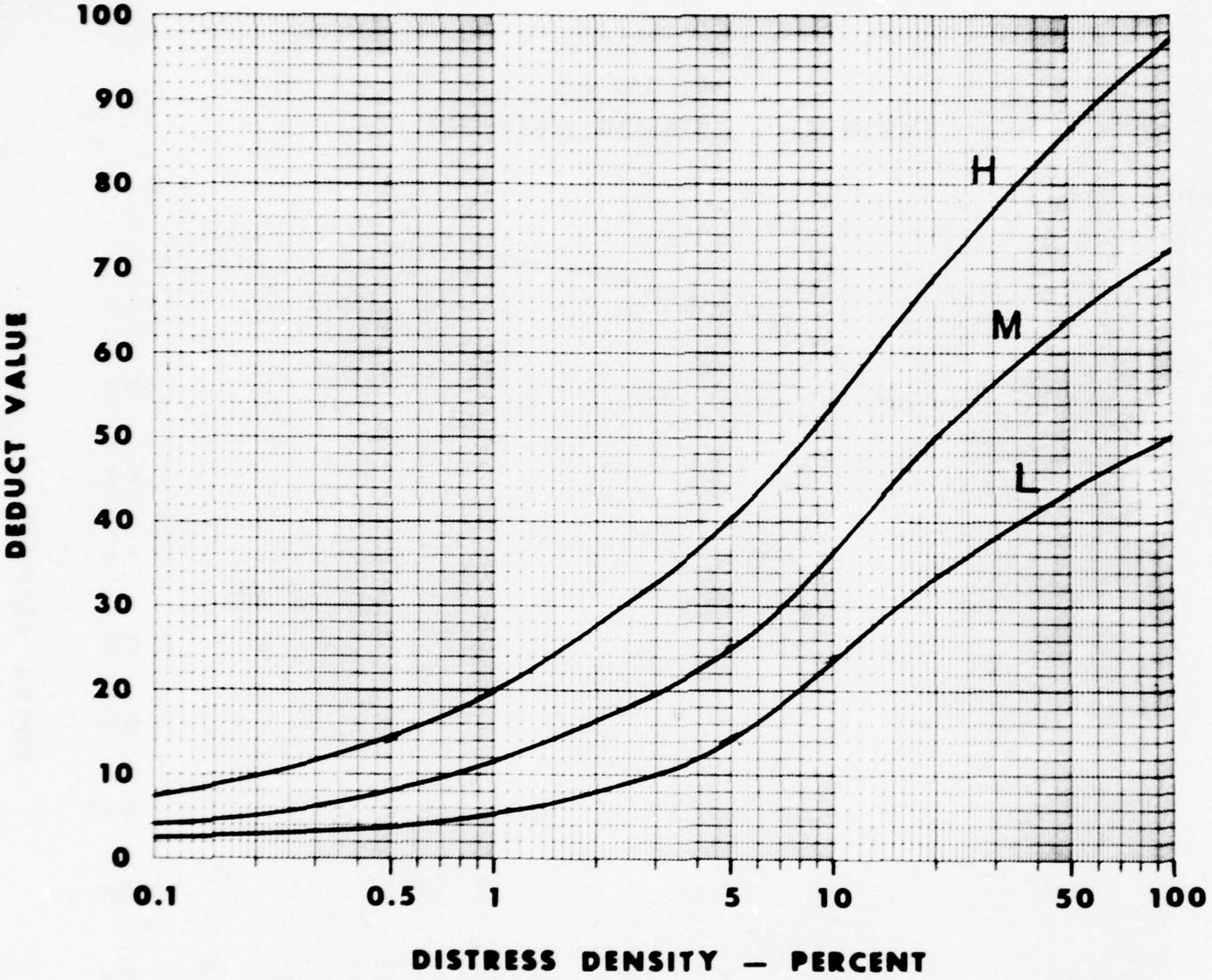
6. Jet blast erosion.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



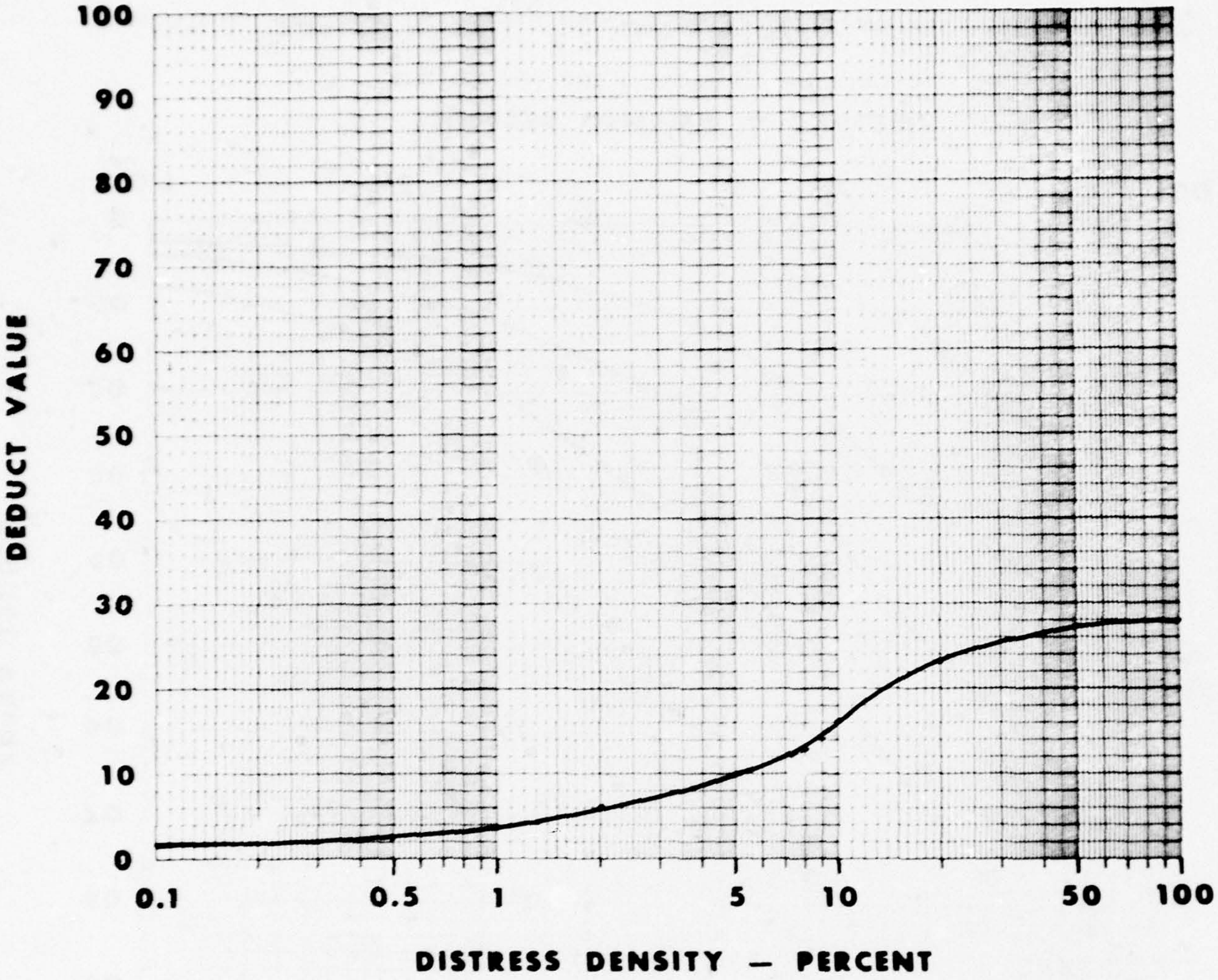
7. Joint reflection cracking.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



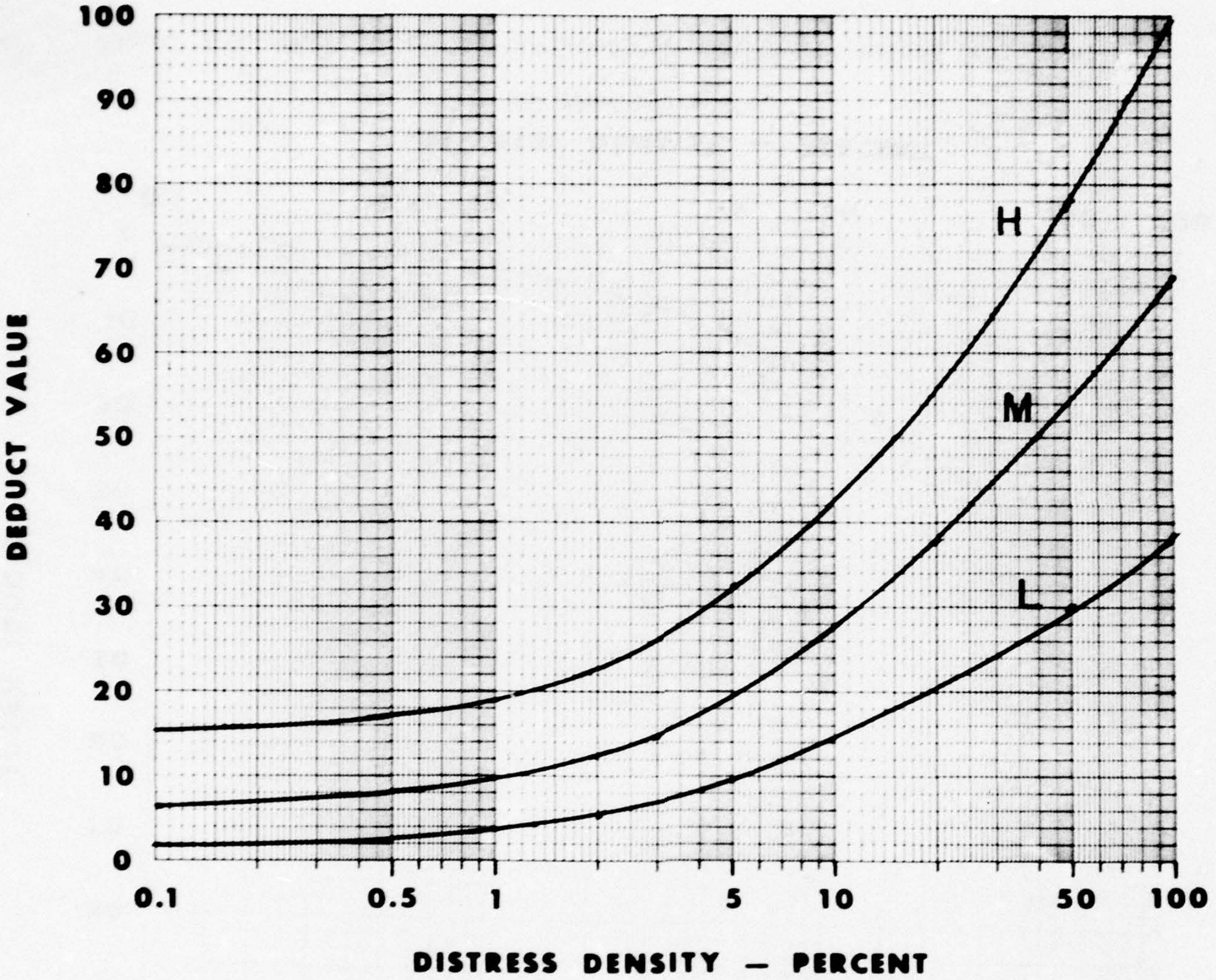
8. Longitudinal and transverse cracking.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



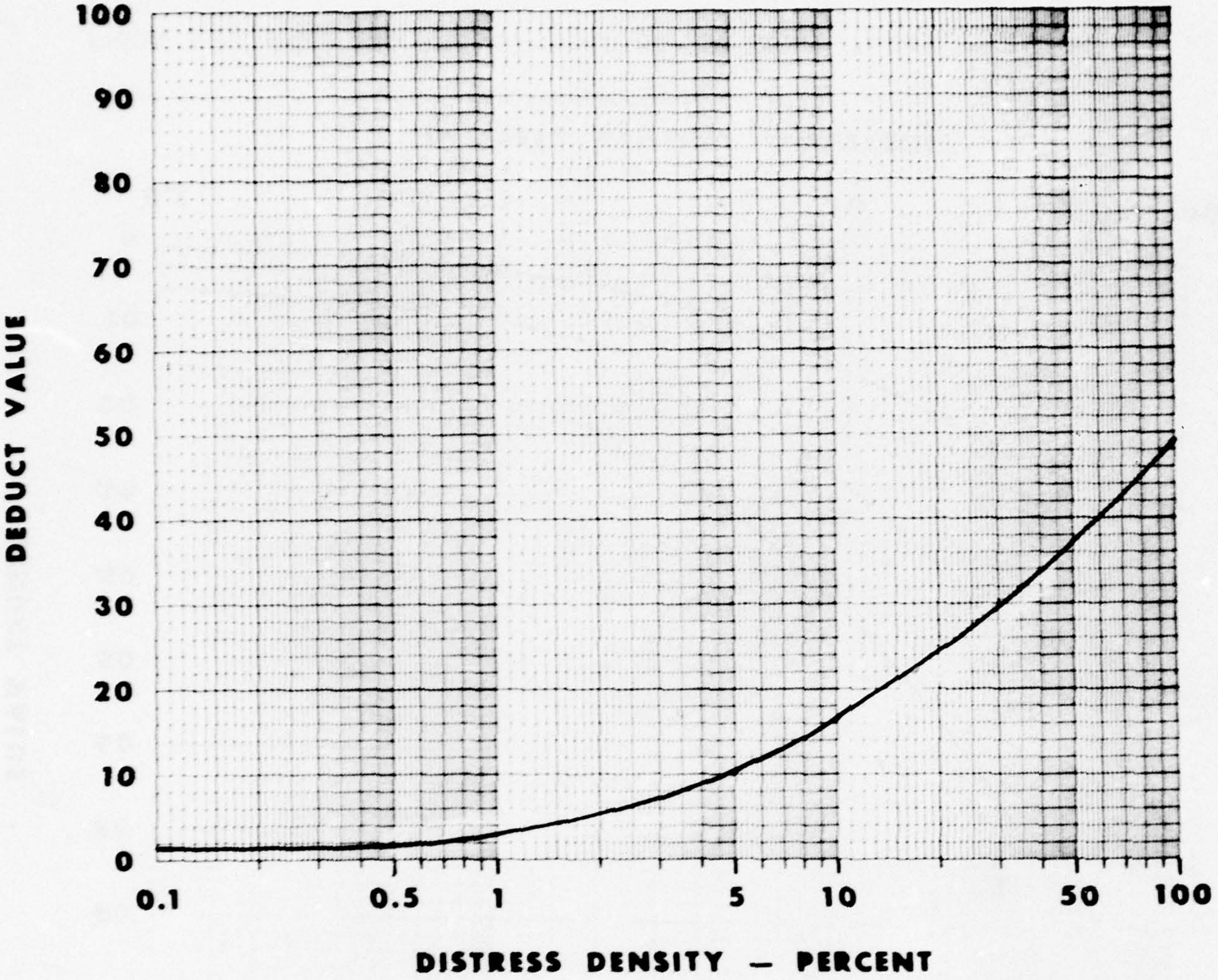
9. Oil spillage.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



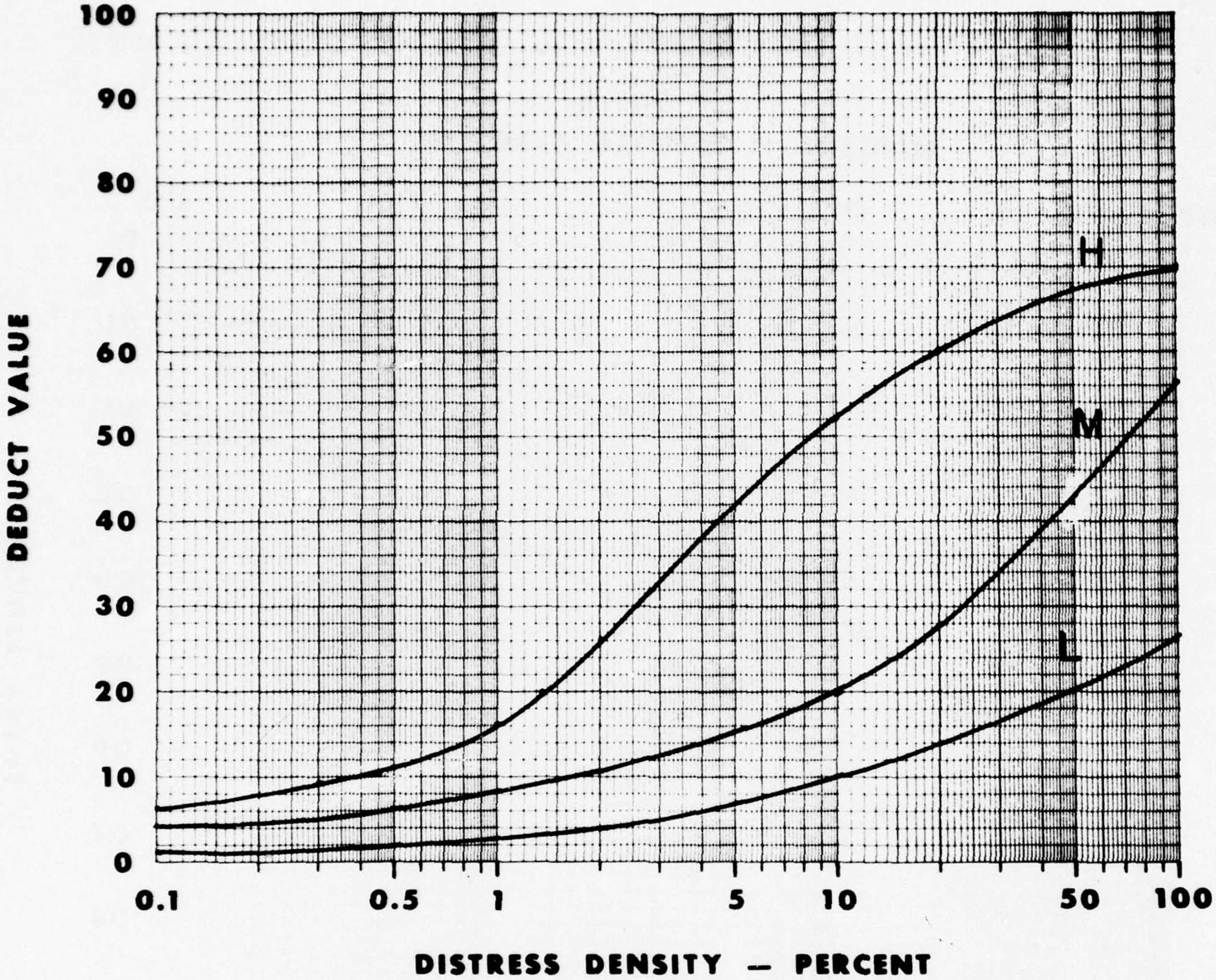
10. Patching and utility cut.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



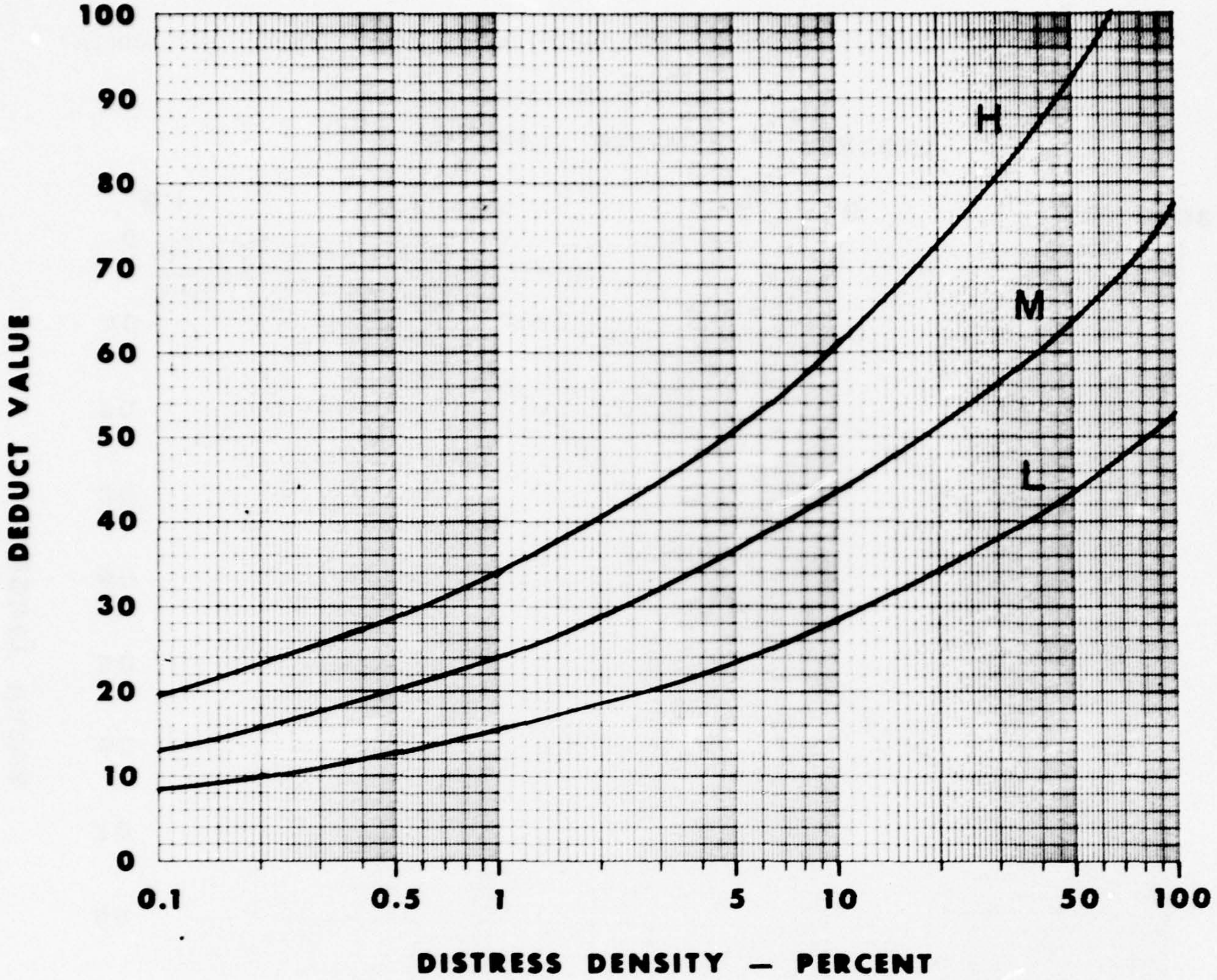
11. Polished aggregate.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



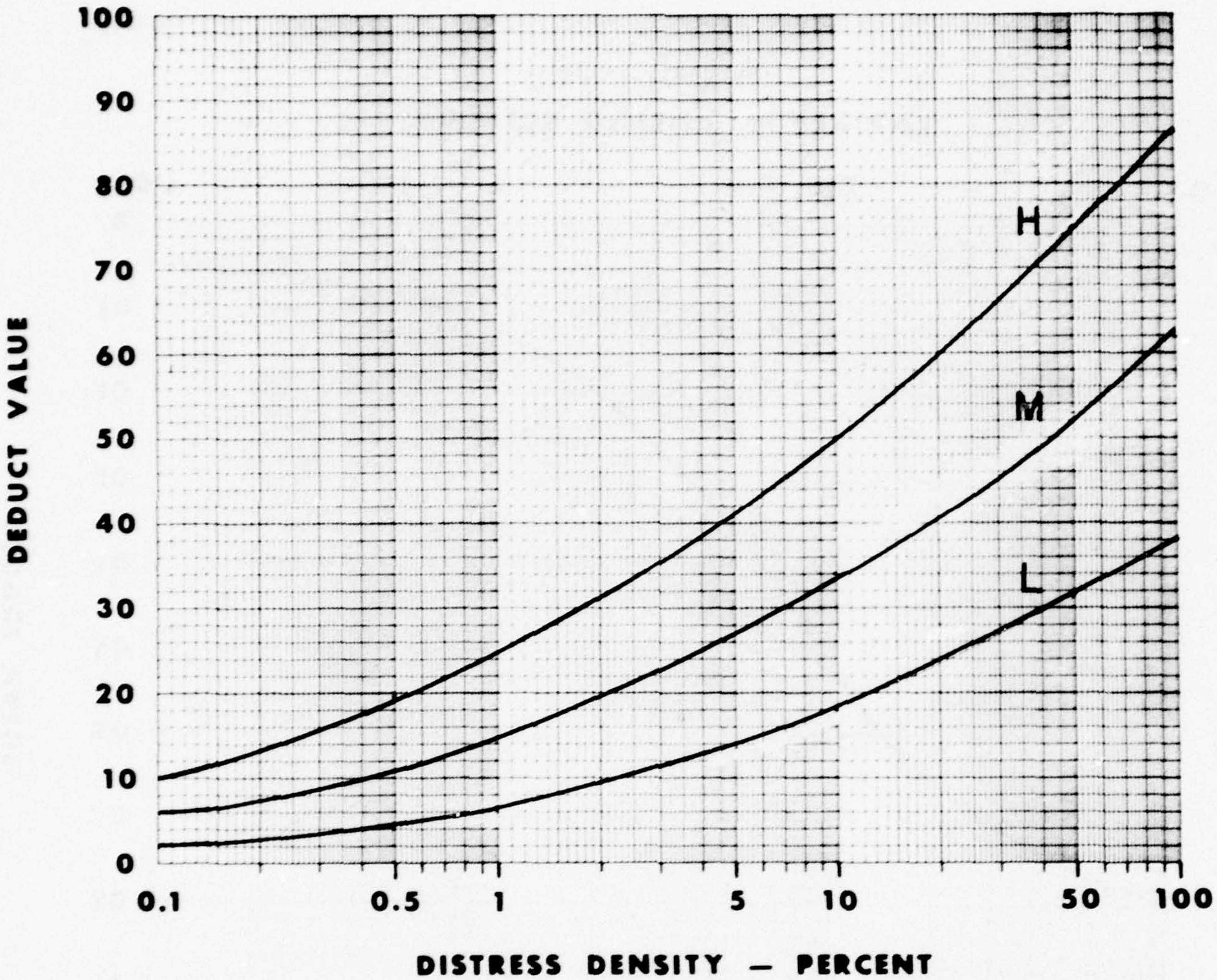
12. Raveling/weathering.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



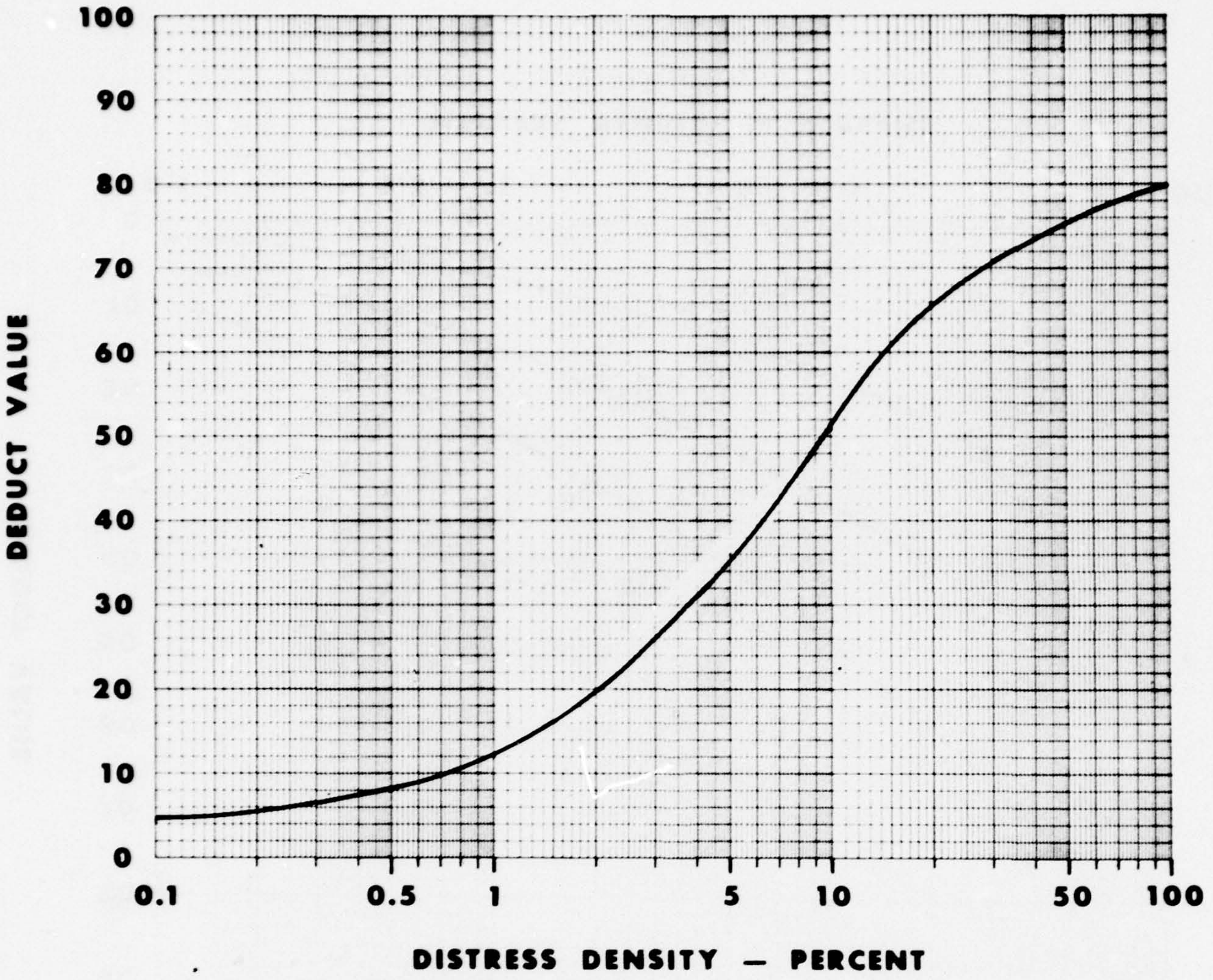
13. Rutting.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



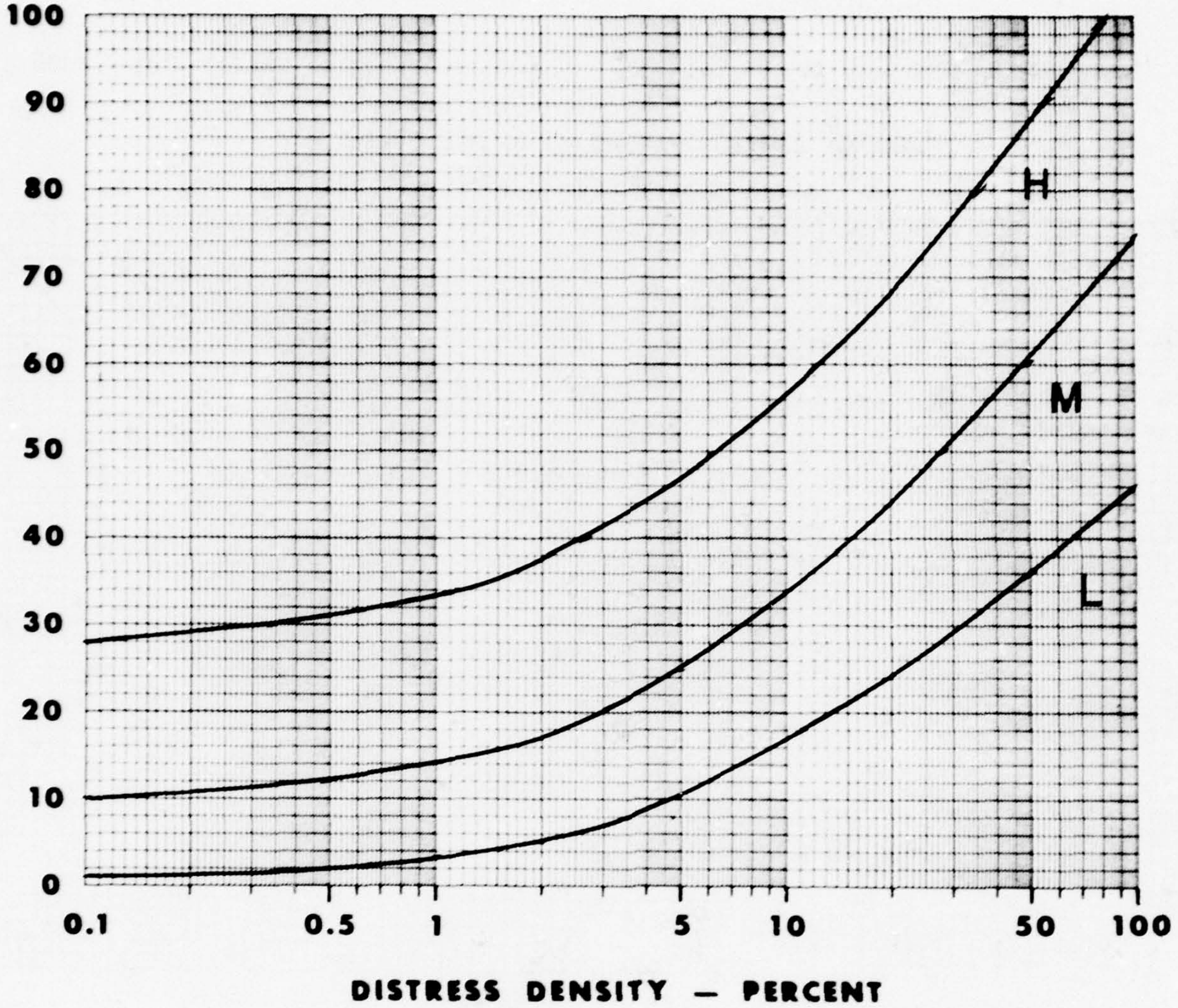
14. Shoving of flexible pavement by PCC slabs.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



15. Slippage cracking.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (continued)



16. Swell.

Figure 3-9. Asphalt- or Tar-Surfaced Pavement Deduct Values (concluded)

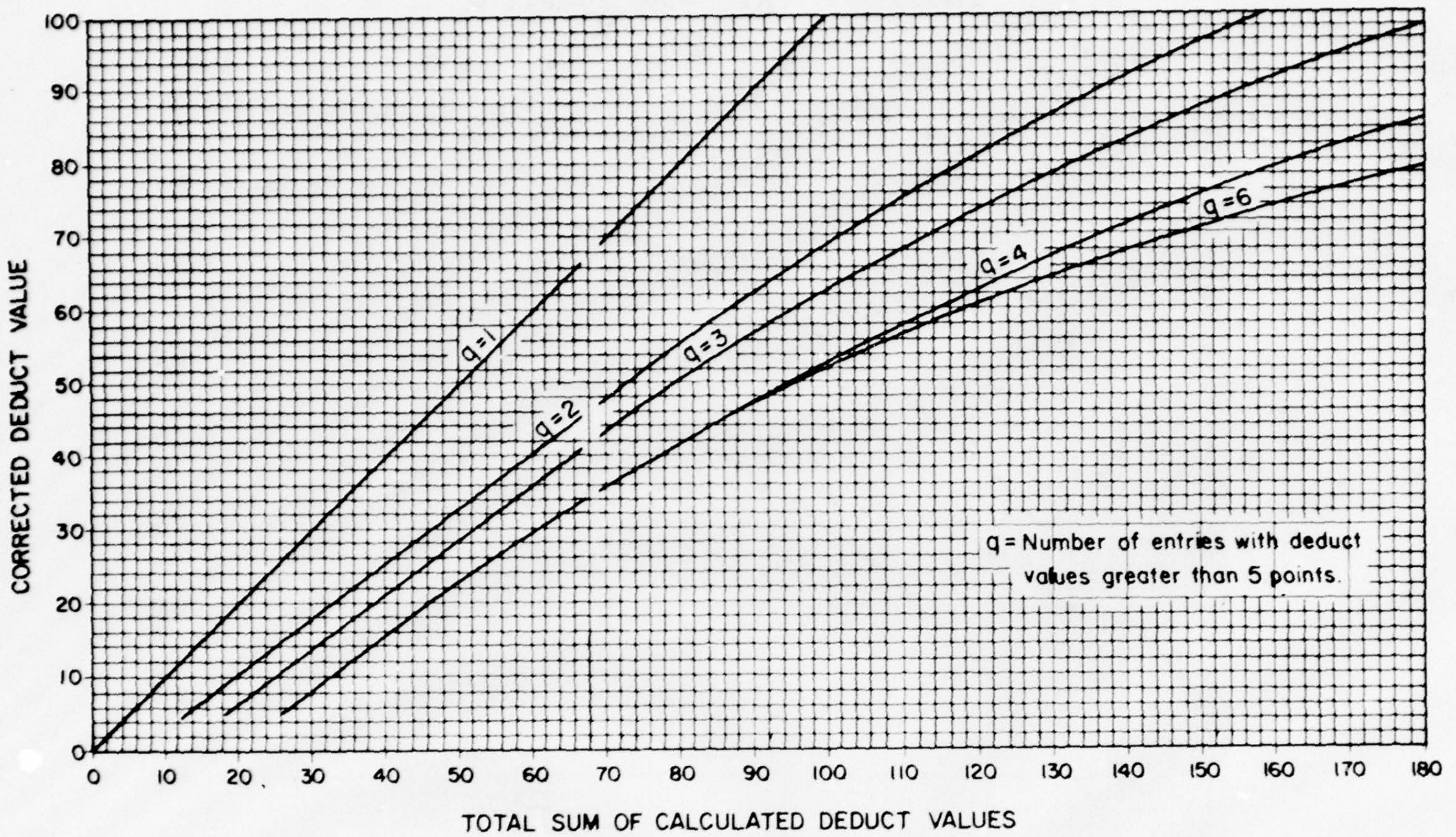


Figure 3-10. Corrected Deduct Values for Asphalt- or Tar-Surfaced Pavements

Pavement Feature: Taxiway 5

Total No. of Units: 25

Date of Survey: 7/13/76

Unit No.	Unit Area ft^2	PCI
1	5000	42
2	5000	33
3	5000	53
4	5000	39
5	5000	23
6	5000	25
7	5000	36
8	5000	38
9	5000	35
10	5000	25
11	5000	32
12	5000	45
13	5000	40
14	5000	55
15	5000	46
16	5000	35
17	5000	22
18	5000	30
19	5000	39
20	5000	35
21	5000	32
22	5000	41
23	5000	49
24	5000	30
25	5000	22

Average PCI for feature: 36

Condition rating: Poor

Figure 3-11. Feature Summary - Asphalt- or Tar-Surfaced Pavements

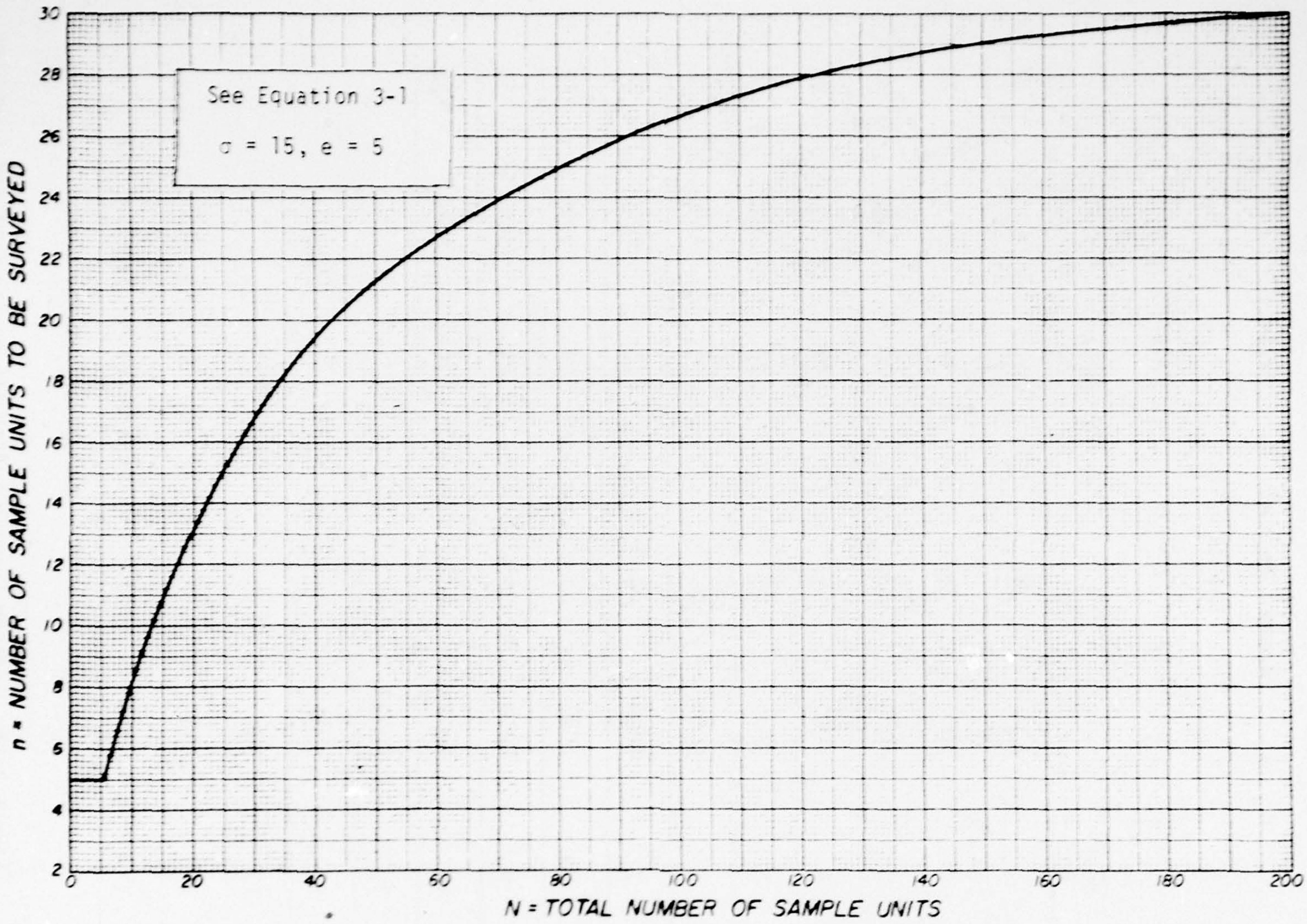


Figure 3-12. Minimum Number of Sample Units Required for Jointed Concrete Pavement Features

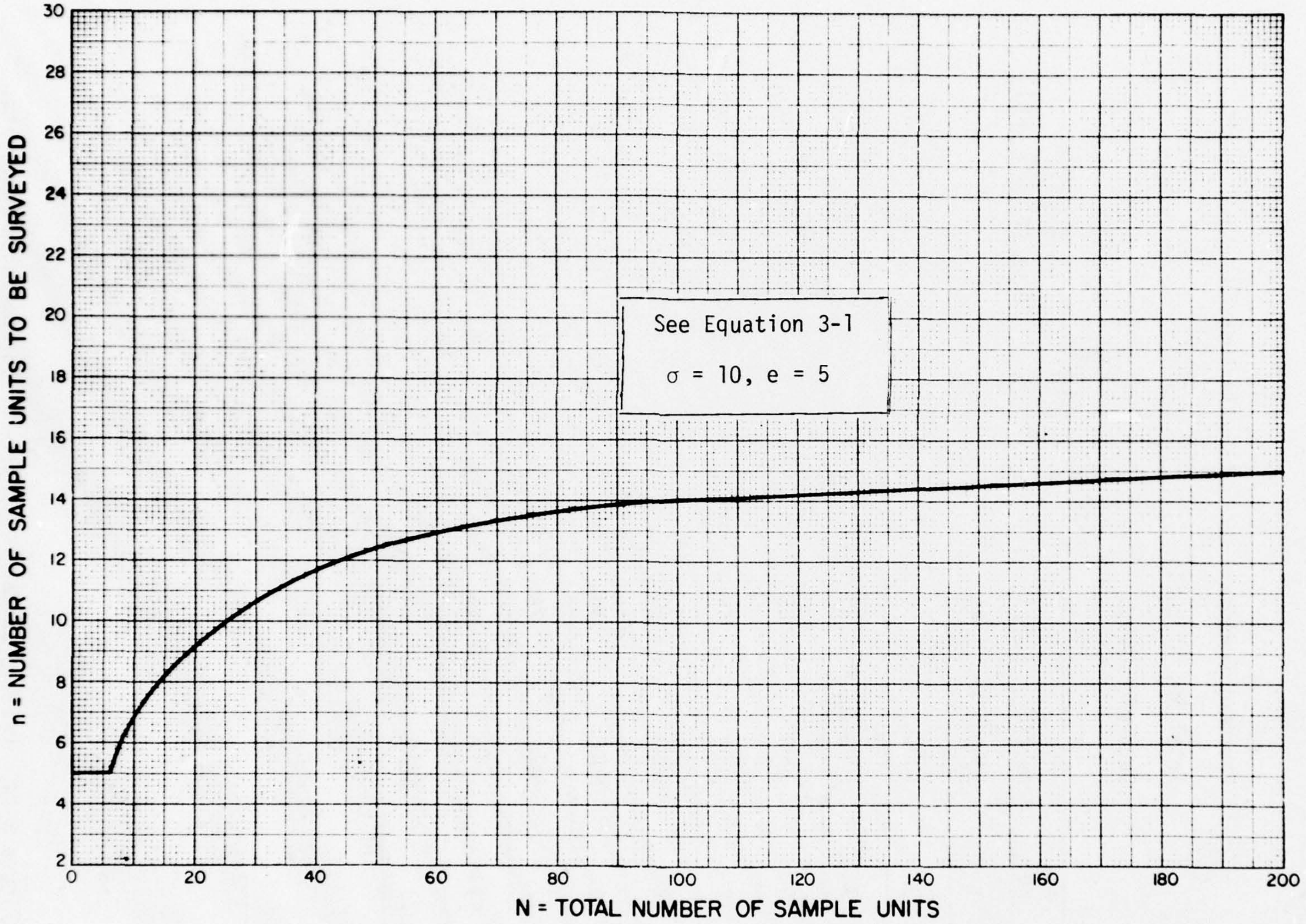


Figure 3-13. Minimum Number of Sample Units Required for Asphalt- or Tar-Surfaced Pavement Features

Pavement Feature: Taxiway 5B

Total No. of Units: 25

Date of Survey: 7/13/76

Unit No.	Unit Area ft^2	PCI
1	5000	42
3	5000	53
9	5000	35
10	5000	25
12	5000	45
13	5000	40
16	5000	35
17	5000	22
21	5000	32
23	5000	49

Unit No.	Unit Area ft^2	PCI

Average PCI for Feature: 38

Condition Rating: Poor

Figure 3-14. Feature Summary--Asphalt- or Tar-Surfaced Pavements, Sampling Option

TITLE PAGE AND COVER. The title page will indicate the major command responsible for the report, base on which the survey was performed, date of inspection, and date of the report.

1. Construction History. Reference the latest condition survey or pavement evaluation report and update construction history to depict airfield construction, maintenance, and repair projects accomplished since last survey or evaluation. Record the construction history changes in the same manner as presented in the last condition survey or evaluation report. Indicate whether pavement was built originally to light, medium, or heavy load design specifications.

2. Character and Composition of Aircraft Traffic and Load Repetitions. Provide a brief narrative paragraph which reflects past and present mission aircraft, by type and estimated frequency of full stop landings and takeoffs of each aircraft.

3. Plans and Cross-Sections of Major Airfield Components.

a. Airfield Layout Plan. The airfield layout plan should depict airfield pavements required to support the mission; pavements not presently used but maintained for possible mission support; and pavements not required and not maintained. All features should be delineated and identified by facility type (runway, taxiway, or apron), feature number within facility type, traffic area (A, B, C, D, or X), and pavement thickness and material type (AC and/or PCC).

b. Condition Rating. Include an airfield plan symbol-keyed to indicate the narrative condition rating of each feature (e.g., E = excellent, VG = very good, G = good, F = fair, P = poor, VP = very poor, FD = failed). The PCI should be indicated in the remark column on the Summary of Physical Property Data.

c. Drainage. Problem areas should be identified. Surface and subsurface drainage should be shown in plan and profile for all potential drainage problem areas.

d. Cross-Section. Cross-sections (pavement structure sections) should be provided in the report only when the original sections have been modified by major reconstruction, maintenance, or repair.

Figure 3-15. Condition Survey Report Format

4. Character and Condition of Pavement Surfaces. Only general statements as to the condition of the various pavement facilities are desired; detailed results, such as the summary of defects, are not to be included in this section of the report. Any areas showing distress as noted during the condition survey will be described as to type and extent of distress. No conclusive statements should be made regarding the effect of the pavement conditions on aircraft operations. (This is to be incorporated into item 7, Narrative Summary.) A plot of the mean PCI of each feature overtime should be included.

5. Summary of Physical Property Data. Using the same format contained in the referenced condition survey report, change the summary to reflect the modifications to pavement structures resulting from recent airfield projects. Use asterisks to annotate the changes.

6. Summary of Allowable Gross Loads. Compute the allowable gross loads for pavement features which have been altered from the last evaluation report by reconstruction or other major change in the pavement structure. The computation procedure is outlined in AFM 88-24, chapters 2 and 3, for flexible and rigid pavements, respectively. Use the table in Figure 4-1 of this regulation for displaying results. If there have been no changes, the summary of allowable gross loads will still be submitted as item 6 of the Condition Survey Report.

7. Narrative Summary. A paragraph which incorporates statements regarding operational condition of the airfield, recommendations for maintenance and repair, and major conclusions developed during the inspection. Problem areas should be highlighted.

8. Photographs Depicting Airfield Conditions. Optional at the discretion of the command pavements engineer.

9. Attachments. Optional for use to present data to support the conclusions and recommendations developed from the condition survey.

10. Reports. The basic report size will be 8 x 10-1/2 inches. The maximum permissible size for a foldout sheet (drawing, gross load summary, etc.) is 15-1/2 x 10-1/2 inches. The completed report shall be securely bound; pages should be numbered in sequence; and each foldout sheet shall be folded properly.

Figure 3-15. Condition Survey Report Format (concluded)

TABLE 3-1. Typical Random Number Table

	00-04	05-09	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49
00	54463	22662	65905	70639	79365	67382	29085	69831	47058	08186
01	15389	85205	18850	39226	42249	90669	96325	23248	60933	26927
02	85941	40756	82414	02015	13858	78030	16269	65978	01385	15345
03	61149	69440	11286	88218	58925	03638	52862	62733	33451	77455
04	05219	81619	10651	67079	92511	59888	84502	72095	83463	75577
05	41417	98326	87719	92294	46614	50948	64886	20002	97365	30976
06	28357	94070	20652	35774	16249	75019	21145	05217	47286	76305
07	17783	00015	10806	83091	91530	36466	39981	62481	49177	75779
08	40950	84820	29881	85966	62800	70326	84740	62660	77379	90279
09	82995	64157	66164	41180	10089	41757	78258	96488	88629	37231
10	96754	17676	55659	44105	47361	34833	86679	23930	53249	27083
11	34357	88040	53364	71726	45690	66334	60332	22554	90600	71113
12	06318	37403	49927	57715	50423	67372	63116	48888	21505	80182
13	62111	52820	07243	79931	89292	84767	85693	73947	22278	11551
14	47534	09243	67879	00544	23410	12740	02540	54440	32949	13491
15	98614	75993	84460	62846	59844	14922	48730	73443	48167	34770
16	24867	03648	44898	09351	98795	18644	39765	71058	90368	44104
17	96887	12479	80621	66223	86085	78285	02432	53342	42846	94771
18	90801	21472	42815	77408	37390	76766	52615	32141	30268	18106
19	55165	77312	83666	36028	28420	70219	81369	41943	47366	41067
20	75884	12952	84318	95108	72305	64620	91381	89872	45375	85436
21	16777	37116	58550	42958	21460	43910	01175	87894	81378	10620
22	46230	43877	80207	88877	89380	32992	91380	03164	98656	59337
23	42902	66892	46134	01432	94710	23474	20423	60137	60609	13119
24	81007	00333	39693	28039	10154	95425	39220	19774	31782	49037
25	68089	01122	51111	72373	06902	74373	96199	97017	41273	21546
26	20411	67081	89950	16944	93054	87687	96693	87236	77054	33848
27	58212	13160	06468	15718	82627	76999	05999	58680	96739	63700
28	70577	42866	24969	61210	76046	67699	42054	12696	93758	03283
29	94522	74358	71659	62038	79643	79169	44741	05437	39038	13163
30	42626	86819	85651	88678	17401	03252	99547	32404	17918	62880
31	16051	33763	57194	16752	54450	19031	58580	47629	54132	60631
32	08244	27647	33851	44705	94211	46716	11738	55784	95374	72655
33	59497	04392	09419	89964	51211	04894	72882	17805	21896	83864
34	97155	13428	40293	09985	58434	01412	69124	82171	59058	82859
35	98409	66162	95763	47420	20792	61527	20441	39435	11859	41567
36	45476	84882	65109	96597	25930	66790	65706	61203	53634	22557
37	89300	69700	50741	30329	11658	23166	05400	66669	48708	03887
38	50051	95137	91631	66315	91428	12275	24816	68091	71710	33258
39	31753	85178	31310	89642	93864	02306	24617	09609	83942	23716
40	79152	53829	77250	20190	56535	18760	69942	77448	33278	48805
41	44560	38750	83635	56540	64900	42912	13953	79149	18710	68618
42	68328	83378	63369	71381	39564	05615	42451	64559	97501	65747
43	46939	38689	58625	08342	30459	85863	20781	09284	26333	91777
44	83544	86141	15707	96256	23068	13782	08467	89469	93842	55349
45	91621	00881	04900	54224	46177	55309	17852	27491	89415	23466
46	91896	67126	04151	03795	59077	11848	12630	98375	52068	60142
47	55751	62515	21108	80830	02263	29303	37204	96926	30506	09808
48	85156	87689	95493	88842	00664	55017	55539	17771	69448	87530
49	07521	56898	12236	60277	39102	62315	12239	07105	11844	01117

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ATTACHMENT A

DISTRESS IDENTIFICATION MANUAL

TABLE OF CONTENTS

1.0 INTRODUCTION

This attachment provides a standardized reference for airfield pavement distress identification. The types of airfield pavement distress are listed alphabetically under the major categories of asphalt- or tar-surfaced pavements and jointed concrete pavements. Names, descriptions, severity levels, photographs, and measurement or count criteria presented for each distress were established based on the effect of the pavement's structural integrity, operational condition, and maintenance and repair requirements.

It is very important that the pavement inspector be able to identify all distress types and their severity levels. The inspector should study this attachment prior to performing the inspection and should carry a copy for reference during the inspection.

The results of the pavement inspection are to be used in conjunction with procedures presented in this document for determining the PCI and pavement rating (Figure A-1).

It should be emphasized that pavement inspectors must follow the distress descriptions in this attachment in order to arrive at meaningful and consistent PCI values.

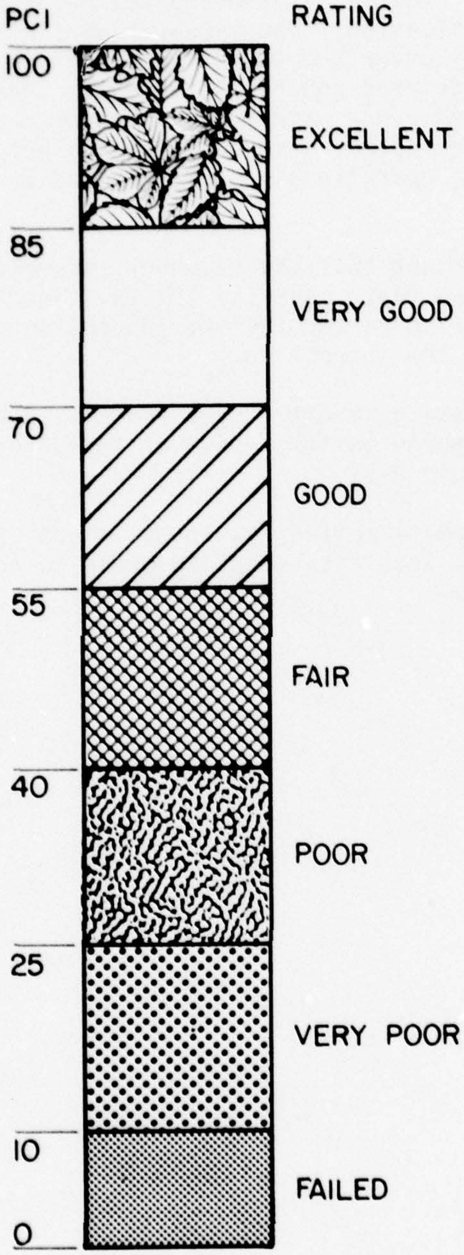

Figure A-1. Airfield Pavement Condition Index (PCI) and Rating.

2.0 DISTRESSES IN ASPHALT- AND TAR-SURFACED PAVEMENTS

Name of Distress: Alligator or Fatigue Cracking

Description: Alligator or fatigue cracking is a series of interconnecting cracks caused by fatigue failure of the asphalt concrete surface under repeated traffic loading. The cracking initiates at the bottom of the asphalt surface (or stabilized base) where tensile stress and strain is highest under a wheel load. The cracks propagate to the surface initially as a series of parallel cracks. After repeated traffic loading the cracks connect, forming many-sided, sharp-angled pieces that develop a pattern resembling chicken wire or the skin of an alligator. The pieces are less than 2 feet on the longest side.

Alligator cracking occurs only in areas that are subjected to repeated traffic loadings, such as wheel paths. Therefore, it would not occur over an entire area unless the entire area was subjected to traffic loading. Pattern-type cracking which occurs over an entire area that is not subjected to loading is rated as block cracking, which is not a load-associated distress.

Alligator cracking is considered a major structural distress.

Severity Levels:

L* - Fine, longitudinal hairline cracks running parallel to each other with none or only a few interconnecting cracks. The cracks are not spalled. (Figures A-2, A-3, A-4)

M - Further development of light alligator cracking into a pattern or network of cracks that may be lightly spalled. (Figures A-5 through A-9)

H - Network or pattern cracking has progressed so that the pieces are well defined and spalled at the edges; some of the pieces rock under traffic. (Figure A-10)

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* L - Low severity level
M - Medium severity level
H - High severity level

How to Measure: Alligator cracking is measured in square feet of surface area. The major difficulty in measuring this type of distress is that many times two or three levels of severity exist within one distressed area. If these portions can be easily distinguished from each other, they should be measured and recorded separately. However, if the different levels of severity cannot be easily divided, the entire area should be rated at the highest severity level present.

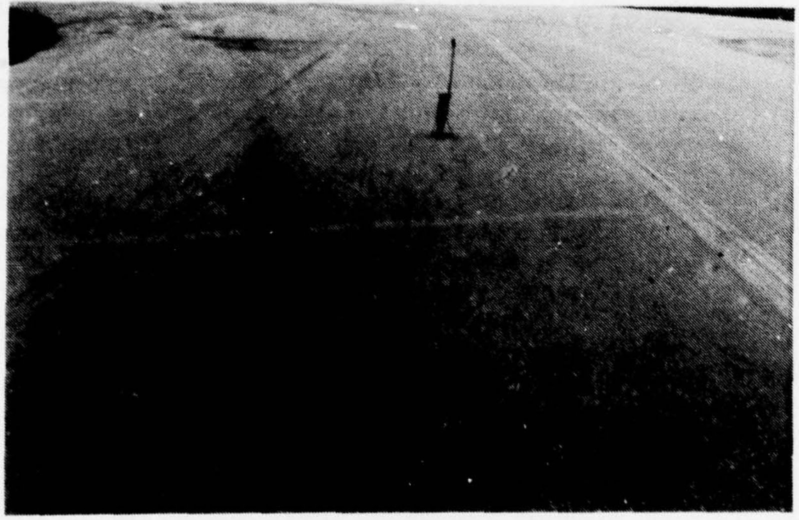

Figure A-2. Low Severity Alligator Cracking.

Figure A-3. Low Severity Alligator Cracking.

Figure A-4. Low Severity Alligator Cracking, Approaching Medium Severity.

Figure A-5. Medium Severity Alligator Cracking. (Note the Depression Occurring With the Cracking.)

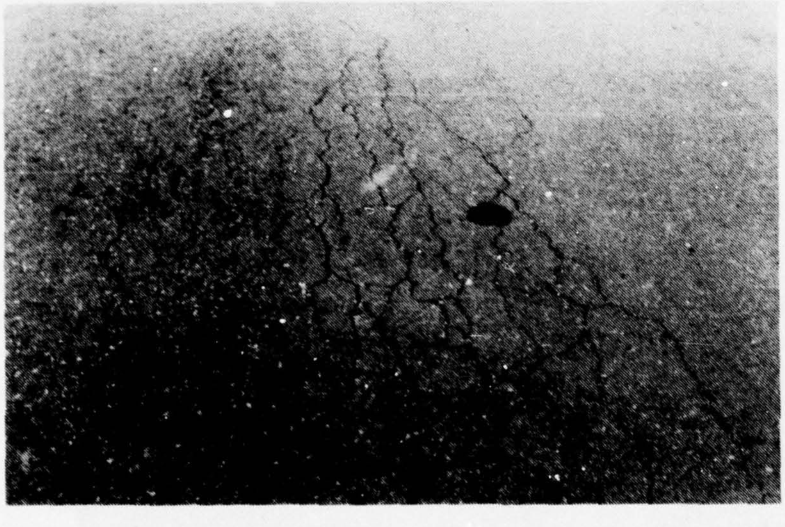

Figure A-6. Medium Severity Alligator Cracking.

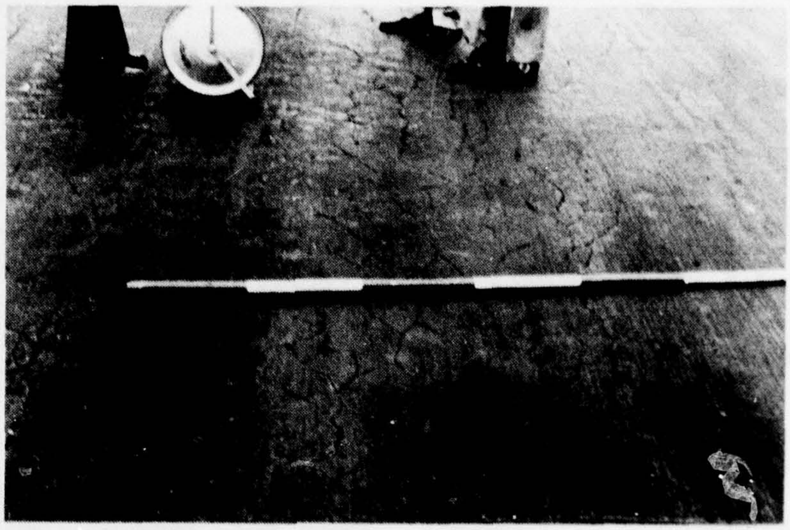

Figure A-7. Medium Severity Alligator Cracking.

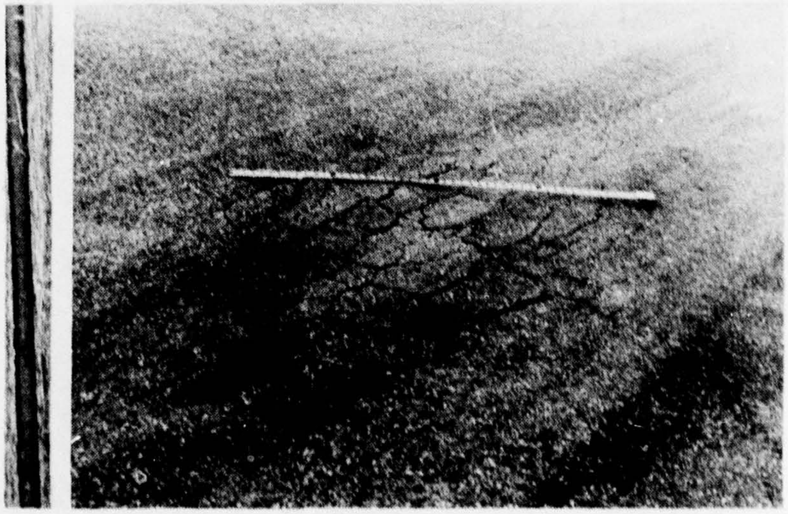

Figure A-8. Medium Severity Alligator Cracking, Approaching High Severity.

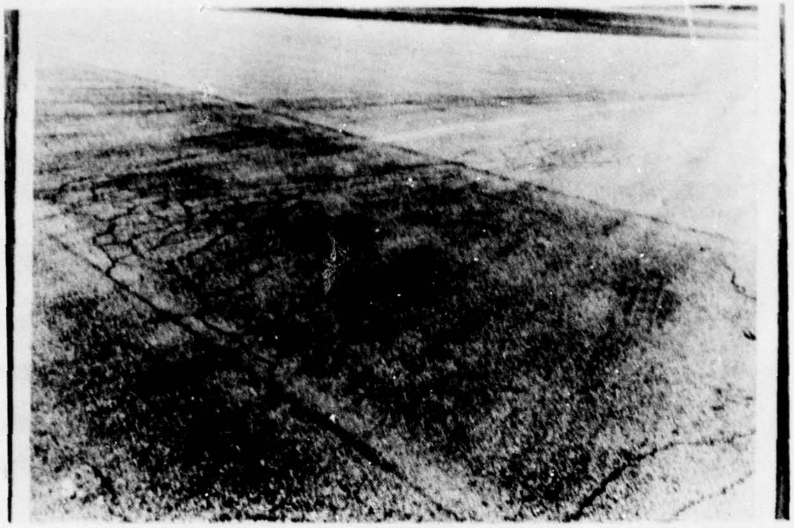

Figure A-9. Medium Severity Alligator Cracking, Approaching High Severity.

Figure A-10. High Severity Alligator Cracking.

Name of Distress: Bleeding

Description: Bleeding is a film of bituminous material on the pavement surface which creates a shiny, glass-like, reflecting surface that usually becomes quite sticky. Bleeding is caused by excessive amounts of asphalt cement or tars in the mix and/or low air void content. It occurs when asphalt fills the voids of the mix during hot weather and then expands out onto the surface of the pavement. Since the bleeding process is not reversible during cold weather, asphalt or tar will accumulate on the surface.

Severity Levels: No degrees of severity are defined. Bleeding should be noted when it is extensive enough to cause a reduction in skid resistance. (Figures A-11, A-12)

How to Measure: Bleeding is measured in square feet of surface area.

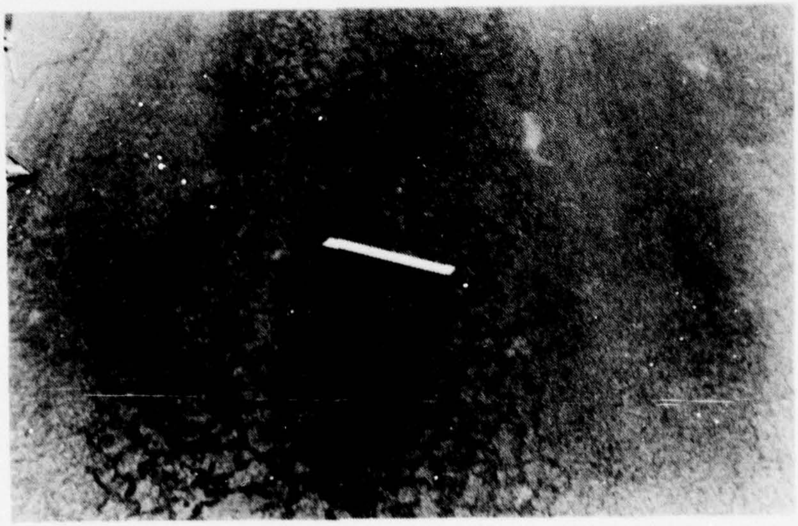

Figure A-11. Bleeding.

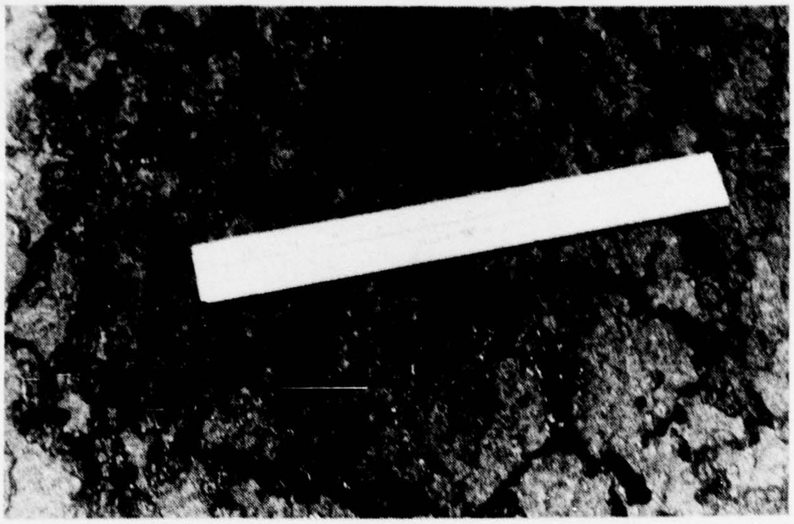

Figure A-12. Close-Up of Figure A-11.

Name of Distress: Block Cracking

Description: Block cracks are interconnected cracks that divide the pavement into approximately rectangular pieces. The blocks may range in size from approximately 1 x 1 foot to 10 x 10 feet. Block cracking is caused mainly by shrinkage of the asphalt concrete and daily temperature cycling (which results in daily stress/strain cycling). It is not load-associated. The occurrence of block cracking usually indicates that the asphalt has hardened significantly. Block cracking normally occurs over a large proportion of pavement area, but sometimes will occur only in nontraffic areas. This type of distress differs from alligator cracking in that alligator cracks form smaller, many-sided pieces with sharp angles. Also unlike block cracks, alligator cracks are caused by repeated traffic loadings, and are therefore located only in traffic areas (i.e., wheel paths).

Severity Levels:

L - Blocks are defined by cracks that are nonspalled (sides of the crack are vertical) or only lightly spalled, causing no foreign object damage (FOD) *potential. Nonfilled cracks* have 1/4 inch or less mean width and filled cracks have a filler in satisfactory condition. (Figures A-13 through A-16)

M - Blocks are defined by either (1) filled or nonfilled cracks that are moderately spalled (some FOD potential); (2) nonfilled cracks that are not spalled or have only minor spalling (some FOD potential), but have a mean width greater than approximately 1/4 inch; or (3) filled cracks that are not spalled or have only minor spalling (some FOD potential), but have filler in unsatisfactory condition. (Figures A-17, A-18)

H - Blocks are well-defined by cracks that are severely spalled, causing a definite FOD potential. (Figures A-19, A-20, A-21)

How to Measure: Block cracking is measured in square feet of surface area. It usually occurs at one severity level in a given pavement section; however, any areas of the pavement section having distinctly different levels of severity should be measured and recorded separately.

Figure A-13. Low Severity Block Cracking.

Figure A-14. Low Severity Block Cracking, Filled Cracks.

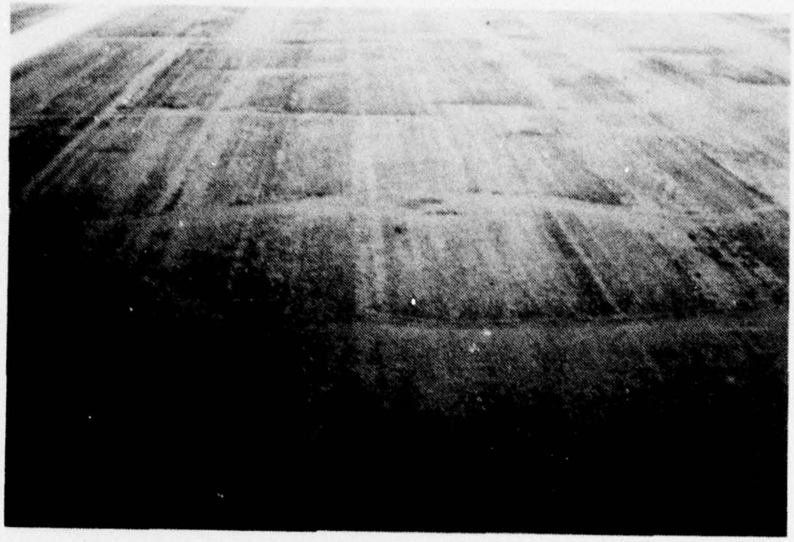

Figure A-15. Low Severity Block Cracking, Filled Cracks.

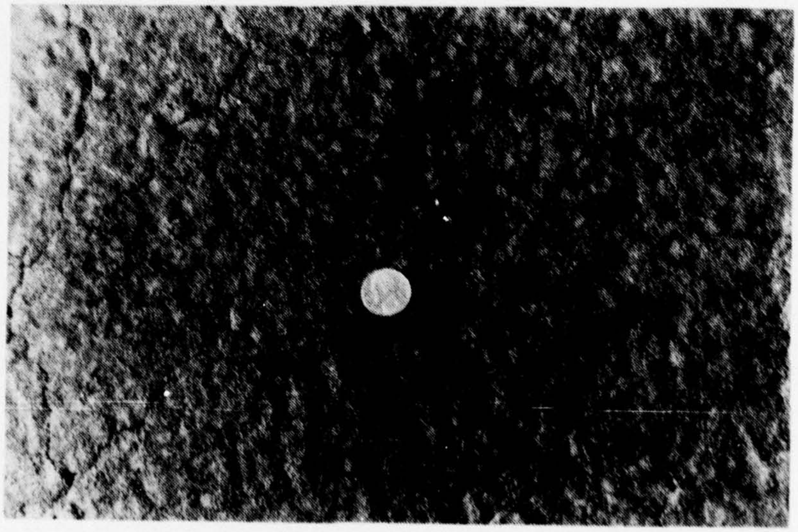

Figure A-16. Low Severity Block Cracking, Small Blocks Defined by Hairline Cracks.

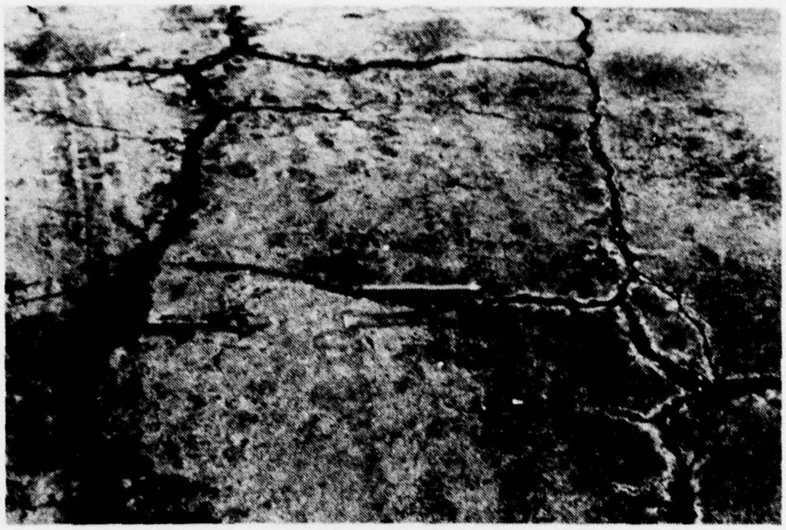

Figure A-17. Medium Severity Block Cracking.

Figure A-18. Medium Severity Block Cracking.

Figure A-19. High Severity Block Cracking.

Figure A-20. High Severity Block Cracking.

Figure A-21. High Severity Block Cracking.

Name of Distress: Corrugation

Description: Corrugation is a series of closely spaced ridges and valleys (ripples) occurring at fairly regular intervals (usually less than 5 feet) along the pavement. The ridges are perpendicular to the traffic direction. Traffic action combined with an unstable pavement surface or base usually causes this type of distress.

Severity Levels:

L - Corrugations are minor and do not significantly affect ride quality (see measurement criteria below). (Figure A-22)

M - Corrugations are noticeable and significantly affect ride quality (see measurement criteria below.) (Figure A-23)

H - Corrugations are easily noticed and severely affect ride quality (see measurement criteria below). (Figure A-24)

How to Measure: Corrugation is measured in square feet of surface area. The mean elevation difference between the ridges and valleys of the corrugations indicates the level of severity. To determine the mean elevation difference, a 10-foot straightedge should be placed perpendicular to the corrugations so that the depth of the valleys can be measured in inches. The mean depth is calculated from five such measurements.

Severity	Runways and High Speed Taxiways	Taxiways and Aprons
L	<1/4 inch	<1/2 inch
M	1/4 - 1/2 inch	1/2 - 1 inch
H	≥1/2 inch	≥1 inch

Some of the following pictures have been taken on roads and streets. Corrugation is not commonly found on airfield pavements.

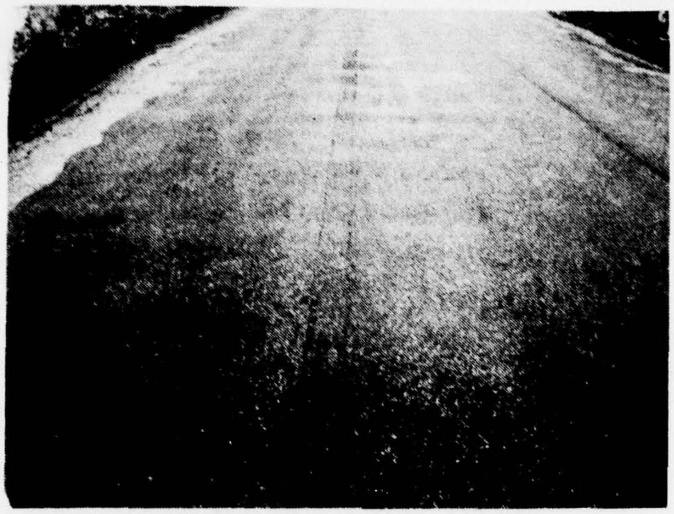

Figure A-22. Low Severity Corrugation in the Foreground, Changing to Medium and High in the Background.

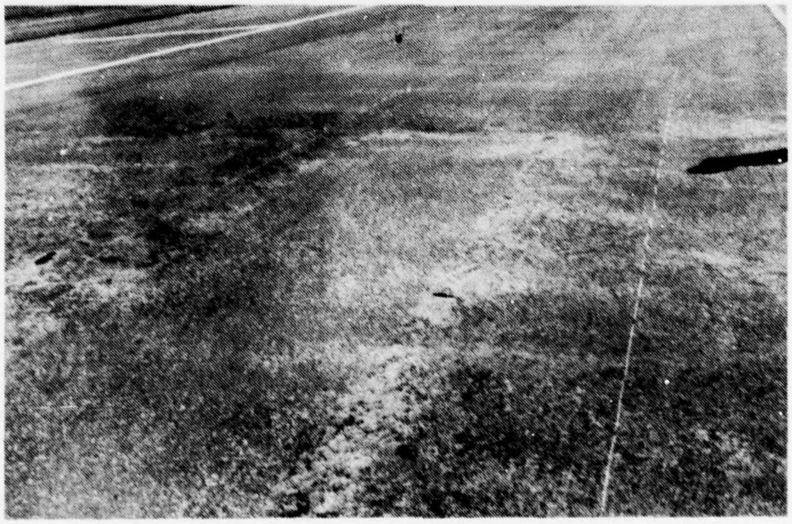

Figure A-23. Medium Severity Corrugation.

Figure A-24. High Severity Corrugation.

Name of Distress: Depression

Description: Depressions are localized pavement surface areas having elevations slightly lower than those of the surrounding pavement. In many instances, light depressions are not noticeable until after a rain, when ponding water creates "birdbath" areas; but the depressions can also be located without rain because of stains created by ponding of water. Depressions can be caused by settlement of the foundation soil or can be "built up" during construction. Depressions cause roughness and, when filled with water of sufficient depth, could cause hydroplaning of aircraft.

Severity Levels:

L - Depression can be observed or located by stained areas, only slightly affects pavement riding quality, and may cause hydroplaning potential on runways (see measurement criteria below). (Figure A-25)

M - The depression can be observed, moderately affects pavement riding quality, and causes hydroplaning potential on runways (see measurement criteria below). (Figures A-26, A-27)

H - The depression can be readily observed, severely affects pavement riding quality, and causes definite hydroplaning potential (see measurement criteria below). (Figure A-28)

How to Measure: Depressions are measured in square feet of surface area. The maximum depth of the depression determines the level of severity. This depth can be measured by placing a 10-foot straightedge across the depressed area and measuring the maximum depth in inches. Depressions larger than 10 feet across must be measured by either visual estimation or direct measurement when filled with water.

Maximum Depth of Depression

Severity	Runways and High Speed Taxiways	Taxiways and Aprons
L	1/8 - 1/2 inch	1/2 - 1 inch
M	>1/2 - 1 inch	>1 - 2 inches
H	>1 inch	>2 inches

Figure A-25. Low Severity Depression.

Figure A-26. Medium Severity Depression (> 1/2 Inch).

Figure A-27. Medium Severity Depression (>1/2 Inch).

Figure A-28. High Severity Depression (2 Inches).

Name of Distress:	Jet Blast Erosion
Description:	Jet blast erosion causes darkened areas on the pavement surface when bituminous binder has been burned or carbonized; localized burned areas may vary in depth up to approximately 1/2 inch.
Severity Levels:	No degrees of severity are defined. It is sufficient to indicate that jet blast erosion exists. (Figures A-29, A-30)
How to Measure:	Jet blast erosion is measured in square feet of surface area.

Figure A-29. Jet Blast Erosion.

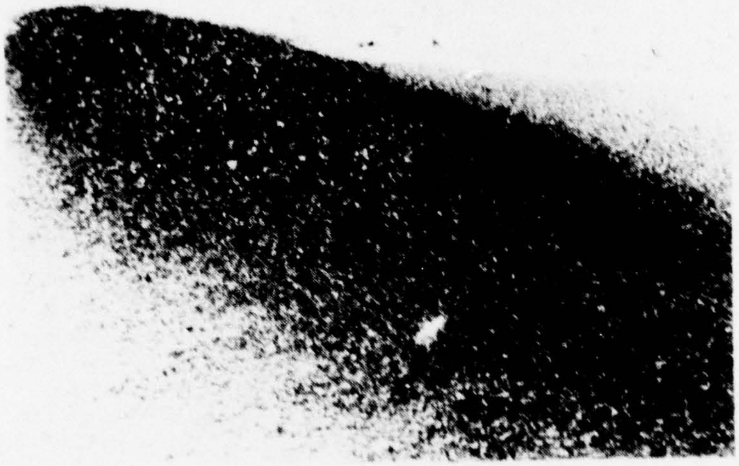

Figure A-30. Jet Blast Erosion.

Name of Distress: Joint Reflection Cracking From PCC (Longitudinal and Transverse)

Description: This distress occurs only on pavements having an asphalt or tar surface over a portland cement concrete (PCC) slab. This category does not include reflection cracking from any other type of base (i.e., cement stabilized, lime stabilized); such cracks are listed as longitudinal and transverse cracks. Joint reflection cracking is caused mainly by movement of the PCC slab beneath the asphalt concrete (AC) surface because of thermal and moisture changes; it is not load related. However, traffic loading may cause a breakdown of the AC near the crack, resulting in spalling and FOD potential. If the pavement is fragmented along a crack, the crack is said to be spalled. A knowledge of slab dimensions beneath the AC surface will help to identify these cracks.

Severity Levels:

L - Cracks have only light spalling (little or no FOD potential) or no spalling, and can be filled or nonfilled. If nonfilled, the cracks have a mean width of 1/4 inch or less; filled cracks are of any width, but their filler material is in satisfactory condition. *(Figures A-31, A-32, A-33)*

M - One of the following conditions exists: (1) cracks are moderately spalled (some FOD potential) and can be either filled or nonfilled of any width; (2) filled cracks are not spalled or are only lightly spalled, but the filler is in unsatisfactory condition; (3) nonfilled cracks are not spalled or are only lightly spalled, but the mean crack width is greater than 1/4 inch; or (4) light random cracking exists near the crack or at the corners of intersecting cracks. (Figures A-34, A-35, A-36)

H - Cracks are severely spalled (definite FOD potential) and can be either filled or nonfilled of any width. (Figure A-37)

How to Measure: Joint reflection cracking is measured in linear feet. The length and severity level of each crack should be identified and recorded. If the crack does not have the same severity level along its entire length, each portion should be recorded separately. For example, a crack that is 50 feet long may have 10 feet of high severity, 20 feet of medium severity, and 20 feet of light severity; these would all be recorded separately.

Figure A-31. Low Severity Joint Reflection Cracking.

Figure A-32. Low Severity Joint Reflection Cracking, Filled Crack.

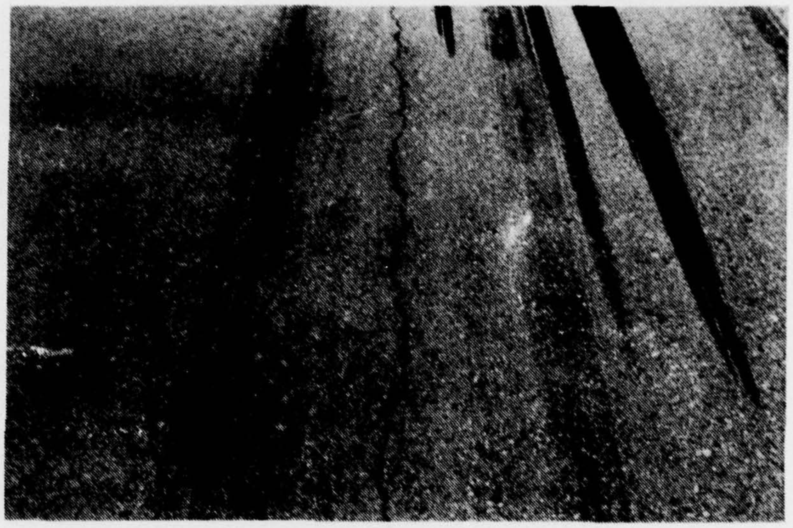

Figure A-33. Low Severity Joint Reflection Cracking, Nonfilled Crack.

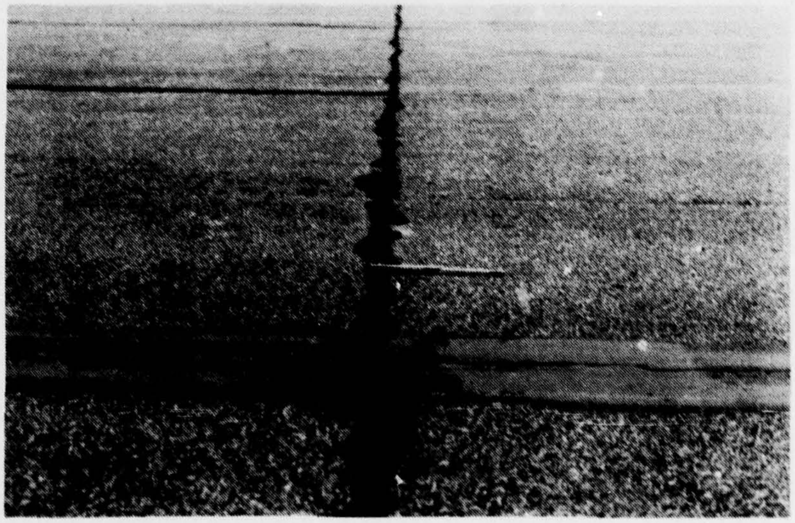

Figure A-34. Medium Severity Joint Reflection Cracking.

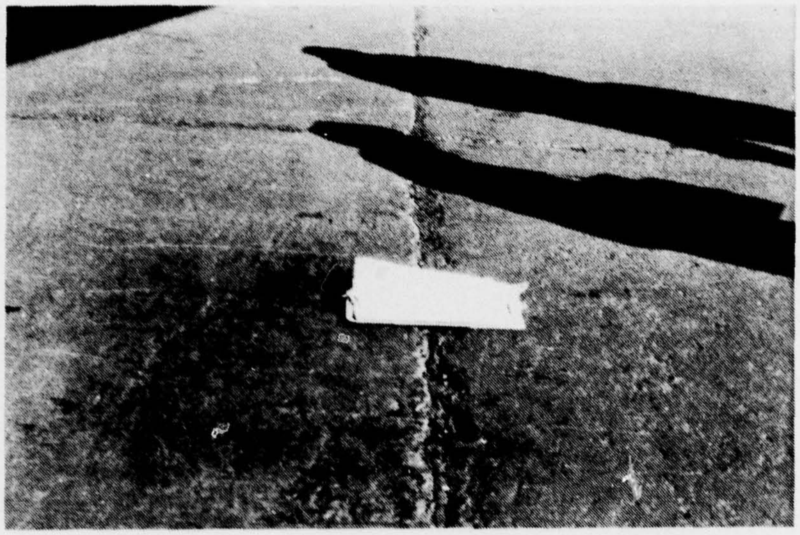

Figure A-35. Medium Severity Joint Reflection Cracking.

Figure A-36. Medium Severity Joint Reflection Cracking.

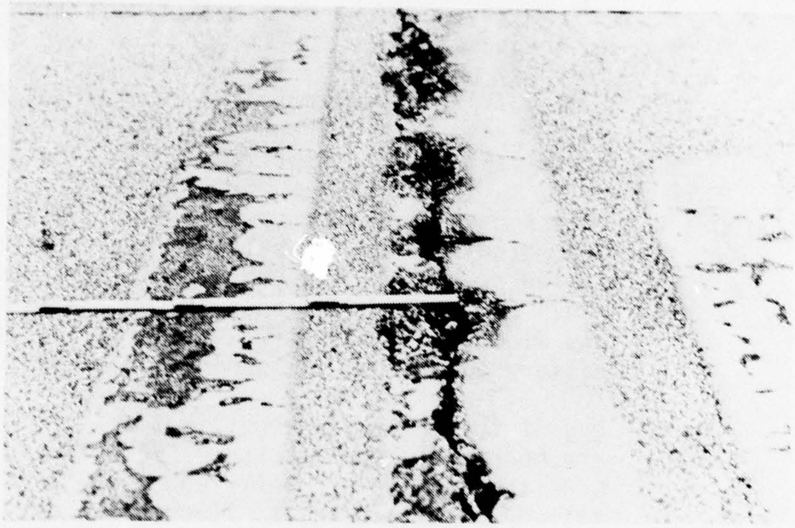

Figure A-37. High Severity Joint Reflection Cracking.

Name of Distress: Longitudinal and Transverse Cracking (Non-PCC Joint Reflective)

Description: Longitudinal cracks are parallel to the pavement's centerline or laydown direction. They may be caused by (1) a poorly constructed paving lane joint, (2) shrinkage of the AC surface due to low temperatures or hardening of the asphalt, or (3) a reflective crack caused by cracks beneath the surface course, including cracks in PCC slabs (but not at PCC joints). Transverse cracks extend across the pavement at approximately right angles to the pavement centerline or direction of laydown. They may be caused by items 2 or 3 above. These types of cracks are not usually load associated. If the pavement is fragmented along a crack, the crack is said to be spalled.

Severity Levels: L - Cracks have either minor spalling (little or no FOD potential) or no spalling. The cracks can be filled or nonfilled. Nonfilled cracks have a mean width of 1/4 inch or less; filled cracks are of any width, but their filler material is in satisfactory condition. (Figures A-38, A-39)

M - One of the following conditions exists: (1) cracks are moderately spalled (some FOD potential) and can be either filled or nonfilled of any width; (2) filled cracks are not spalled or are only lightly spalled, but the filler is in unsatisfactory condition; (3) nonfilled cracks are not spalled or are only lightly spalled, but mean crack width is greater than 1/4 inch; or (4) light random cracking exists near the crack or at the corners of intersecting cracks. (Figures A-40, A-41, A-42)

H - Cracks are severely spalled, causing definite FOD potential. They can be either filled or nonfilled of any width. (Figure A-43)

How to Measure: Longitudinal and transverse cracks are measured in linear feet. The length and severity of each crack should be identified and recorded. If the crack does not have the same severity level along its entire length, each portion of the crack having a different severity level should be recorded separately. For an example, see Joint Reflection Cracking.

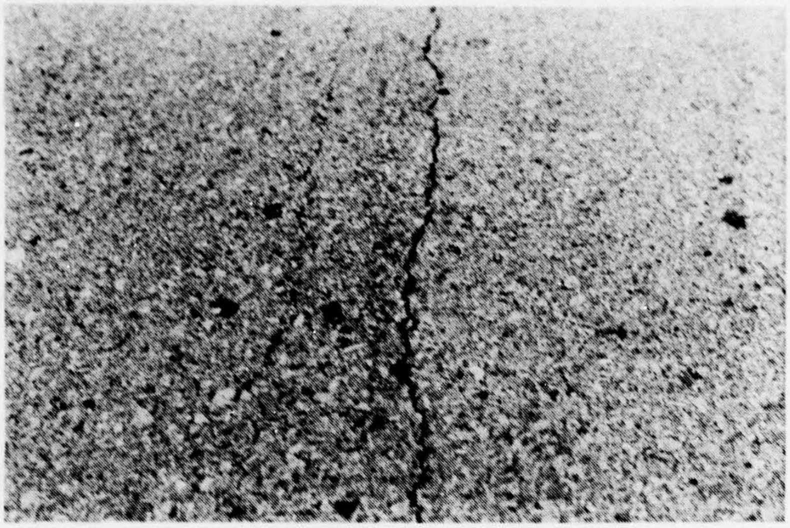

Figure A-38. Low Severity Longitudinal Crack.

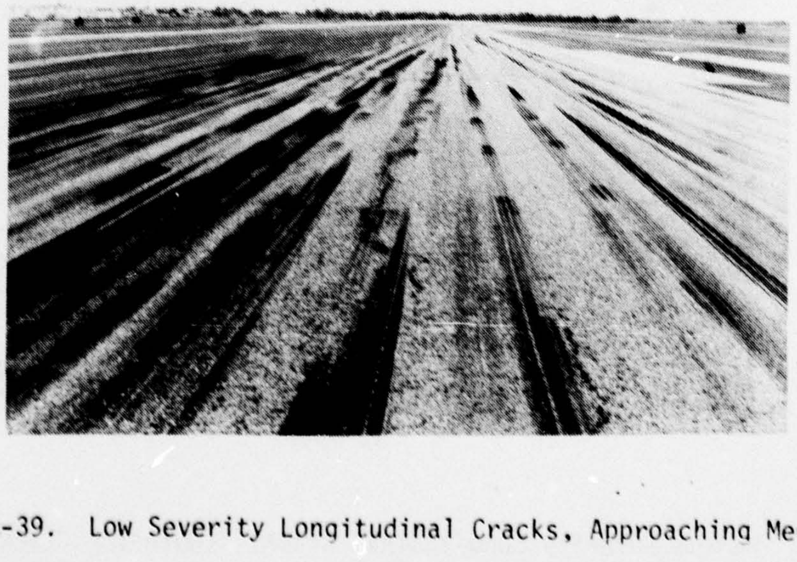

Figure A-39. Low Severity Longitudinal Cracks, Approaching Medium.

Figure A-40. Medium Severity Longitudinal Construction Joint Crack.

Figure A-41. Medium Severity Longitudinal Crack. (Note the Crack Is Reflective But Not at the Joint of Slab.

Figure A-42. Medium Severity Longitudinal Crack.

Figure A-43. High Severity Longitudinal Crack.

Name of Distress:	Oil Spillage
Description:	Oil spillage is the deterioration or softening of the pavement surface caused by the spilling of oil, fuel, or other solvents. (Figures A-44, A-45)
Severity Levels:	No degrees of severity are defined. It is sufficient to indicate that oil spillage exists.
How to Measure:	Oil spillage is measured in square feet of surface area.

Figure A-44. Oil Spillage.

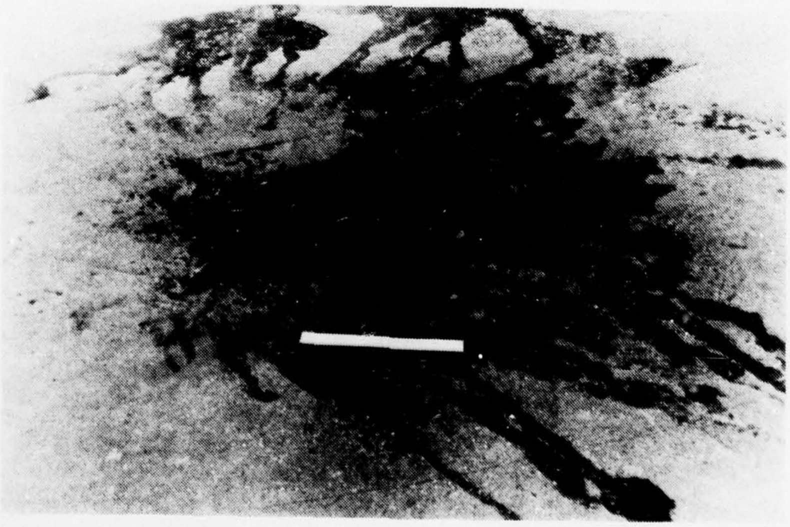

Figure A-45. Oil Spillage.

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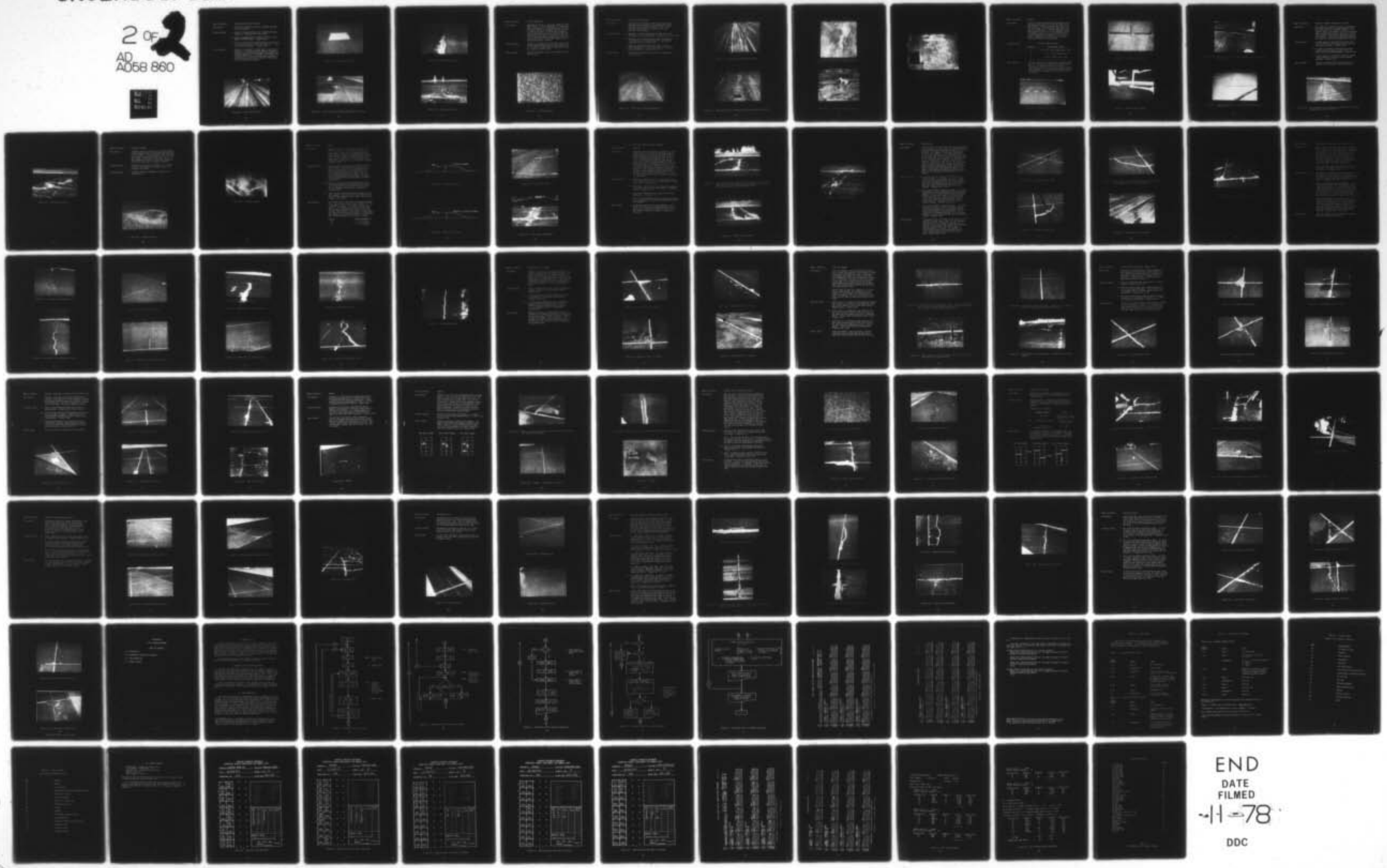

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Name of Distress:	Patching and Utility Cut Patch
Description:	A patch is considered a defect, no matter how well it is performing.
Severity Levels:	L - Patch is in good condition and is performing satisfactorily. (Figures A-46, A-47, A-48) M - Patch is somewhat deteriorated and affects riding quality to some extent. (Figure A-49) H - Patch is badly deteriorated and affects riding quality significantly or has high FOD potential. Patch soon needs replacement. (Figure A-50)
How to Measure:	Patching is measured in square feet of surface area. However, if a single patch has areas of differing severity levels, these areas should be measured and recorded separately. For example, a 25-square foot patch may have 10 square feet of medium severity and 15 square feet of light severity. These areas would be recorded separately.

Figure A-46. Light Severity Patch.

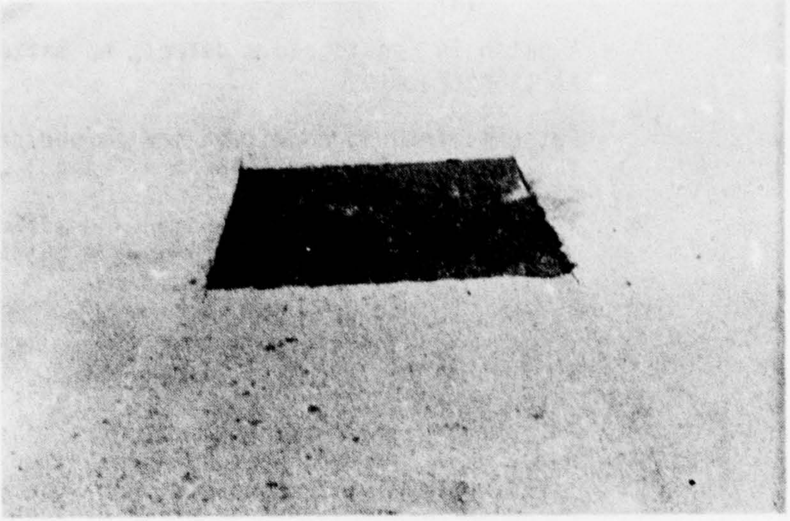


Figure A-47. Light Severity Patch.

Figure A-48. Light Severity Patch With Medium Severity Portion.

Figure A-49. Medium Severity Patch.

Figure A-50. High Severity Patch.

Name of Distress: Polished Aggregate

Description: Aggregate polishing is caused by repeated traffic applications. Polished aggregate is present when close examination of a pavement reveals that the portion of aggregate extending above the asphalt is either very small, or there are no rough or angular aggregate particles to provide good skid resistance. Existence of this type of distress is also indicated when the number on a skid resistance rating test is low or has dropped significantly from previous ratings.

Severity Levels: No degrees of severity are defined. However, the degree of polishing should be significant before it is included in the condition survey and rated as a defect. (Figure A-51)

How to Measure: Polished aggregate is measured in square feet of surface area.

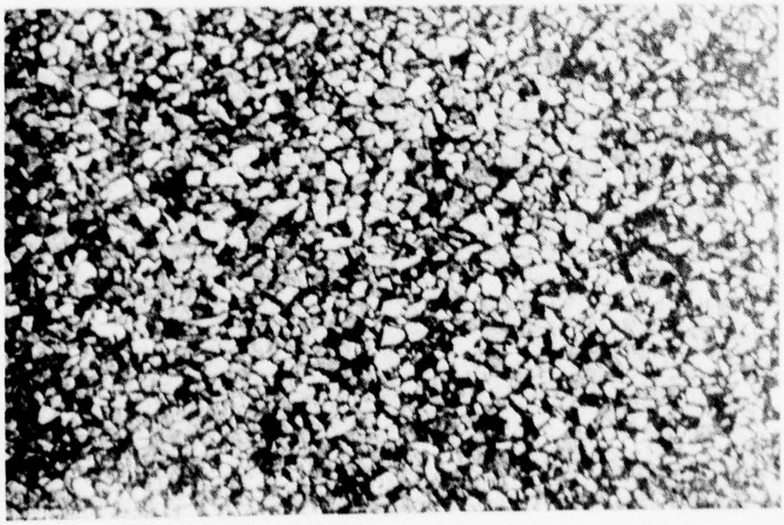


Figure A-51. Polished Aggregate.

Name of Distress: Raveling and Weathering

Description: Raveling and weathering are the wearing away of the pavement surface caused by the dislodging of aggregate particles and loss of asphalt or tar binder. They may indicate that the asphalt binder has hardened significantly.

Severity Levels:

L - Aggregate or binder has started to wear away, causing little or no FOD potential. (Figures A-52, A-53, A-54)

M - Aggregate and/or binder has worn away, causing some FOD potential. The surface texture is moderately rough and pitted. (Figure A-55)

H - Aggregate and/or binder has worn away, causing a high FOD potential. The surface texture is severely rough and pitted. (Figures A-56, A-57)

How to Measure: Raveling and weathering are measured in square feet of surface area.

Figure A-52. Light Severity Raveling/Weathering.

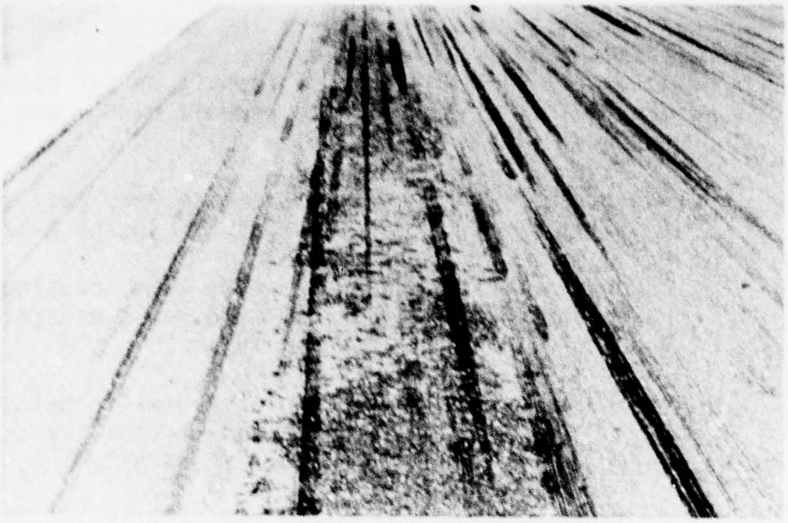


Figure A-53. Light Severity Raveling/Weathering.

Figure A-54. Light Severity Raveling/Weathering, Approaching Medium Severity.

Figure A-55. Medium Severity Raveling/Weathering.

Figure A-56. High Severity Raveling/Weathering.

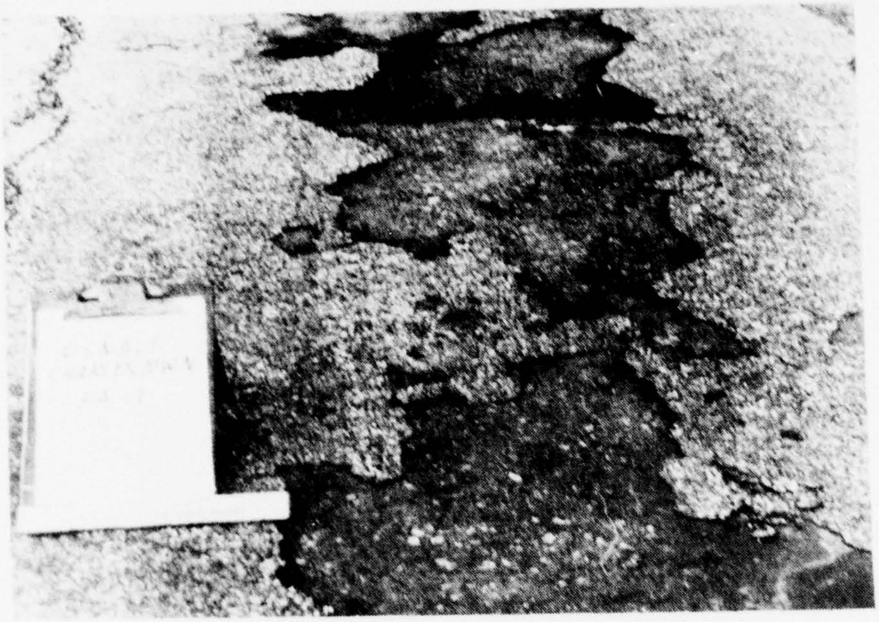


Figure A-57. High Severity Raveling/Weathering.

Name of Distress: Rutting

Description: A rut is a surface depression in the wheel paths. Pavement uplift may occur along the sides of the rut; however, in many instances ruts are noticeable only after a rainfall, when the wheel paths are filled with water. Rutting stems from a permanent deformation in any of the pavement layers or subgrade, usually caused by consolidation or lateral movement of the materials due to traffic loads. Significant rutting can lead to major structural failure of the pavement.

Severity Levels: Mean Rut Depth Criteria

Severity	All Pavement Sections
L	1/4 - 1/2 inch (Figures A-58, A-59)
M	>1/2 1 inch (Figure A-60)
H	>1 inch (Figures A-61, A-62)

How to Measure: Rutting is measured in square feet of surface area, and its severity is determined by the mean depth of the rut. To determine the mean rut depth, a straightedge should be laid across the rut and the depth measured. The mean depth in inches should be computed from measurements taken along the length of the rut.

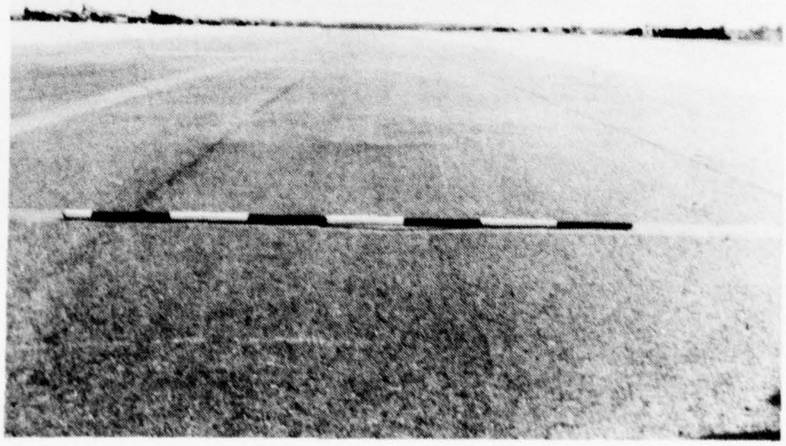


Figure A-58. Light Severity Rutting.

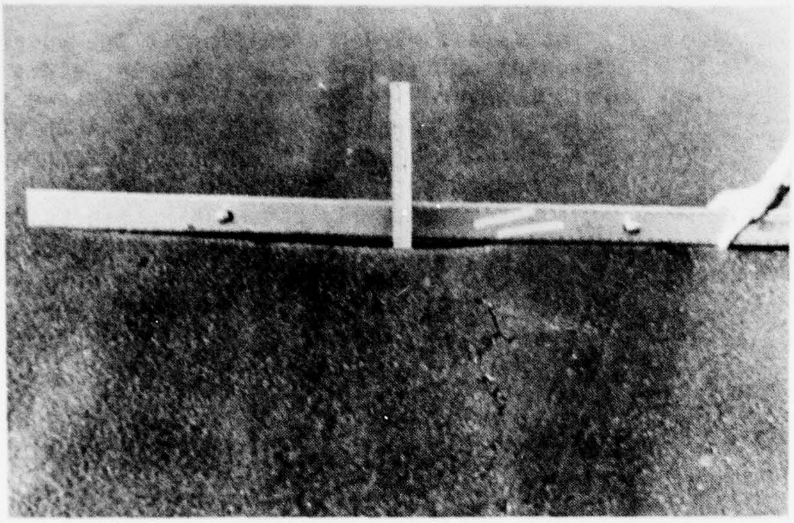


Figure A-59. Light Severity Rutting.

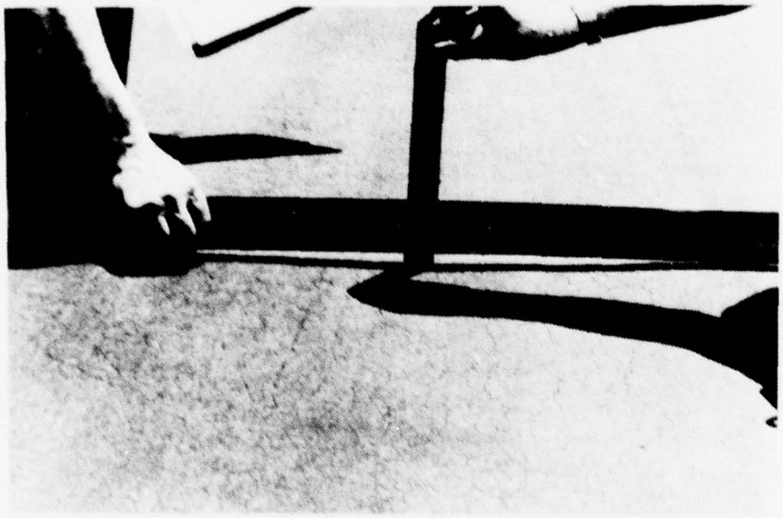


Figure A-60. Medium Severity Rutting.

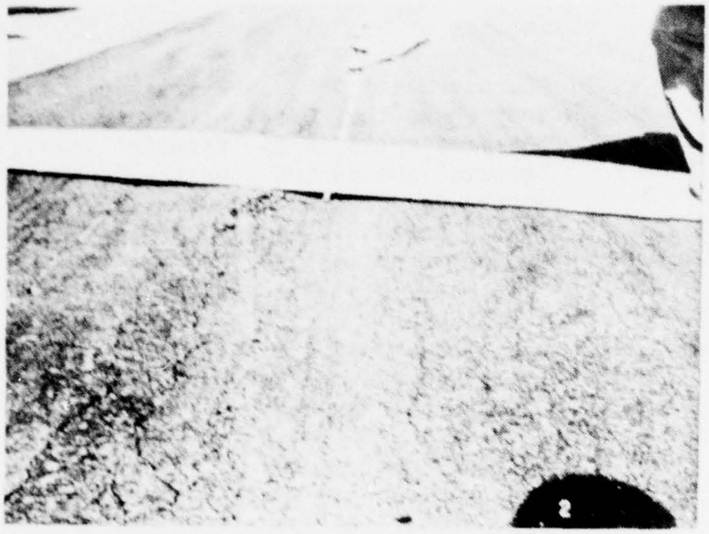


Figure A-61. High Severity Rutting. (Note Alligator Cracking Associated With Rutting.)

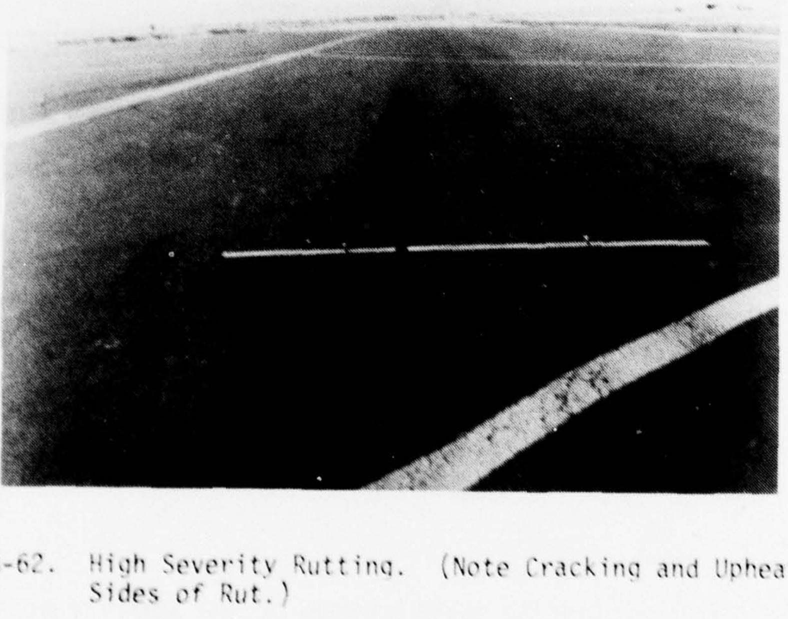


Figure A-62. High Severity Rutting. (Note Cracking and Upheaval on Sides of Rut.)

Name of Distress: Shoving of Asphalt Pavement by PCC Slabs

Description: PCC pavements occasionally increase in length at ends where they adjoin flexible pavements (commonly referred to as "pavement growth"). This "growth" shoves the asphalt- or tar-surfaced pavements, causing them to swell and crack. The PCC slab "growth" is caused by a gradual opening up of the joints as they are filled with incompressible materials that prevent them from reclosing.

Severity Levels:

L - A slight amount of shoving has occurred, with little effect on ride quality and no break-up of the asphalt pavement. (Figure A-63)

M - A significant amount of shoving has occurred, causing moderate roughness and little or no break-up of the asphalt pavement. (Figure A-64)

H - A large amount of shoving has occurred, causing severe roughness or break-up of the asphalt pavement. (Figure A-64)

How to Measure: Shoving is measured by determining the area in square feet of the swell caused by shoving.

Figure A-63. This Photograph Shows a Shove of Low Severity on the Outside and Medium Severity in the Middle.

Figure A-64. High Severity Shoving.

Name of Distress:	Slippage Cracking
Description:	Slippage cracks are crescent- or half-moon-shaped cracks having two ends pointed away from the direction of traffic. They are produced when braking or turning wheels cause the pavement surface to slide and deform. This usually occurs when there is a low strength surface mix or poor bond between the surface and next layer of pavement structure.
Severity Levels:	*No degrees of severity are defined.* It is sufficient to indicate that a slippage crack exists. (Figures A-65, A-66)
How to Measure:	Slippage cracking is measured in square feet of surface area.

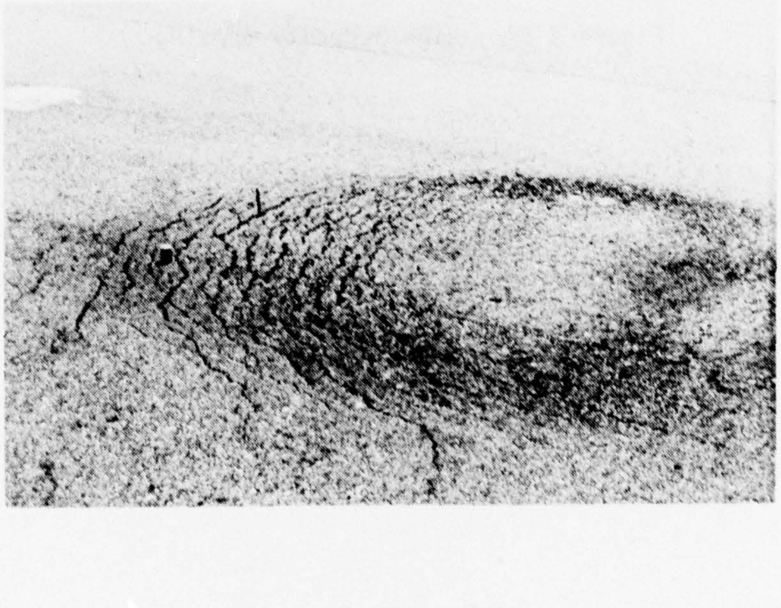


Figure A-65. Slippage Cracking.

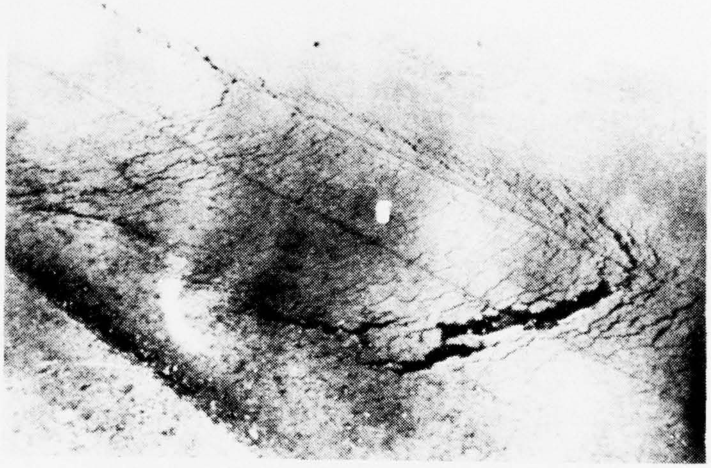


Figure A-66. Slippage Cracking.

Name of Distress: Swell

Description: Swell is characterized by an upward bulge in the pavement's surface. A swell may occur sharply over a small area or as a longer, gradual wave. Either type of swell can be accompanied by surface cracking. A swell is usually caused by frost action in the subgrade or by swelling soil, but a small swell can also occur on the surface of an asphalt overlay (over PCC) as a result of a blowup in the PCC slab.

Severity Levels:

L - Swell is barely visible and has a minor effect on the pavement's ride quality as determined at the normal aircraft speed for the pavement section under consideration. (Low severity swells may not always be observable, but their existence can be confirmed by driving a vehicle over the section at the normal aircraft speed. An upward acceleration will occur if the swell is present.) (Figure A-67)

M - Swell can be observed without difficulty and has a significant effect on the pavement's ride quality as determined at the normal aircraft speed for the pavement section under consideration. (Figure A-68)

H - Swell can be readily observed and severely affects the pavement's ride quality at the normal aircraft speed for the pavement section under consideration. (Figures A-69, A-70)

How to Measure: The surface area of the swell is measured in square feet. The severity rating should consider the type of pavement section (i.e., runway, taxiway, or apron). For example, a swell of sufficient magnitude to cause considerable roughness on a runway at high speeds would be rated as more severe than the same swell located on the apron or taxiway where the normal aircraft operating speeds are much lower. The following guidance is provided for runways:

Severity	Height Differential
L	<3/4 inch
M	3/4 - 1 1/2 inches
H	>1 1/2 inches

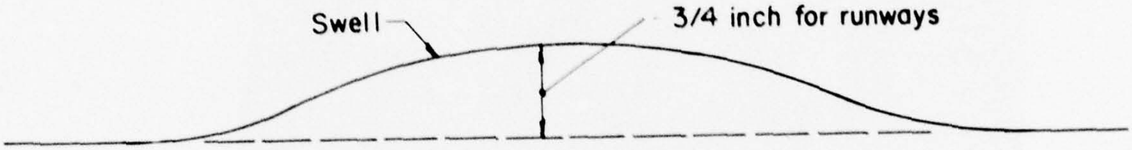


Figure A-67. Low Severity Swell.

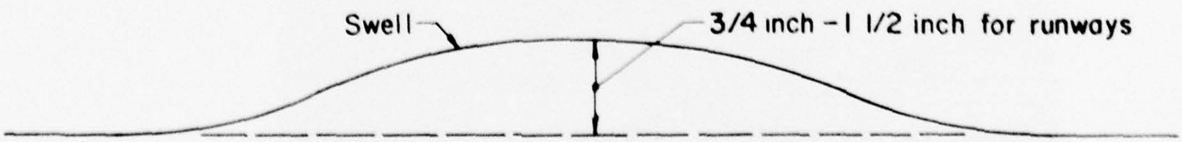


Figure A-68. Medium Severity Swell.

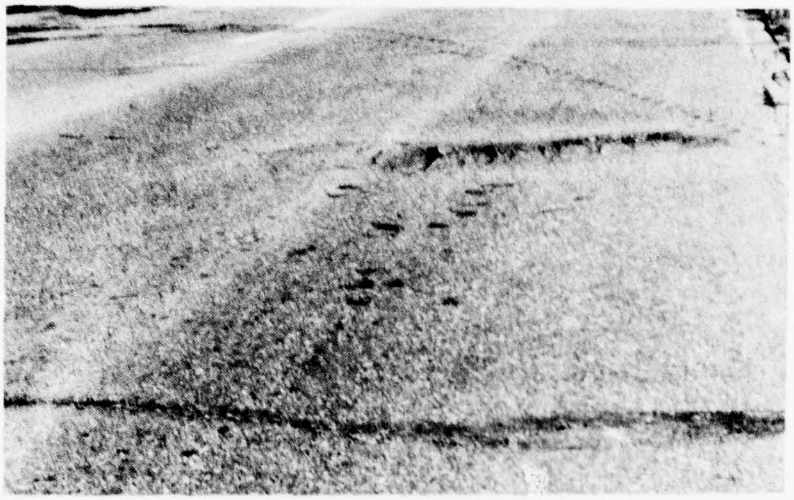


Figure A-69. High Severity Swell.

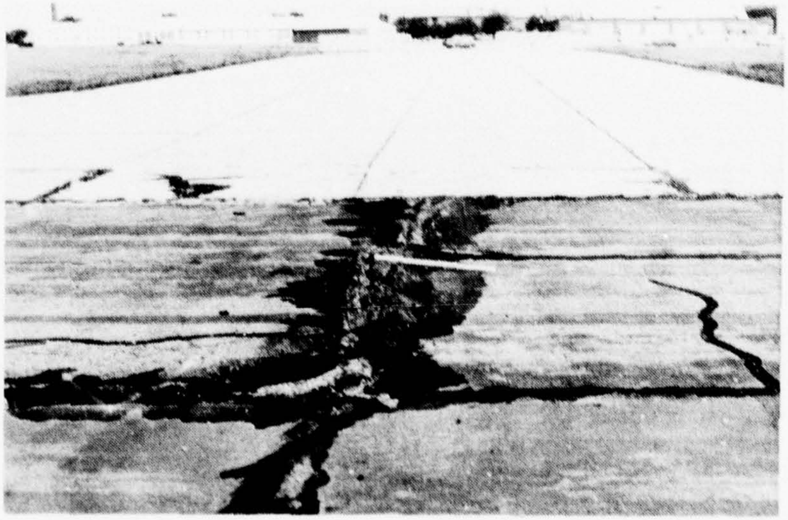


Figure A-70. High Severity Sharp Swell.

3.0 DISTRESSES ON JOINTED CONCRETE PAVEMENTS

Name of Distress: Blow-Up

Description: Blow-ups occur in hot weather, usually at a transverse crack or joint that is not wide enough to permit expansion of the concrete slabs. The insufficient width is usually caused by infiltration of incompressible materials into the joint space. When expansion cannot relieve enough pressure, a localized upward movement of the slab edges (buckling) or shattering will occur in the vicinity of the joint. Blow-ups can also occur at utility cuts and drainage inlets. This type of distress is almost always repaired immediately because of severe damage potential to aircraft. The main reason blow-ups are included here is for reference when closed sections are being evaluated for reopening.

Severity Levels:

L - Buckling or shattering has not rendered the pavement inoperative, and only a slight amount of roughness exists. (Figure A-71)

M - Buckling or shattering has not rendered the pavement inoperative, but a significant amount of roughness exists. (Figure A-72)

H - Buckling or shattering has rendered the pavement inoperative. (Figure A-73)

NOTE: For the pavement to be considered operational, all foreign material caused by the blow-up must have been removed.

How to Count: A blow-up usually occurs at a transverse crack or joint. At a crack it is counted as being in one slab, but at a joint, two slabs are affected and the distress should be recorded as occurring in two slabs.

Figure A-71. Low Severity Blow-Up. (Note That This Would Only Be Considered Low Severity If the Shattering in the Foreground Was the Only Part Existing and the Foreign Material Removed.)

Figure A-72. Medium Severity Blow-Up.

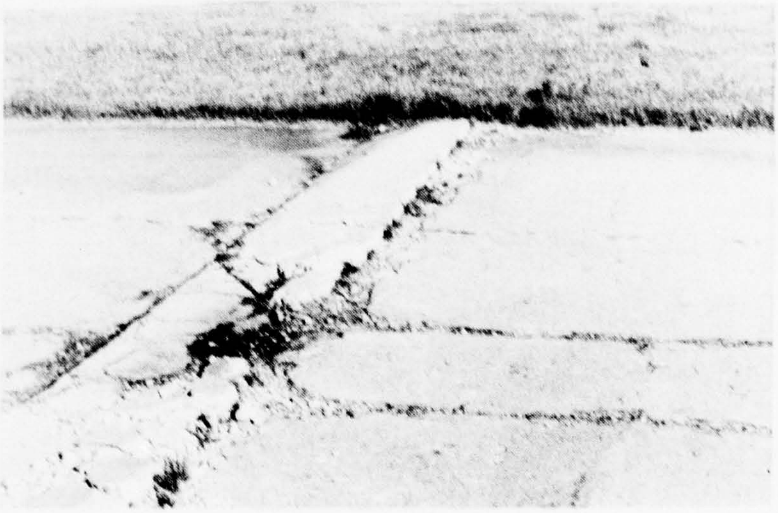


Figure A-73. High Severity Blow-Up.

Name of Distress: Corner Break

Description: A corner break is a crack that intersects the joints at a distance less than or equal to one-half the slab length on both sides, measured from the corner of the slab. For example, a slab with dimensions of 25 by 25 feet that has a crack intersecting the joint 5 feet from the corner on one side and 17 feet on the other side is not considered a corner break; it is a diagonal crack. However, a crack that intersects 7 feet on one side and 10 feet on the other is considered a corner break. A corner break differs from a corner spall in that the crack extends vertically through the entire slab thickness, while a corner spall intersects the joint at an angle. Load repetition combined with loss of support and curling stresses usually causes corner breaks.

Severity Levels:

L - Crack has either no spalling or minor spalling (no FOD potential). If nonfilled, it has a mean width less than approximately 1/8 inch; a filled crack can be of any width, but the filler material must be in satisfactory condition. The area between the corner break and the joints is not cracked. (Figures A-74, A-75)

M - One of the following conditions exists: (1) filled or nonfilled crack is moderately spalled (some FOD potential); (2) a nonfilled crack has a mean width between 1/8 inch and 1 inch; (3) a filled crack is not spalled or only lightly spalled, but the filler is in unsatisfactory condition; (4) the area between the corner break and the joints is lightly cracked. (Figures A-76, A-77)

H - One of the following conditions exists: (1) filled or nonfilled crack is severely spalled, causing definite FOD potential; (2) a nonfilled crack has a mean width greater than approximately 1 inch, creating a tire damage potential; or (3) the area between the corner break and the joints is severely cracked. (Figure A-78)

How to Count: A distressed slab is recorded as one slab if it (1) contains a single corner break, (2) contains more than one break of a particular severity, or (3) contains two or more breaks of different severities. For two or more breaks, the highest level of severity should be recorded. For example, a slab containing both light and medium severity corner breaks should be counted as one slab with a medium corner break.

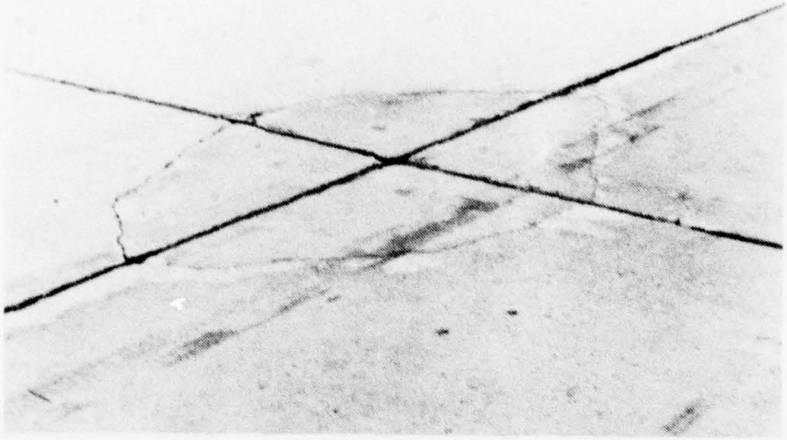


Figure A-74. Low Severity Corner Break.

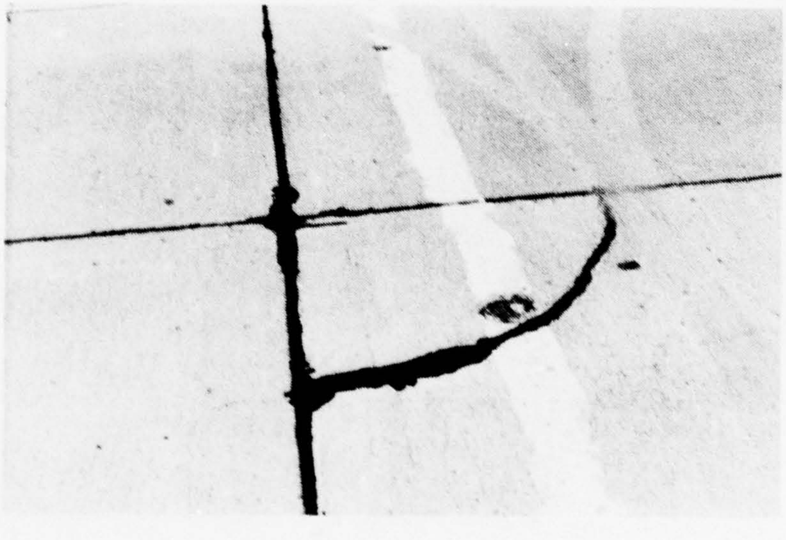


Figure A-75. Low Severity Corner Break.

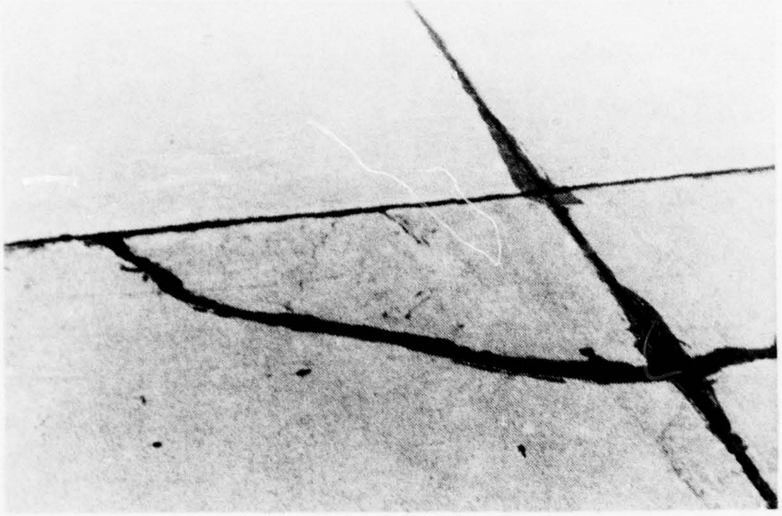


Figure A-76. Medium Severity Corner Break. (Area Between the Corner Break and the Joints Is Lightly Cracked).

Figure A-77. Medium Severity Corner Break.

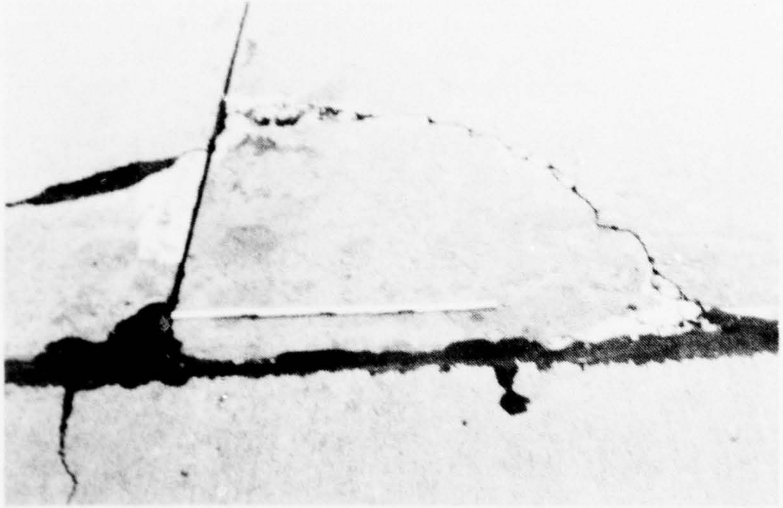


Figure A-78. High Severity Corner Break.

Name of Distress: Longitudinal, Transverse, and Diagonal Cracks

Description: These cracks, which divide the slab into two or three pieces, are usually caused by a combination of load repetition, curling stresses, and shrinkage stresses. (For slabs divided into four or more pieces see Shattered/Intersecting Cracks.) Low severity cracks are usually warping- or friction-related and are not considered major structural distresses. Medium or high severity cracks are usually working cracks and are considered major structural distresses.

NOTE: Hairline cracks that are only a few feet long and do not extend across the entire slab are rated as shrinkage cracks.

Severity Levels:

L - (1) crack has no spalling or minor spalling (no FOD potential). If nonfilled, it is less than 1/8 inch wide; a filled crack can be of any width, but its filler material must be in satisfactory condition. (Figures A-79, A-80, A-81)

M - One of the following conditions exists: (1) a filled or nonfilled crack is moderately spalled (some FOD potential); (2) a nonfilled crack has a mean width between 1/8 inch and 1 inch; (3) a filled crack has no spalling or minor spalling, but the filler is in unsatisfactory condition; or (4) the slab is divided into three pieces by low severity cracks. (Figures A-82, A-83, A-84)

H - One of the following conditions exists: (1) a filled or nonfilled crack is severely spalled (definite FOD potential); (2) a nonfilled crack has a mean width approximately greater than 1 inch, creating tire damage potential; or (3) the slab is divided into three pieces by two or more cracks, one of which is at least medium severity. (Figures A-85, A-86, A-87)

How to Count: Once the severity has been identified, the distress is recorded as one slab.

Figure A-79. Low Severity Longitudinal Crack.

Figure A-80. Low Severity Filled Longitudinal Cracks.

Figure A-81. Low Severity Diagonal Crack.

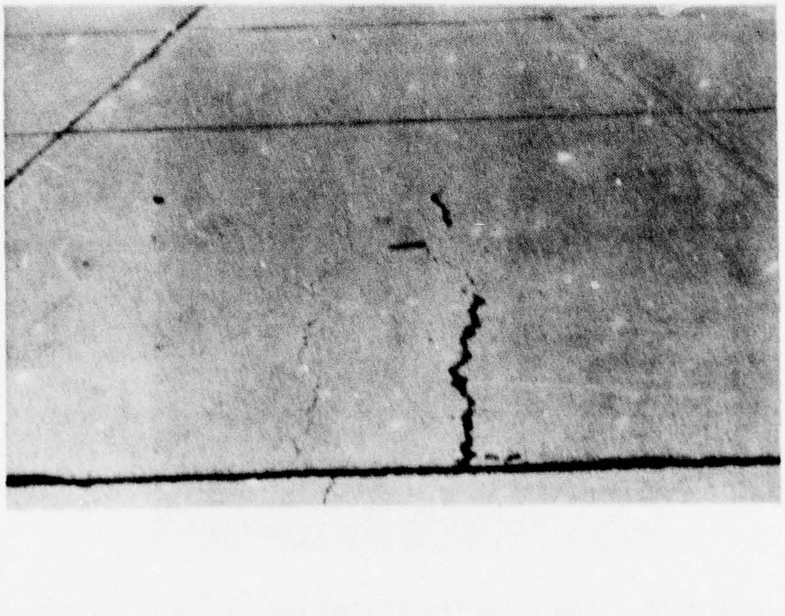


Figure A-82. Medium Severity Longitudinal Crack.

Figure A-83. Medium Severity Transverse Crack.

Figure A-84. Medium Severity Transverse Crack.

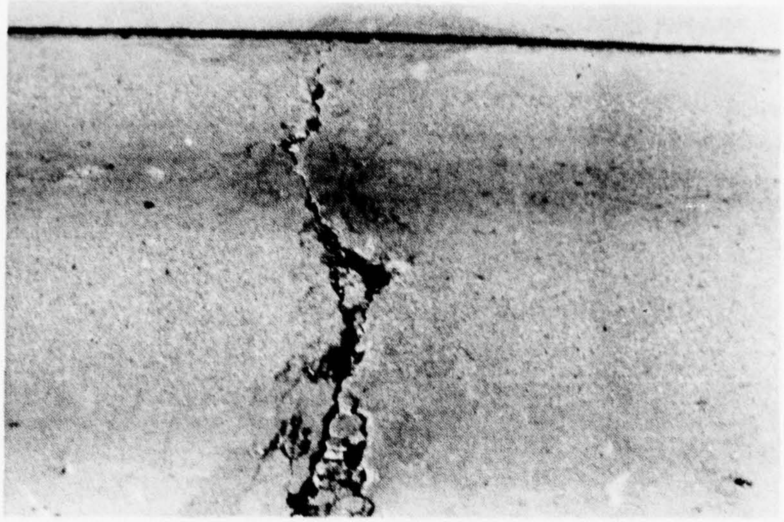


Figure A-85. High Severity Crack.

Figure A-86. High Severity Longitudinal Cracks.

Figure A-87. High Severity Crack.

Name of Distress:	Durability ("D") Cracking
Description:	Durability cracking is caused by the concrete's inability to withstand environmental factors such as freeze-thaw cycles. It usually appears as a pattern of cracks running parallel to a joint or linear crack. A dark coloring can usually be seen around the fine durability cracks. This type of cracking may eventually lead to disintegration of the concrete within 1 to 2 feet of the joint or crack.
Severity Levels:	L - Pieces are defined by light cracks and cannot be removed; little or no FOD potential exists. (Figure A-88) M - "D" cracks are well defined; small pieces have been displaced, causing some FOD potential. (Figures A-89, A-90) H - "D" cracking has developed over a considerable amount of slab area and the pieces are well defined and can be removed easily. The area is a considerable source of FOD potential. (Figure A-91)
How to Count:	When the distress is located and rated at one severity it is counted as one slab. If more than one severity level is found, the slab is counted as having the higher severity distress. For example, if light and medium durability cracking are located on one slab, the slab is counted as having medium only.

Figure A-88. Low Severity "D" Cracking.

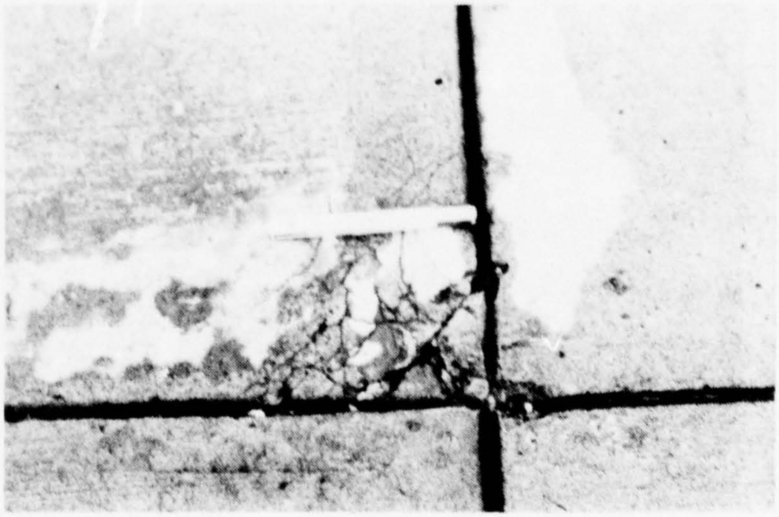


Figure A-89. Medium Severity "D" Cracking.

Figure A-90. Medium Severity "D" Cracking.

Figure A-91. High Severity "D" Cracking.

Name of Distress: Joint Seal Damage

Description: Joint seal damage is any condition which enables soil or rocks to accumulate in the joints or allows significant infiltration of water. Accumulation of incompressible materials prevents the slabs from expanding and may result in buckling, shattering, or spalling. A pliable joint filler bonded to the edges of the slabs protects the joints from accumulation of materials and also prevents water from seeping down and softening the foundation supporting the slab.

Typical types of joint seal damage are (1) stripping of joint sealant, (2) extrusion of joint sealant, (3) weed growth, (4) hardening of the filler (oxidation), (5) loss of bond to the slab edges, and (6) lack or absence of sealant in the joint.

Severity Levels:

L - Joint sealer is in generally good condition throughout the section. Sealant is performing well with only a minor amount of any of the above types of damage present. (Figure A-92)

M - Joint sealer is in generally fair condition over the entire surveyed section, with one or more of the above types of damage occurring to a moderate degree. Sealant needs replacement within 2 years. (Figure A-93)

H - Joint sealer is in generally poor condition over the entire surveyed section, with one or more of the above types of damage occurring to a severe degree. Sealant needs immediate replacement. (Figures A-94, A-95)

How to Count: Joint seal damage is not counted on a slab-by-slab basis, but is rated based on the overall condition of the sealant over the entire section.

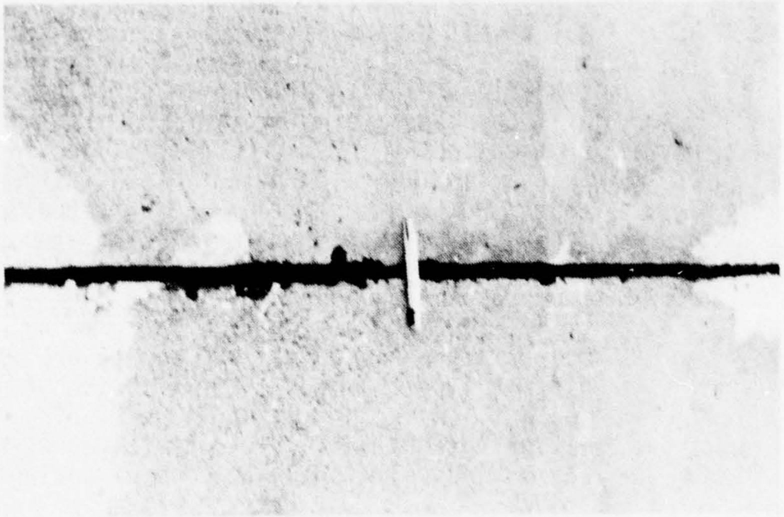


Figure A-92. Light Severity Joint Seal Damage. (This Condition Existed Only on a Few Joints in the Pavement Section. If All Joint Sealant Were as Shown, It Would Have Been Rated Medium.)

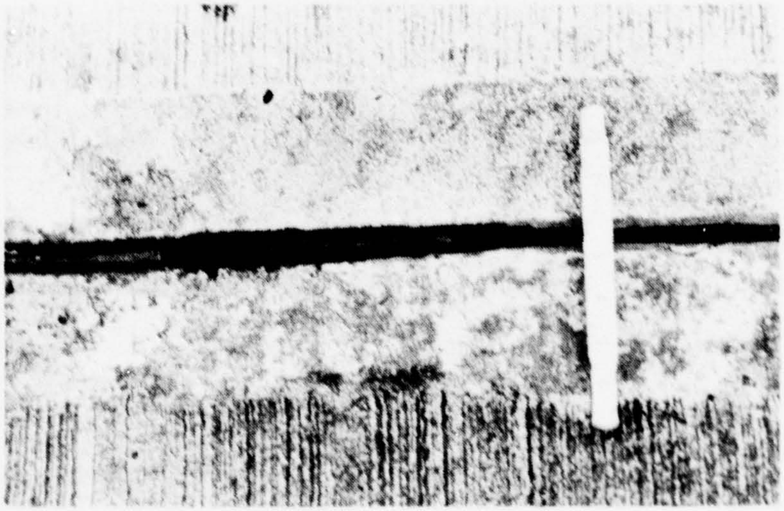


Figure A-93. Medium Severity Joint Seal Damage. (Note That Sealant Has Lost Bond and Is Highly Oxidized.)

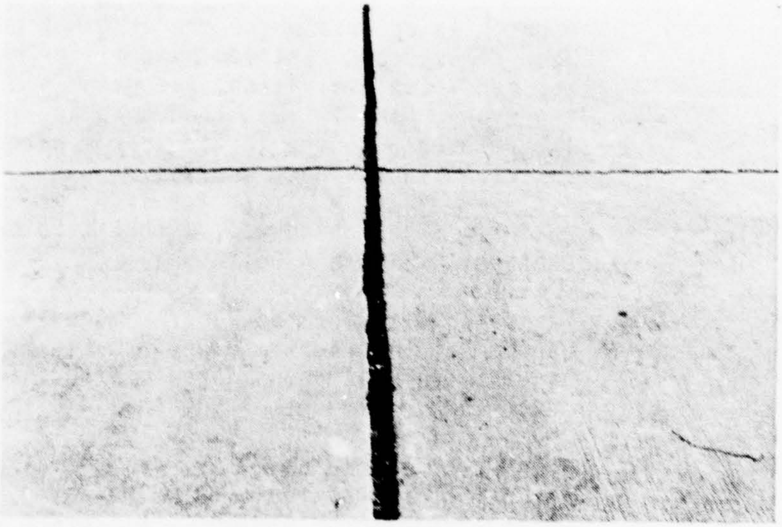


Figure A-94. High Severity Joint Seal Damage. (Complete Loss of Sealant; Joint Is Filled With Incompressible Material.)

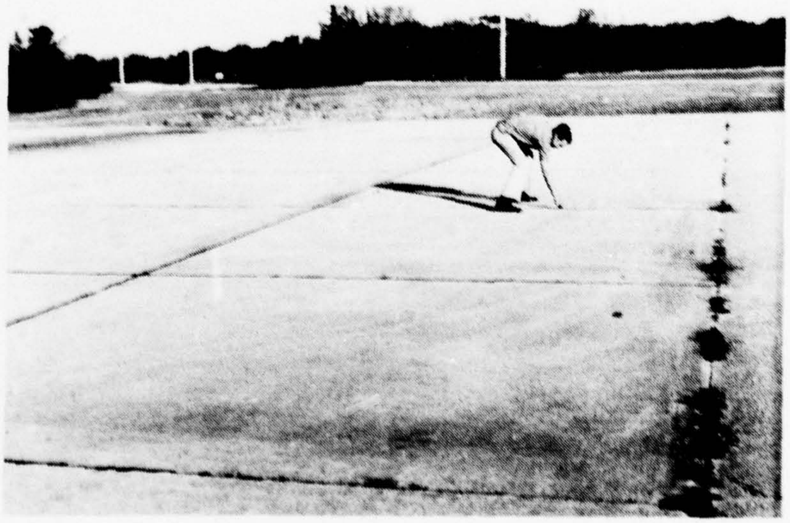


Figure A-95. High Severity Joint Seal Damage. (Extensive Amount of Weed Growth.)

Name of Distress: Patching, Small (Less Than 5 Square Feet)

Description: A patch is an area where the original pavement has been removed and replaced by a filler material. For condition evaluation, patching is divided into two types: small (less than 5 square feet) and large (over 5 square feet). Large patches are described in the next section.

Severity Levels:

L - Patch is functioning well with little or no deterioration. (Figure A-96, A-97)

M - Patch has deteriorated, and/or moderate spalling can be seen around the edges. Patch material can be dislodged with considerable effort (minor FOD potential). (Figures A-98, A-99)

H - Patch has deteriorated, either by spalling around the patch or cracking within the patch, to a state which warrants replacement. (Figure A-100)

How to Measure: If one or more small patches having the same severity level are located in a slab, it is counted as one slab containing that distress. If more than one severity level occurs, it is counted as one slab with the higher severity level being recorded.

Figure A-96. Low Severity Small Patch.

Figure A-97. Low Severity Small Patch.

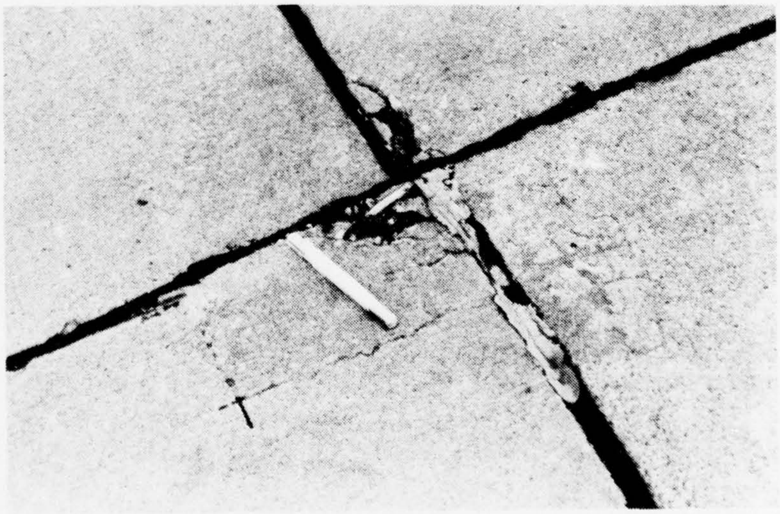


Figure A-98. Medium Severity Small Patch.

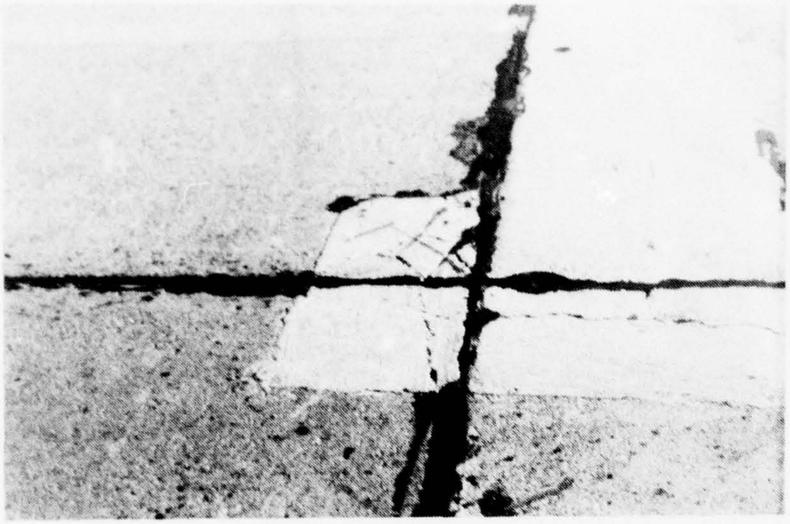


Figure A-99. Medium Severity Small Patch.

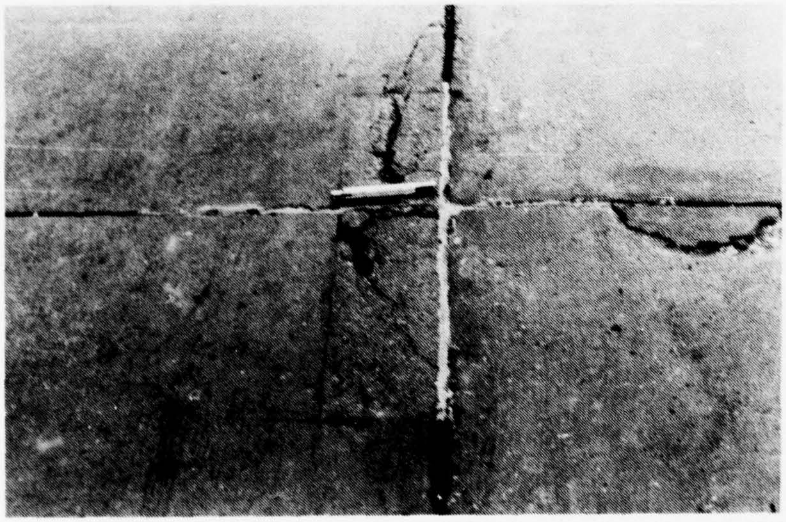


Figure A-100. High Severity Small Patch.

Name of Distress: Patching, Large (Over 5 Square Feet) and Utility Cut

Description: Patching is the same as defined in the previous section. A utility cut is a patch that has replaced the original pavement because of placement of underground utilities. The severity levels of a utility cut are the same as those for regular patching.

Severity Levels:

L - Patch is functioning well with very little or no deterioration. (Figures A-101, A-102, A-103)

M - Patch has deteriorated and/or moderate spalling can be seen around the edges. Patch material can be dislodged with considerable effort, causing some FOD potential. (Figure A-104)

H - Patch has deteriorated to a state which causes considerable roughness and/or high FOD potential. The extent of the deterioration warrants replacement of the patch. (Figure A-105)

How to Count: The criteria are the same as for small patches.

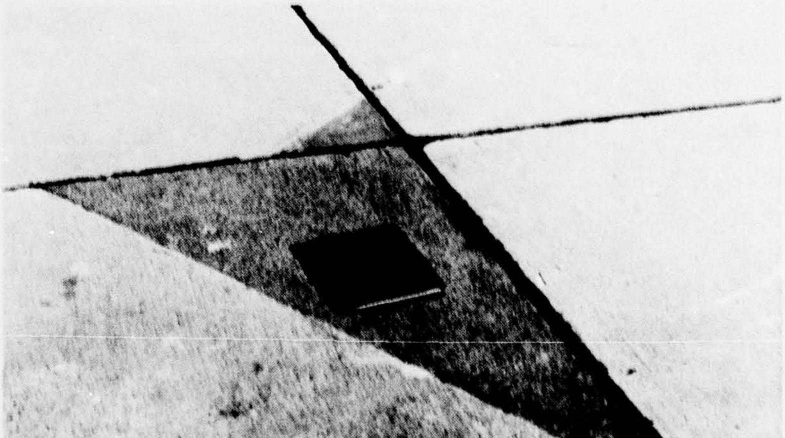


Figure A-101. Low Severity Patch.

Figure A-102. Low Severity Patch.

Figure A-103. Low Severity Utility Cut.

Figure A-104. Medium Severity Utility Cut.

Figure A-105. High Severity Patch.

Name of Distress: Popouts

Description: A popout is a small piece of pavement that breaks loose from the surface due to freeze-thaw action in combination with expansive aggregates. Popouts usually range from approximately 1 inch to 4 inches in diameter and from 1/2 inch to 2 inches deep.

Severity Levels: No degrees of severity are defined for popouts. However, popouts must be extensive before they are counted as a distress; i.e., average popout density must exceed approximately three popouts per square yard over the entire slab area. (Figure A-106)

How to Count: The density of the distress must be measured. If there is any doubt about the average being greater than three popouts per square yard, at least three random 1-square-yard areas should be checked. When the average is greater than this density, the slab is counted.

Figure A-106. Popouts

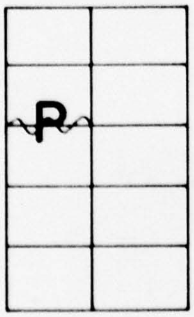
Name of Distress: Pumping

Description: Pumping is the ejection of material by water through joints or cracks, caused by deflection of the slab under passing loads. As the water is ejected, it carries particles of gravel, sand, clay, or silt, resulting in a progressive loss of pavement support. Surface staining and base or subgrade material on the pavement close to joints or cracks are evidence of pumping. Pumping near joints indicates poor joint sealer and loss of support which will lead to cracking under repeated loads.

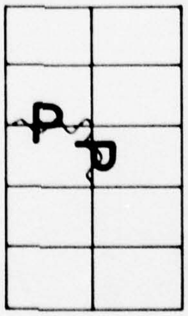
Severity Levels: No degrees of severity are defined. It is sufficient to indicate that pumping exists. (Figures A-107 through A-110)

How to Count: Slabs are counted as follows (see diagram): one pumping joint between two slabs is counted as two slabs. However, if the remaining joints around the slab are also pumping, one slab is added per additional pumping joint (see diagram below).

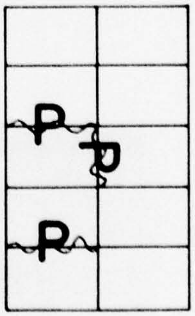
two slabs counted



three slabs counted



five slabs counted



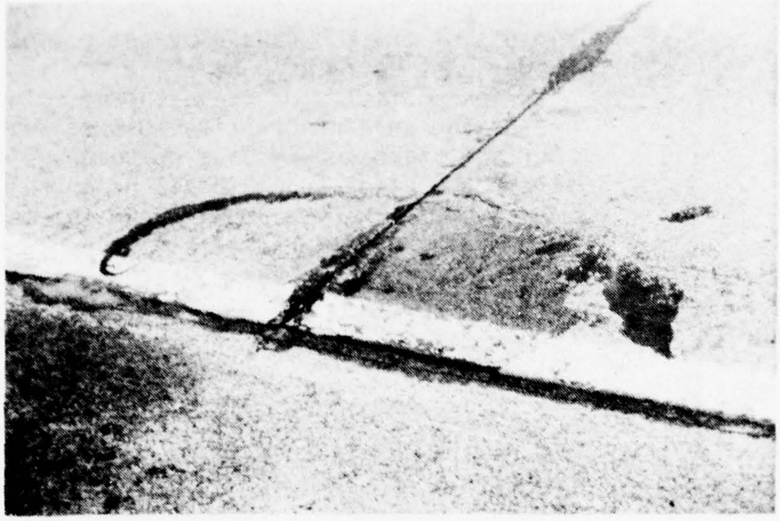


Figure A-107. Pumping. (Note Fine Material on Surface That Has Been Pumped Out, Causing Corner Break.)

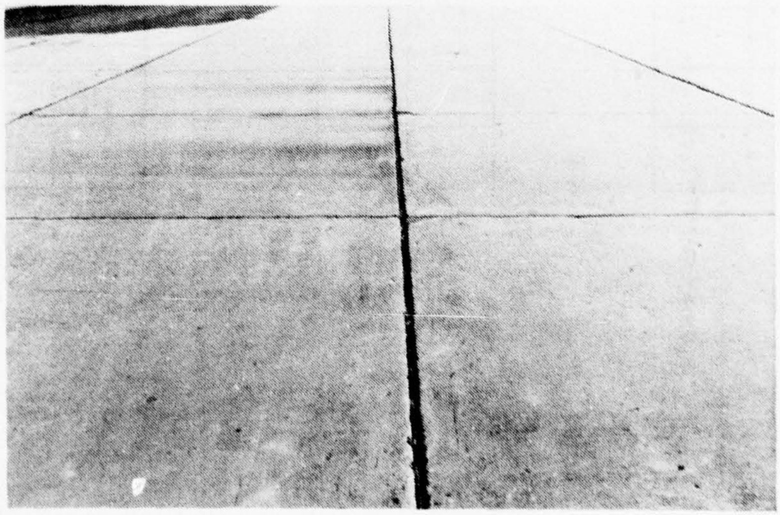


Figure A-108. Pumping. (Note Stains on Pavement.)

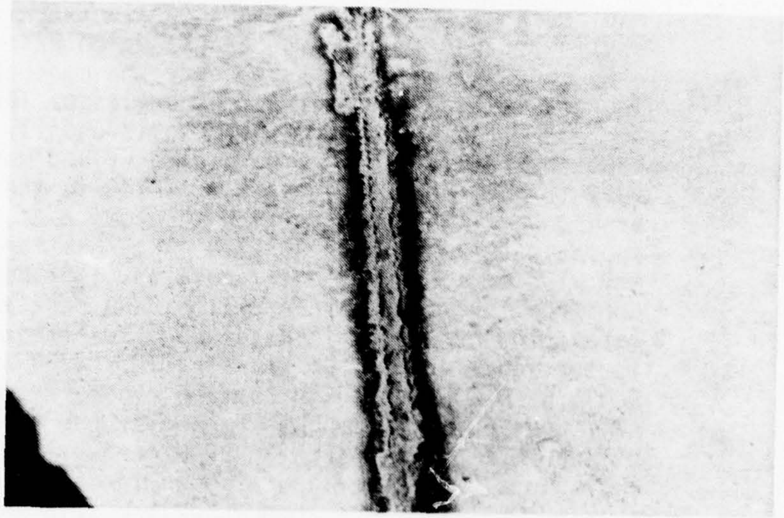


Figure A-109. Pumping. (Close-Up of Fine Materials Collecting in the Joint.)

Figure A-110. Pumping.

Name of Distress: Scaling, Map Cracking, and Crazing

Description: Map cracking or crazing refers to a network of shallow, fine, or hairline cracks which extend only through the upper surface of the concrete. The cracks tend to intersect at angles of 120 degrees. Map cracking or crazing is usually caused by overfinishing the concrete, and may lead to scaling of the surface, which is the breakdown of the slab surface to a depth of approximately 1/4 inch to 1/2 inch. Scaling may also be caused by deicing salts, improper construction, freeze-thaw cycles, and poor aggregate. Another recognized source of distress is the reaction between the alkalies (Na_2O and K_2O) in some cements and certain minerals in some aggregates. Products formed by the reaction between the alkalies and aggregate results in expansions that cause a breakdown in the concrete. This generally occurs throughout the slab and not just at joints where "D" cracking normally occurs.

Severity Levels:

L - Crazing or map cracking exists over most of the slab area; the surface is in good condition with no scaling. (Figure A-111)

NOTE: The low severity level is an indicator that scaling may develop in the future. A slab should only be counted if in the judgment of the pavement inspector scaling is likely to occur within a few years.

M - Slab is scaled over approximately 5 percent or less of the surface, causing some FOD potential. (Figure A-112).

H - Slab is severely scaled, causing a high FOD potential. Usually more than 5 percent of the surface is affected. (Figures A-113, A-114)

How to Count: If two or more levels of severity exist on a slab, the slab is counted as one slab having the maximum level of severity. For example, if both low severity crazing and medium scaling exist on one slab, the slab is counted as one slab containing medium scaling.

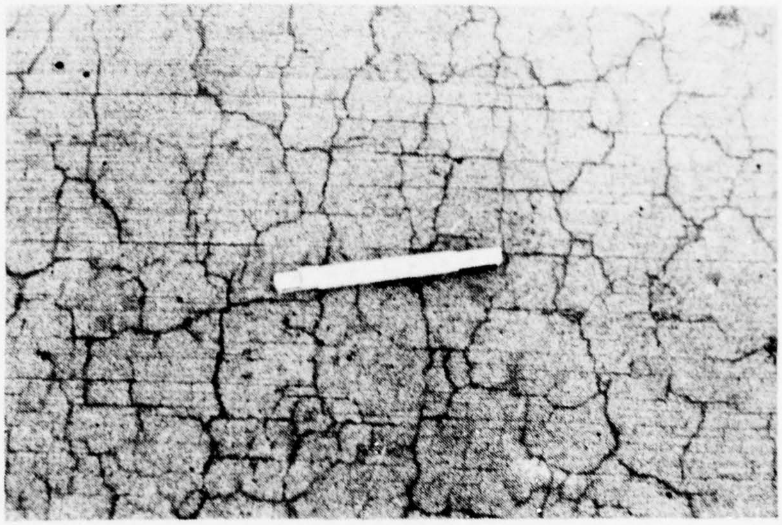


Figure A-111. Low Severity Crazing.

Figure A-112. Medium Severity Scaling.

Figure A-113. High Severity Scaling.

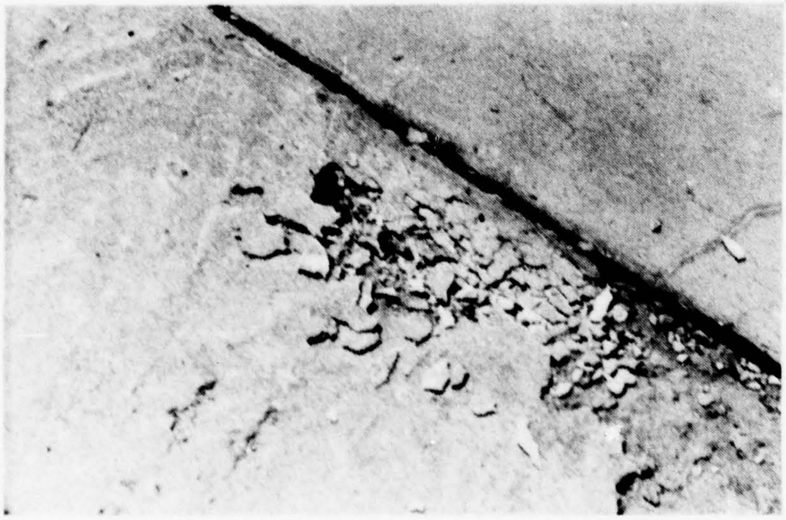


Figure A-114. Close-Up of High Severity Scaling.

Name of Distress: Settlement or Faulting

Description: Settlement or faulting is a difference of elevation at a joint or crack caused by upheaval or consolidation.

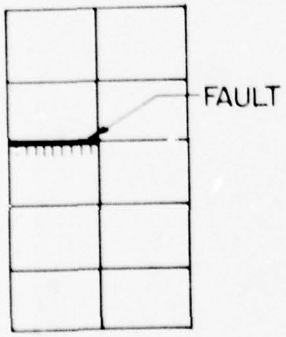
Severity Levels: Severity levels are defined by the difference in elevation across the fault and the associated decrease in ride quality and safety as severity increases.

Difference in elevation:

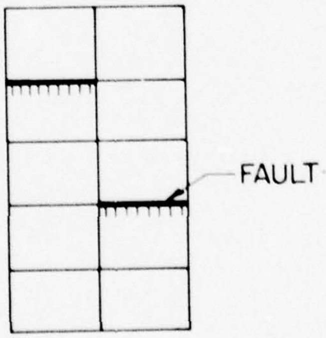
	Runways/Taxiways	Aprons
L	< 1/4 inch	1/8 inch ≤ 1/2 inch (Figures A-115, A-116)
M	1/4 inch ≤ 1/2 inch	1/2 inch ≤ 1 inch (Figure A-117)
H	> 1/2 inch (Figures A-118, A-119)	> 1 inch

How to Count: In counting settlement, a fault between two slabs is counted as one slab (see diagram). A straightedge or level should be used to aid in measuring the difference in elevation between the two slabs (Figure A-117).

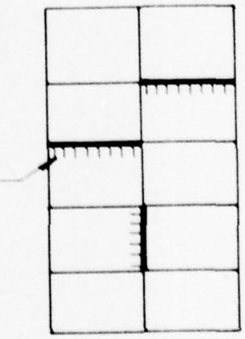
one slab counted



two slabs counted



three slabs counted



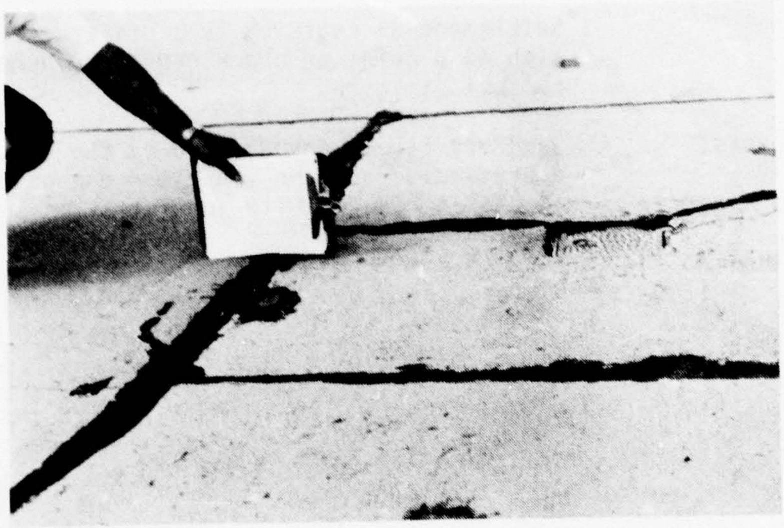


Figure A-115. Low Severity Settlement (3/8 Inch) on Apron.

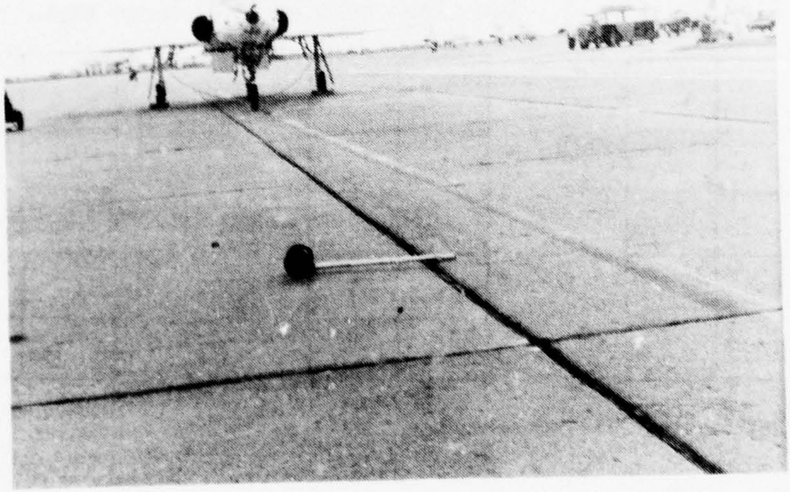


Figure A-116. Low Severity Settlement on Apron.

Figure A-117. Medium Severity Settlement on Apron (> 1/2 Inch).

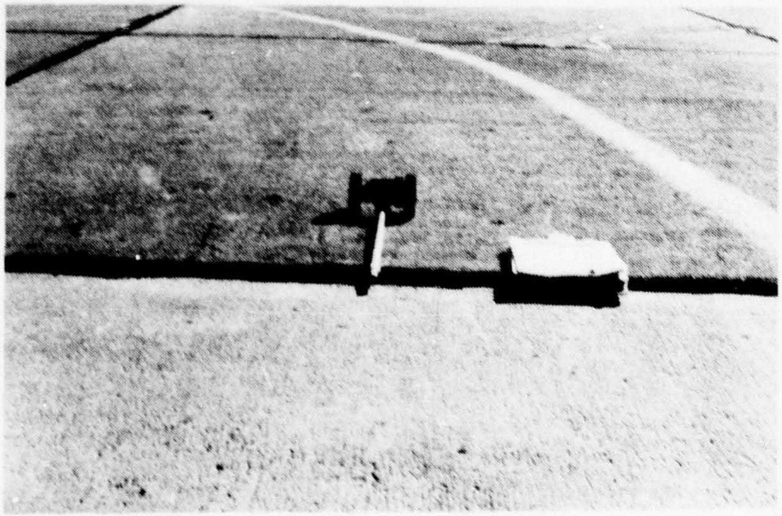


Figure A-118. High Severity Settlement on Taxiway/Runway (3/4 Inch).

Figure A-119. High Severity Settlement.

Name of Distress: Shattered Slab/Intersecting Cracks

Description: Intersecting cracks are cracks that break the slab into four or more pieces due to overloading and/or inadequate support. The high severity level of this distress type, as defined below, is referred to as shattered slab. If all pieces or cracks are contained within a corner break, the distress is categorized as a severe corner break.

Severity Levels:

L - Slab is broken into four or five pieces with some or all cracks of low severity. (Figures A-120, A-121)

M - (1) Slab is broken into four or five pieces with some or all cracks of medium severity (no high severity cracks); or (2) slab is broken into six or more pieces with all cracks of low severity.

H - At this level of severity the slab is called shattered: (1) slab is broken into four or five pieces with some or all cracks of high severity; (2) slab is broken into six or more pieces with some or all cracks of medium or high severity.

How to Count: No other distress such as scaling, spalling, or durability cracking should be recorded if the slab is medium or high severity level, since the severity of this distress would affect the slab's rating.

Figure A-120. Low Severity Intersecting Cracks.

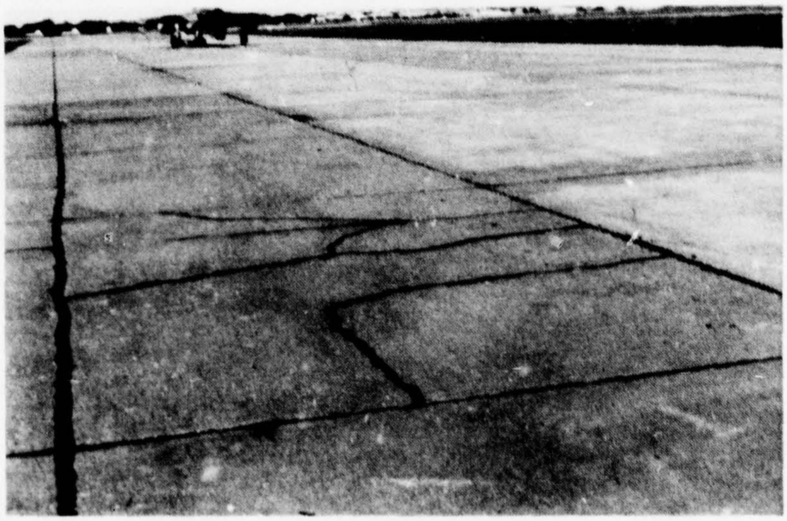


Figure A-121. Low Severity Intersecting Cracks.

Figure A-122. Medium Severity Intersecting Cracks.

Figure A-123. Medium Severity Intersecting Cracks.

Figure A-124. Shattered Slab.

Name of Distress: Shrinkage Cracks

Description: Shrinkage cracks are hairline cracks that are usually only a few feet long and do not extend across the entire slab. They are formed during the setting and curing of the concrete and usually do not extend through the depth of the slab.

Severity Levels: No degrees of severity are defined. It is sufficient to indicate that shrinkage cracks exist. (Figures A-125, A-126, A-127)

How to Count: If one or more shrinkage cracks exist on one particular slab, the slab is counted as one slab with shrinkage cracks.

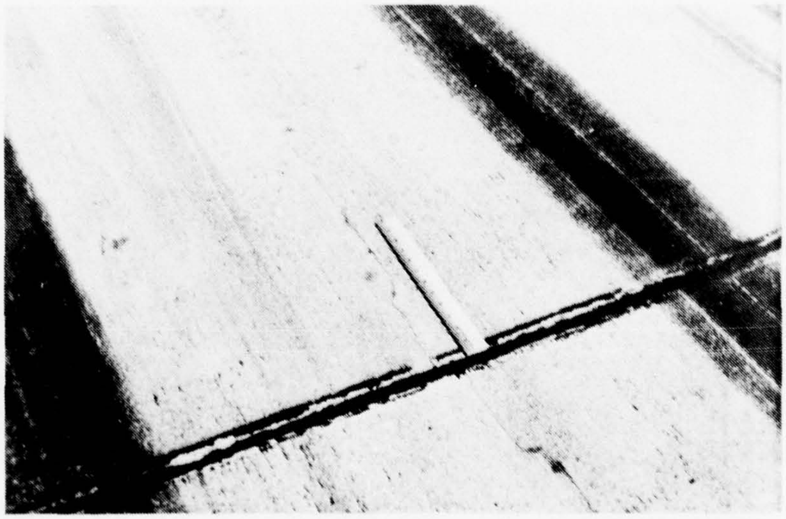


Figure A-125. Shrinkage Crack.

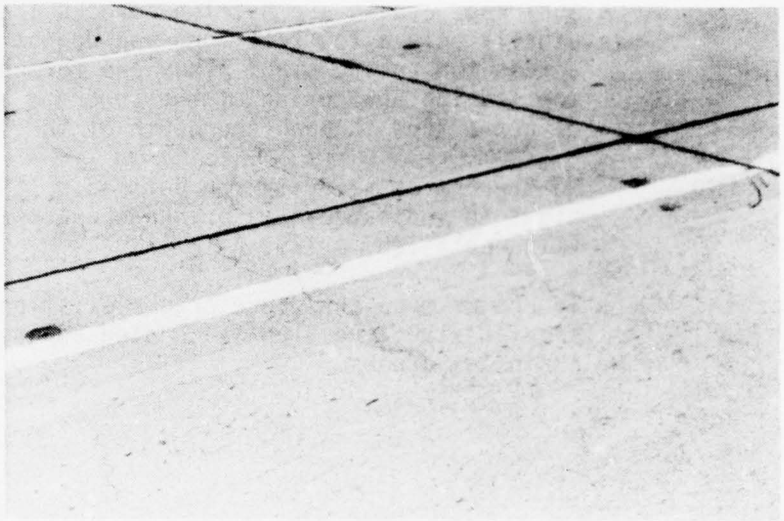


Figure A-126. Shrinkage Cracks.

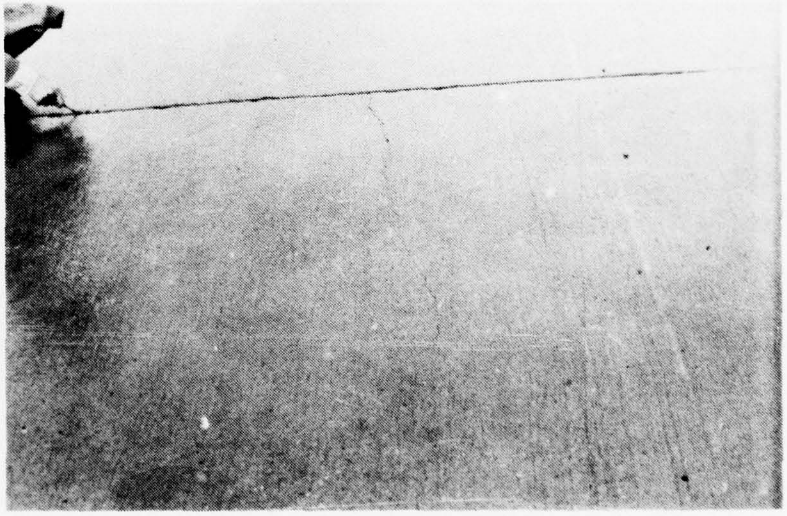


Figure A-127. Shrinkage Cracks.

Name of Distress: Spalling (Transverse and Longitudinal Joint)

Description: Joint spalling is the breakdown of the slab edges within 2 feet of the side of the joint. A joint spall usually does not extend vertically through the slab, but intersects the joint at an angle. Spalling results from excessive stresses at the joint or crack caused by infiltration of incompressible materials or traffic load. Weak concrete at the joint (caused by overworking) combined with traffic loads is another cause of spalling.

Severity Levels: L - a. Spall over 2 feet long: (1) spall is broken into no more than three pieces defined by low or medium severity cracks; little or no FOD potential exists; or (2) joint is lightly frayed; little or no FOD potential exists.

b. Spall less than 2 feet long: spall is broken into pieces or fragmented; little FOD or tire damage potential exists. (Figures A-128, A-129, A-130)

M - a. Spall over 2 feet long: (1) spall is broken into more than three pieces defined by light or medium cracks; (2) spall is broken into no more than three pieces with one or more of the cracks being severe with some FOD potential existing; or (3) joint is moderately frayed, with some FOD potential.

b. Spall less than 2 feet long: spall is broken into pieces or fragmented, with some of the pieces loose or absent, causing considerable FOD or tire damage potential. (Figures A-131, A-132)

H - a. Spall over 2 feet long: (1) spall is broken into more than three pieces defined by one or more high severity cracks, with high FOD potential; or (2) joint is severely frayed, with high FOD potential. (Figures A-133, A-134)

NOTE: If less than 2 feet of the joint is lightly frayed, the spall should not be counted.

How to Count: If the joint spall is located along the edge of one slab, it is counted as one slab with joint spalling. If spalling is located on more than one edge of the same slab, the edge having the highest severity is counted and recorded as one slab. Joint spalling can also occur along the edges of two adjacent slabs. If this is the case, each slab is counted as having joint spalling.

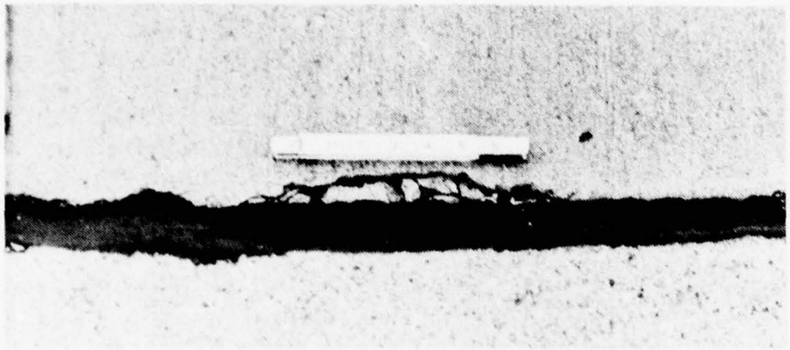


Figure A-128. Low Severity Joint Spall.

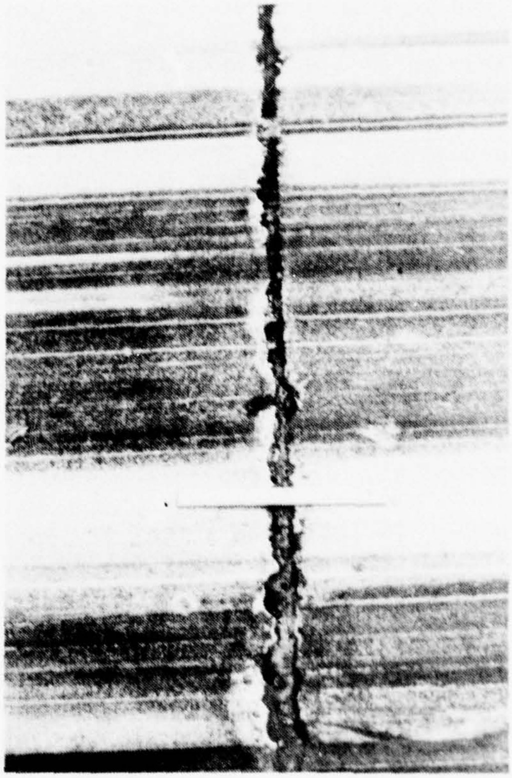


Figure A-129. Low Severity Joint Spalling. (If the Frayed Area Was Less Than 2 Feet Long It Would Not Be Counted.)

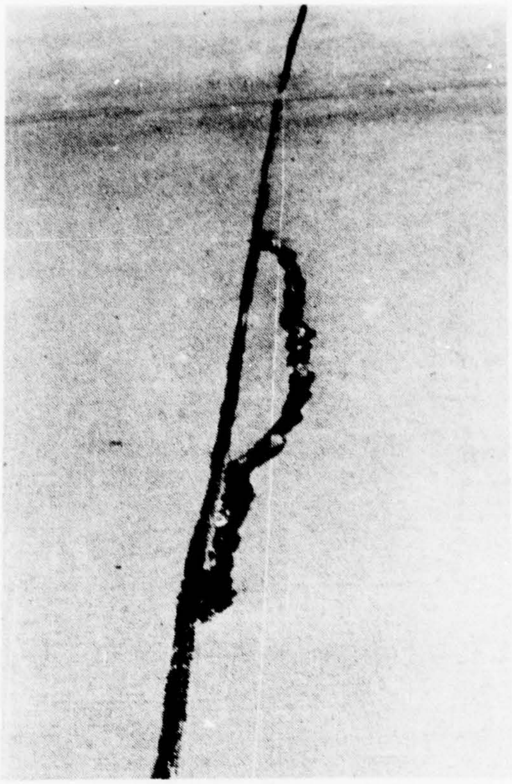


Figure A-130. Low Severity Joint Spall.

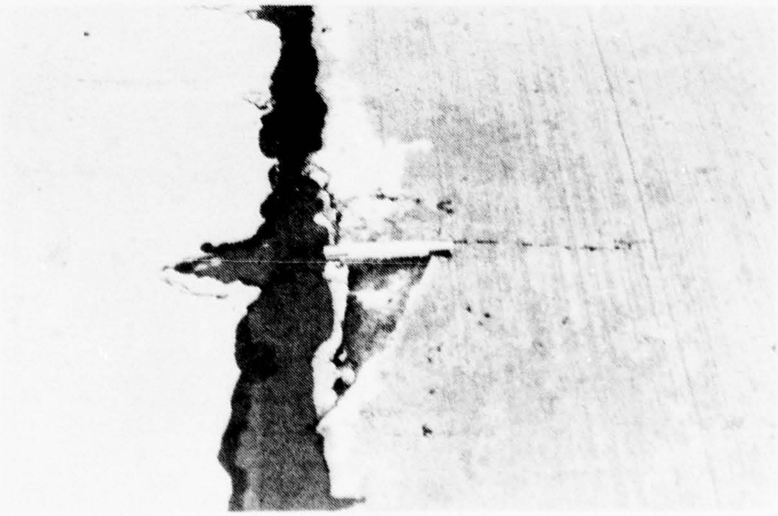


Figure A-131. Medium Severity Joint Spall.

Figure A-132. Medium Severity Joint Spall.

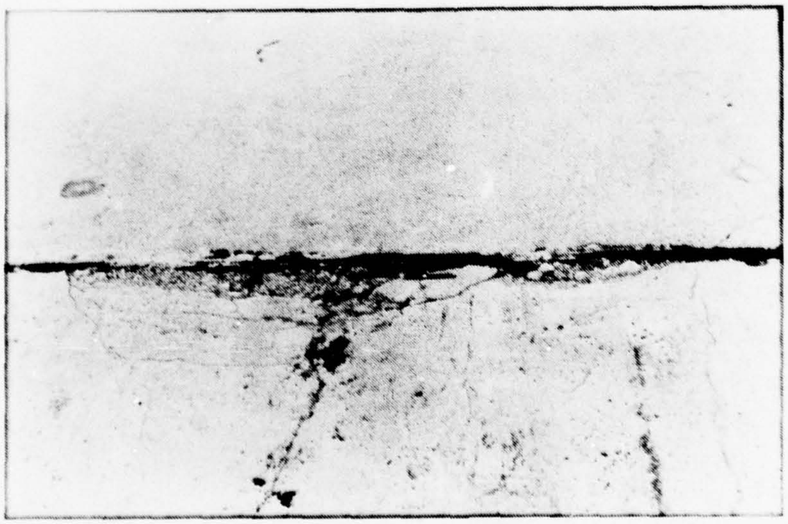


Figure A-133. High Severity Joint Spall.

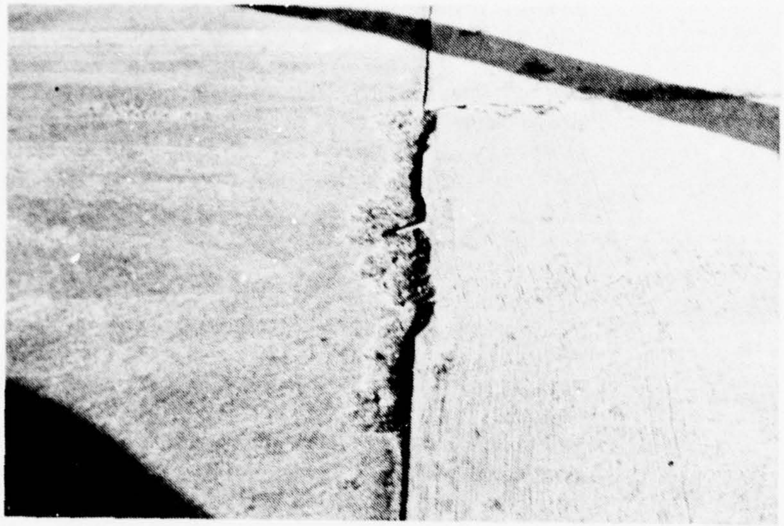


Figure A-134. High Severity Joint Spall.

Name of Distress: Spalling (Corner)

Description: Corner spalling is the raveling or breakdown of the slab within approximately 2 feet of the corner. A corner spall differs from the corner break in that the spall usually angles downward to intersect the joint, while a break extends vertically through the slab.

Severity Levels:

L - One of the following conditions exists: (1) spall is broken into one or two pieces defined by low severity cracks (little or no FOD potential), or (2) spall is defined by one medium severity crack (little or no FOD potential). (Figures A-135, A-136)

M - One of the following conditions exists: (1) spall is broken into two or more pieces defined by medium severity crack(s), and a few small fragments may be absent or loose; (2) spall is defined by one severe, fragmented crack that may be accompanied by a few hairline cracks; or (3) spall has deteriorated to the point where loose material is causing some FOD potential. (Figures A-137, A-138)

H - One of the following conditions exists: (1) spall is broken into two or more pieces defined by high severity fragmented crack(s), with loose or absent fragments; (2) pieces of the spall have been displaced to the extent that a tire damage hazard exists; or (3) spall has deteriorated to the point where loose material is causing high FOD potential. (Figures A-139, A-140)

How to Count: If one or more corner spalls having the same severity level are located in a slab, the slab is counted as one slab with corner spalling. If more than one severity level occurs, it is counted as one slab having the higher severity level.

Figure A-135. Low Severity Corner Spall.

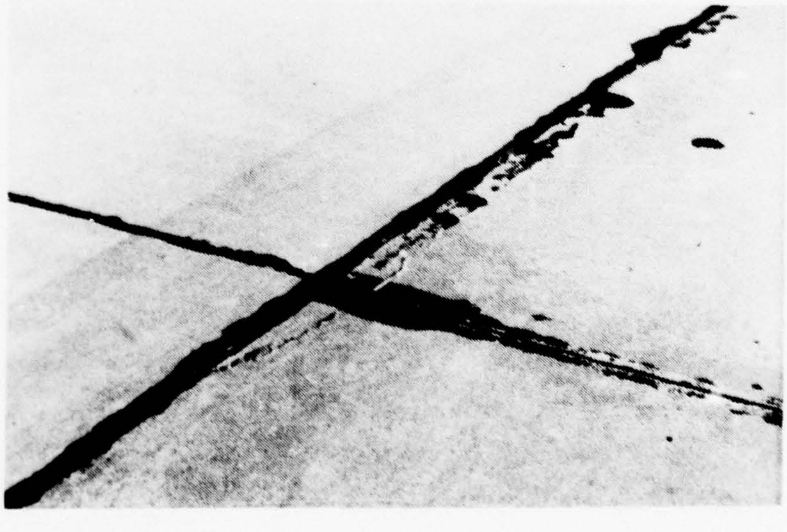


Figure A-136. Low Severity Corner Spall.

Figure A-137. Medium Severity Corner Spall.

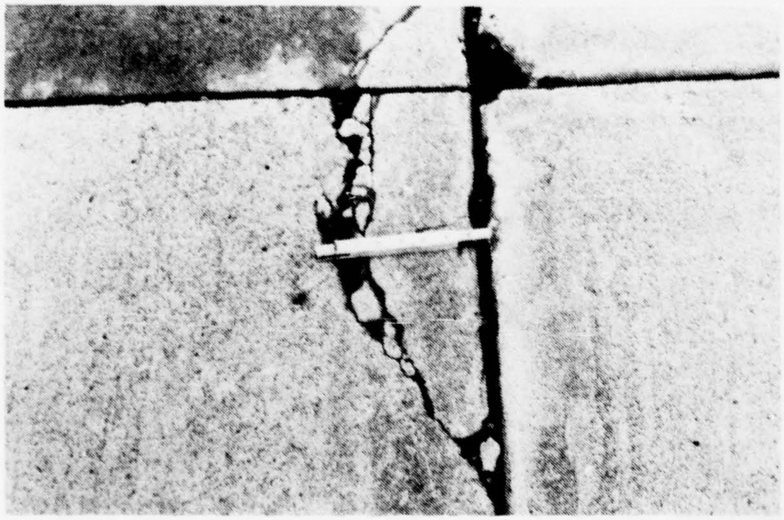


Figure A-138. Medium Severity Corner Spall.

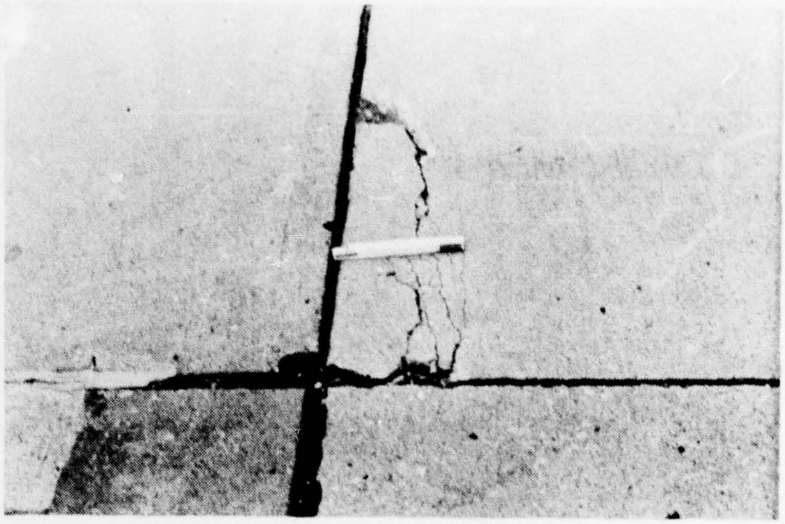


Figure A-139. High Severity Corner Spall.

Figure A-140. High Severity Corner Spall.

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ATTACHMENT B

PCI-1 COMPUTER PROGRAM

TABLE OF CONTENTS

1.0 INTRODUCTION

A manual procedure for calculating the PCI for asphalt or tar surfaces and jointed concrete pavements has been described. The description includes details of how to perform the pavement inspection, optional sampling plan, and calculation of the PCI. Computing the PCI manually is a simple operation for a few sample units, but the volume of data and calculations generated from the survey of an entire airfield can become quite large and time-consuming. Therefore, a computer program, named PCI-1, has been developed to aid in the calculation of the PCI.

This attachment describes the computer program and provides the user with the necessary information to operate the program.

2.0 PROGRAM DESCRIPTION AND FLOWCHART

The steps for manually calculating the PCI are shown in Figure 3-1. These are the same basic steps followed in the PCI computer program. The program will accept data from inspections performed on entire features and from inspections conducted using the optional sampling plan. Also, a standard deviation of PCIs from sample units within the feature is computed based on the inspection results, and a better estimate of the number of random samples to be surveyed during the next inspection is determined.

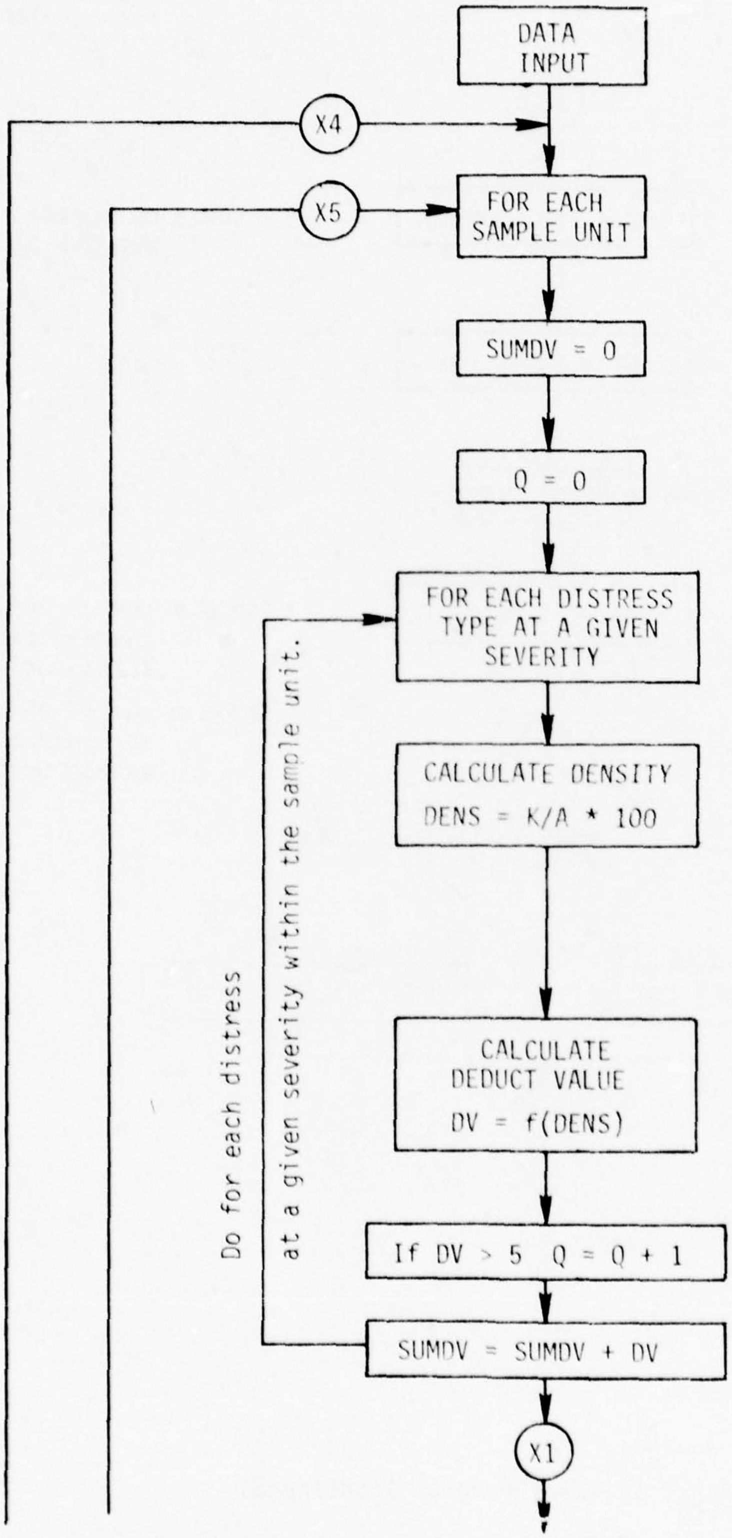
The PCI-1 program is written in COBOL language for use on the Burroughs 3500 and CDC 6600 computers. The required field length for program execution is 6500 (30K). A flow chart of the program is shown in Figure B-1.

3.0 INPUT GUIDELINES

The input forms for the PCI computation program are shown in Figures B-2 and B-3. The information boxes are labeled with column numbers so that computer cards can be keypunched directly from the forms. Each line of information on the forms will produce one computer card. At the top of the first form there is a place to enter the name of the feature and include such information as the allowable error* in the estimate of the mean PCI. The rest of the form is used to identify each sample unit surveyed and enter the type, quantity, and severity of up to 18 distress/severity combinations for each sample unit. The second form (Figure B-3) is a continuation of the first form. As many continuation sheets as necessary may be used to record the inspection data for the feature.

---

*The allowable error is the number of points the calculated PCI for an inspection performed by sampling may vary from the value the PCI would take if the inspection were performed on the entire pavement feature. A typical value for the allowable error is 5 points.



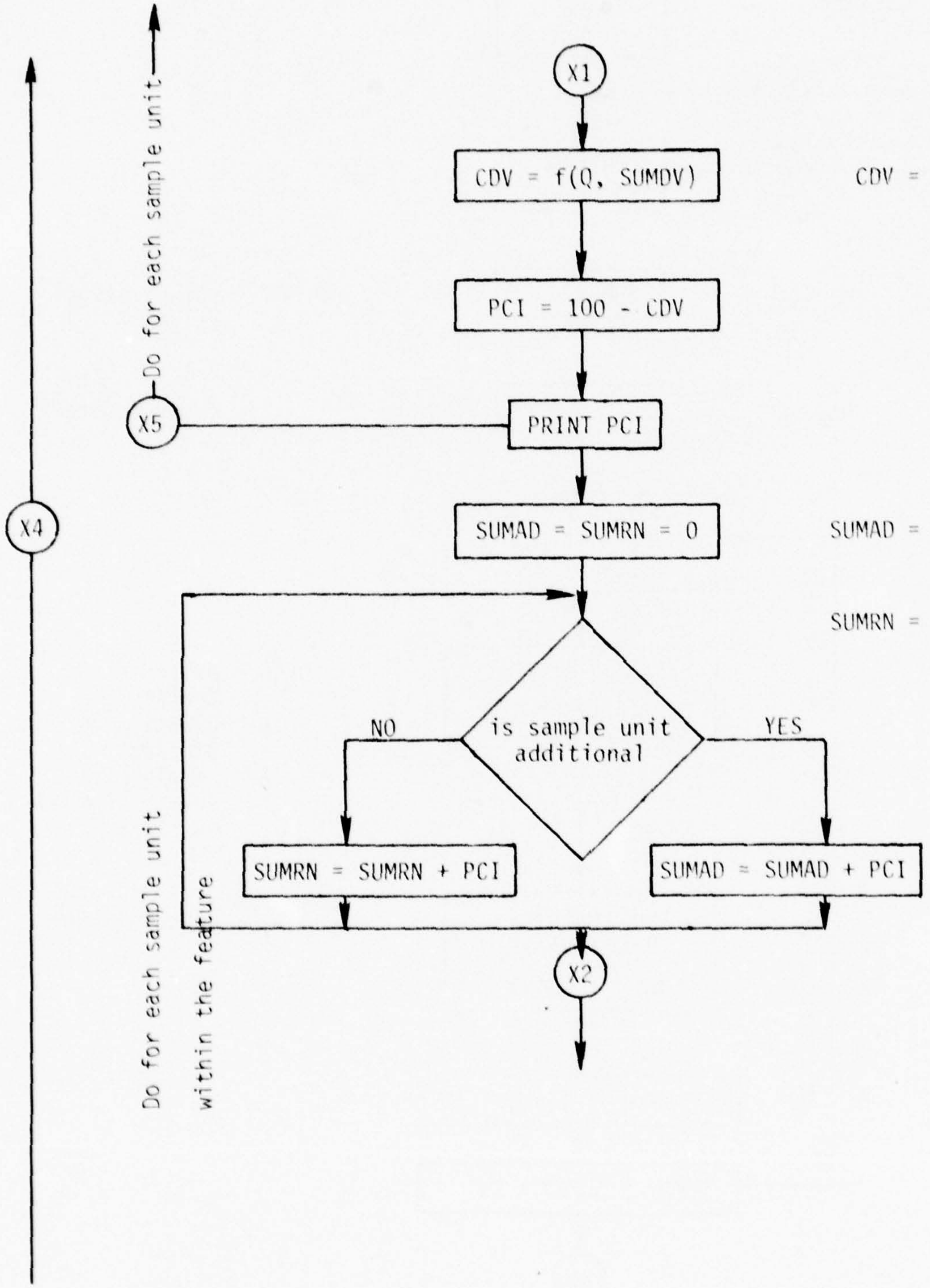
SUMDV = sum of deduct values

Q = dummy counter

DENS = Distress Density
K = Quantity of Distress
A = Sample unit area or number of slabs

DV = Deduct Value

Figure B-1. Flow Chart of PCI-1 Program

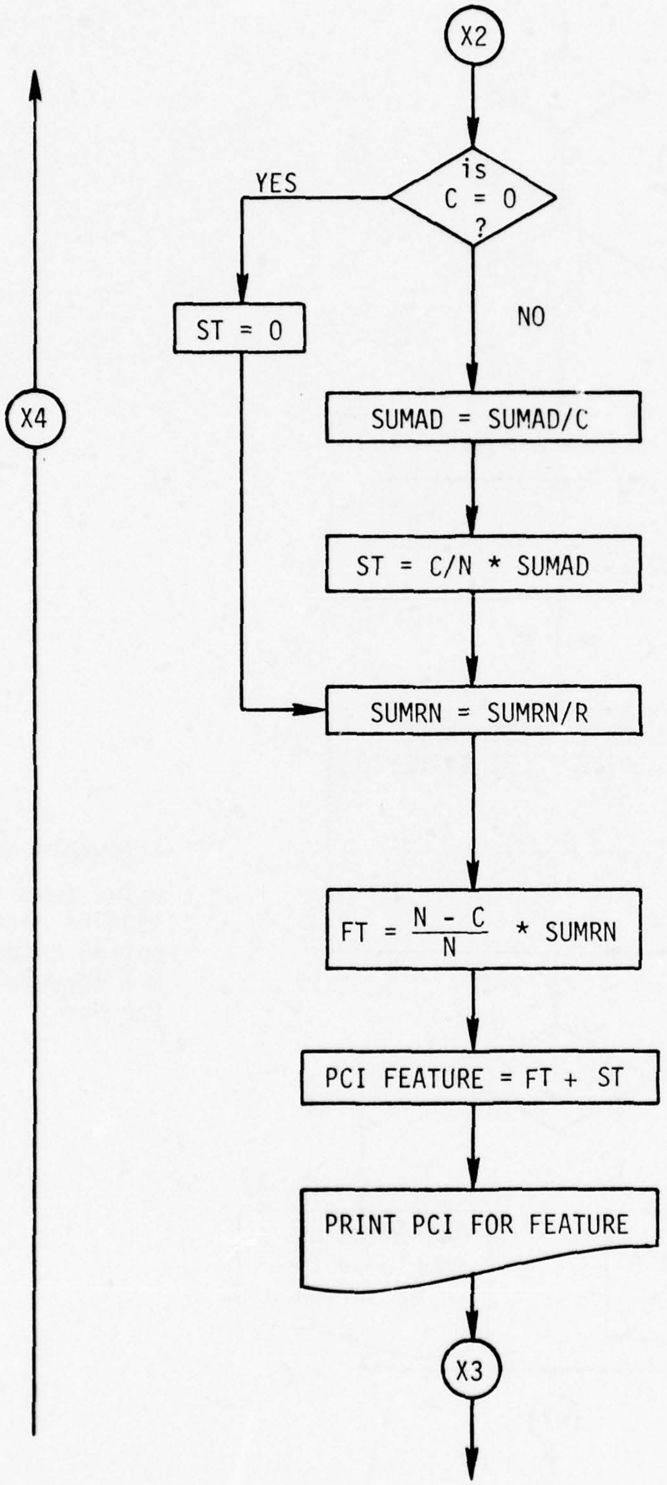


CDV = corrected deduct value

SUMAD = sum of PCIs for additional sample units

SUMRN = sum of PCIs for random sample units

Figure B-1. Flow Chart of PCI-1 Program (continued)

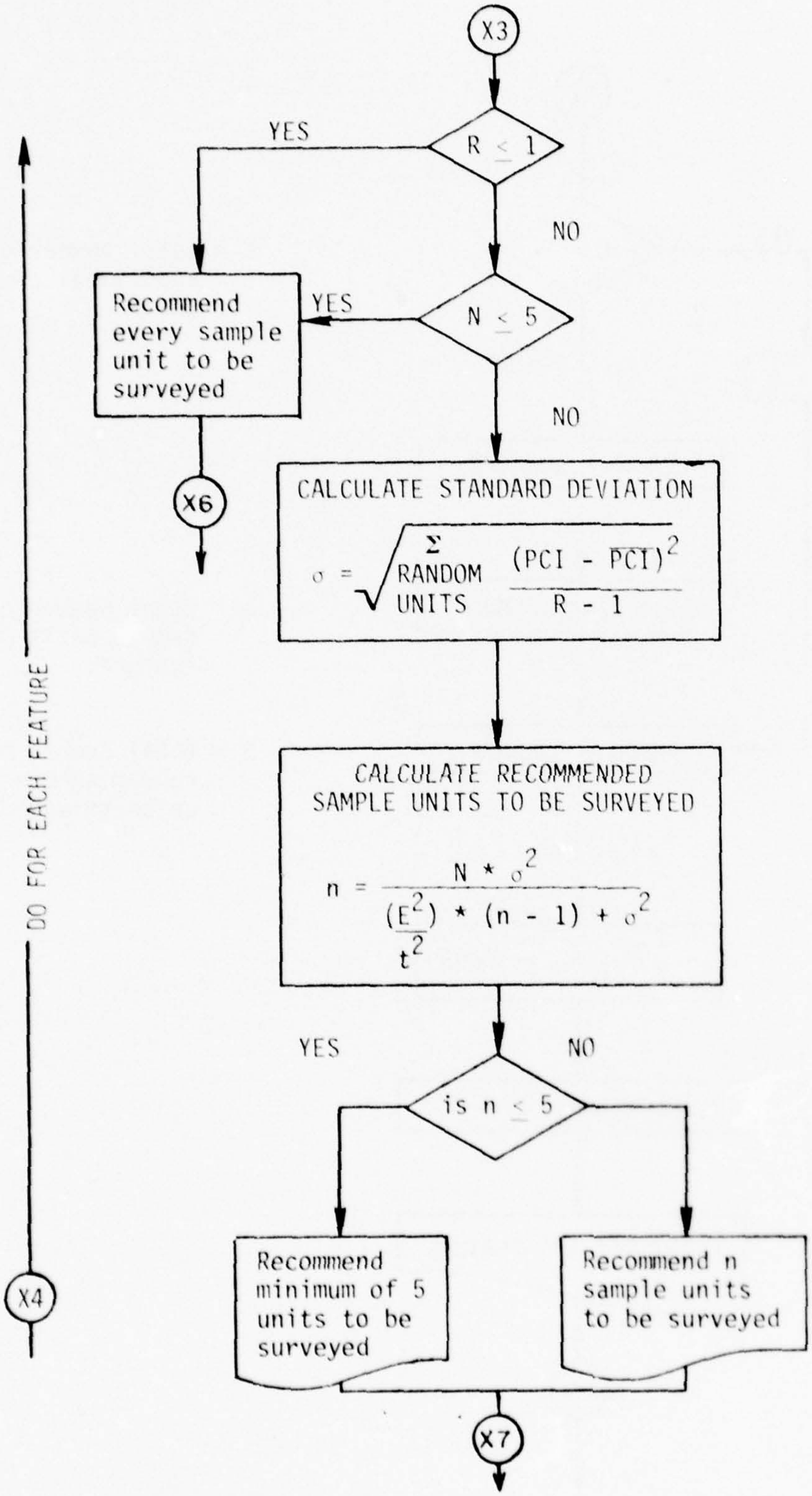


C = total number of additional sample units

N = total number of sample units in feature

R = total number of random sample units surveyed

Figure B-1. Flow Chart of PCI-1 Program (continued)



E = allowable error

t = value form t-student distribution based on R-1 degrees of freedom

Figure B-1. Flow Chart of PCI-1 Program (continued)

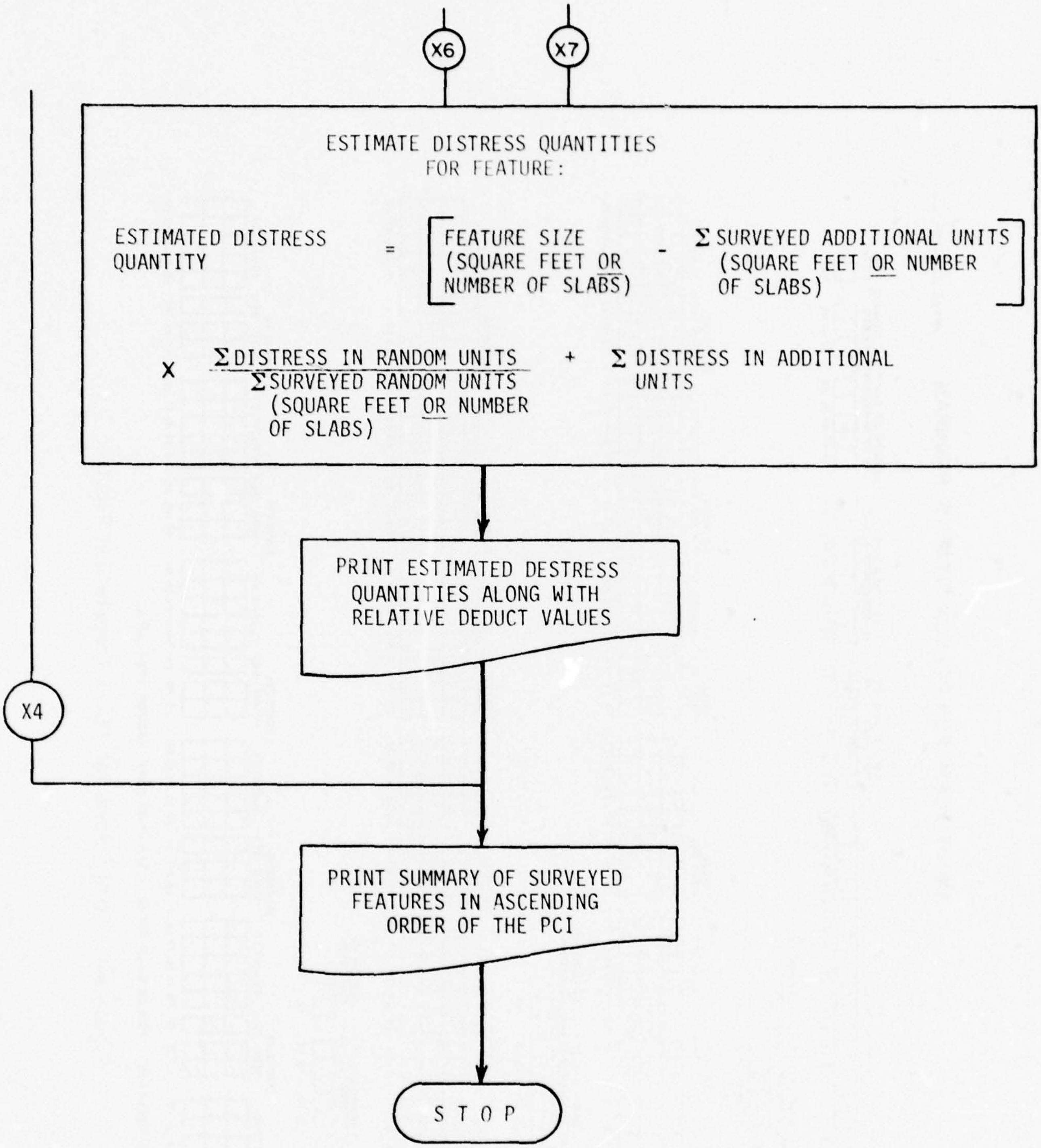
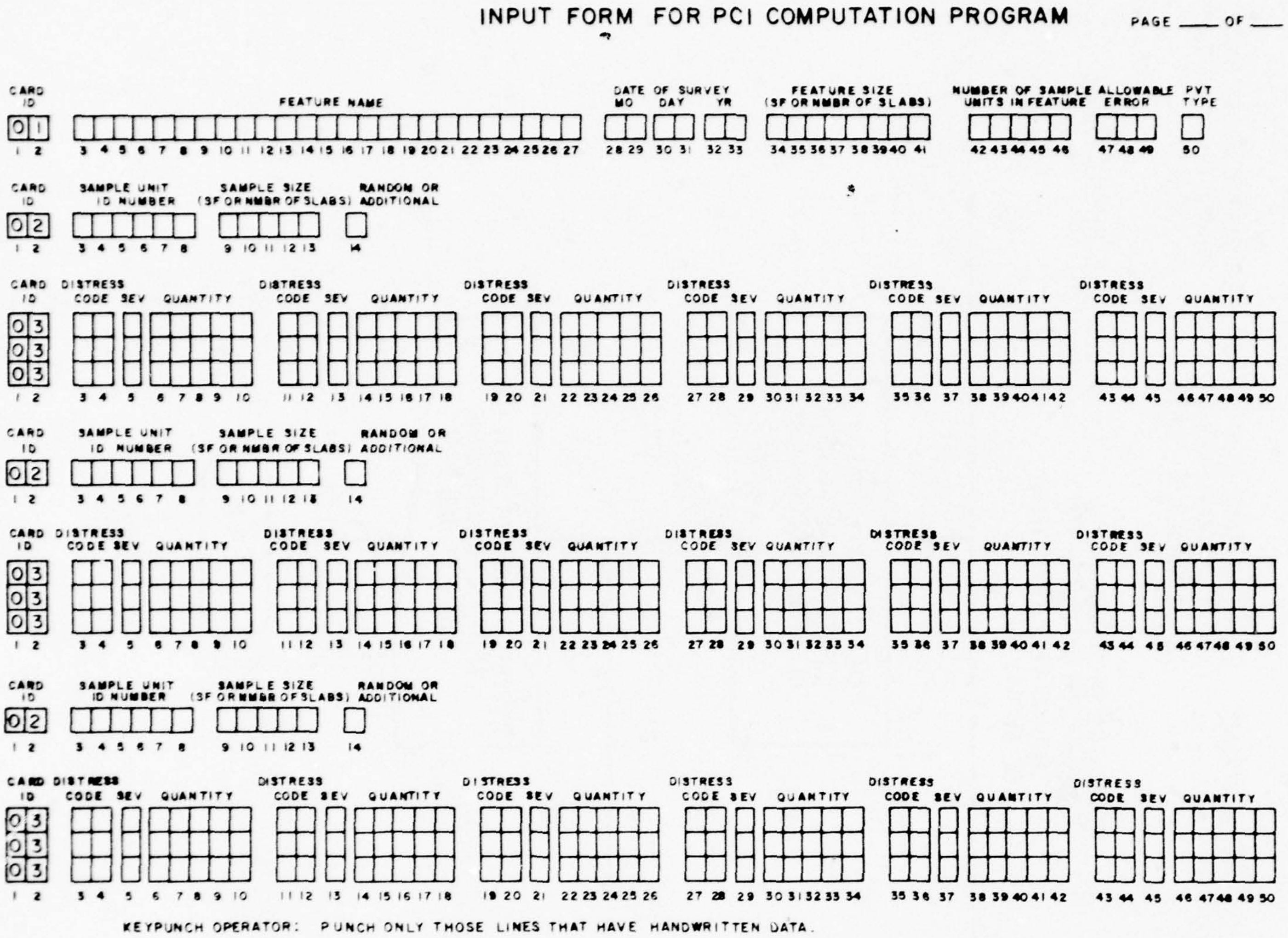


Figure B-1. Flow Chart of PCI-1 Program (concluded)



INPUT FORM FOR PCI COMPUTATION PROGRAM

PAGE ____ OF ____

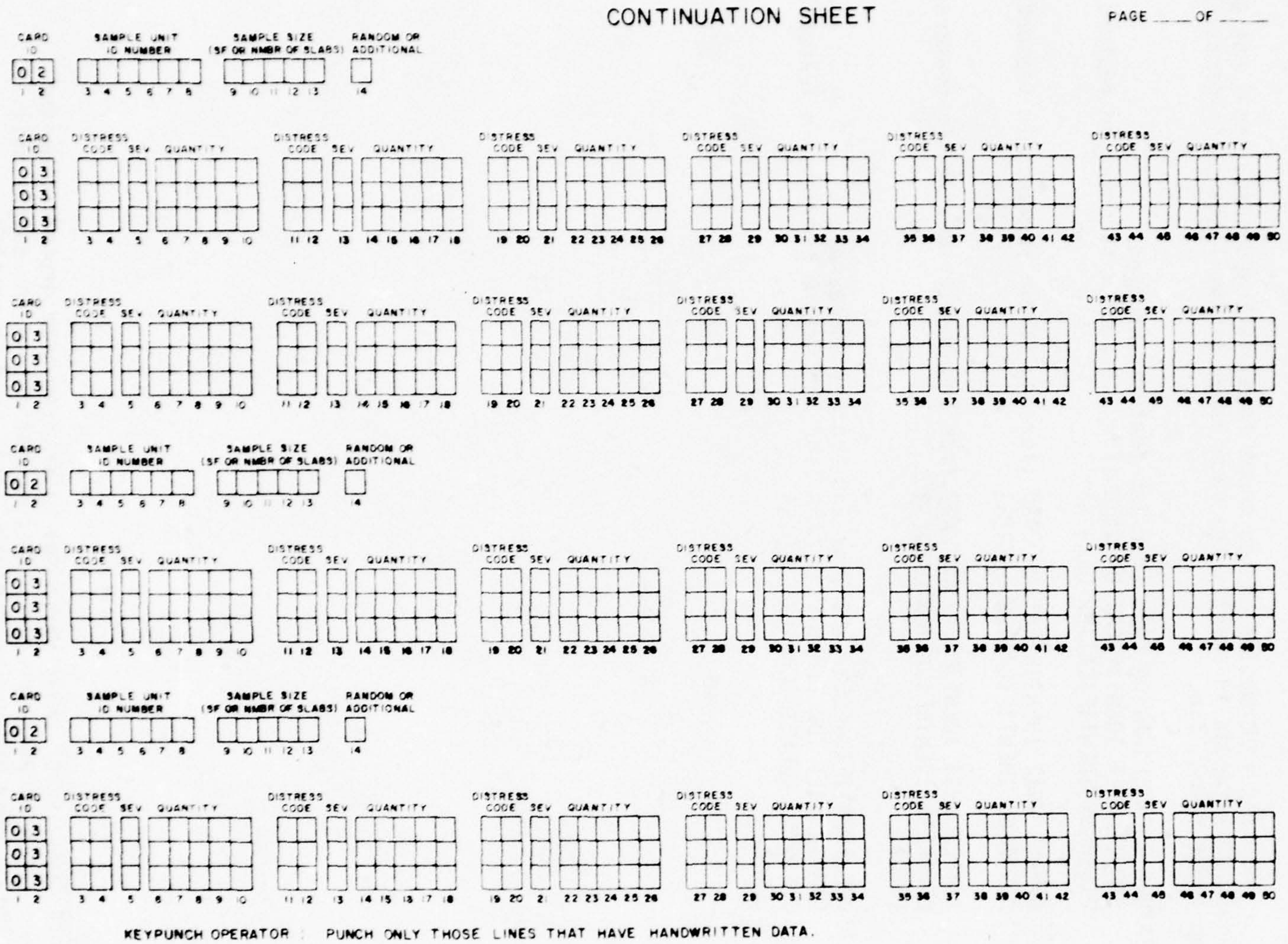
CARD ID 0 1 (1 2) FEATURE NAME (3–27) DATE OF SURVEY MO (28 29) DAY (30 31) YR (32 33) FEATURE SIZE (SF OR NMBR OF SLABS) (34–41) NUMBER OF SAMPLE UNITS IN FEATURE (42–46) ALLOWABLE ERROR (47 48 49) PVT TYPE (50)

CARD ID 0 2 (1 2) SAMPLE UNIT ID NUMBER (3–8) SAMPLE SIZE (SF OR NMBR OF SLABS) (9–13) RANDOM OR ADDITIONAL (14)

CARD ID 0 3 (1 2) DISTRESS CODE (3 4) SEV (5) QUANTITY (6–10) DISTRESS CODE (11 12) SEV (13) QUANTITY (14–18) DISTRESS CODE (19 20) SEV (21) QUANTITY (22–26) DISTRESS CODE (27 28) SEV (29) QUANTITY (30–34) DISTRESS CODE (35 36) SEV (37) QUANTITY (38–42) DISTRESS CODE (43 44) SEV (45) QUANTITY (46–50)

KEYPUNCH OPERATOR: PUNCH ONLY THOSE LINES THAT HAVE HANDWRITTEN DATA.

Figure B-2. Input Form for PCI-1 Computation Program



CONTINUATION SHEET

PAGE ____ OF ____

CARD ID	SAMPLE UNIT ID NUMBER	SAMPLE SIZE (SF OR NMBR OF SLABS)	RANDOM OR ADDITIONAL
0 2			
1 2	3 4 5 6 7 8	9 10 11 12 13	14

CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
0 3																		
0 3																		
0 3																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
0 3																		
0 3																		
0 3																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

CARD ID	SAMPLE UNIT ID NUMBER	SAMPLE SIZE (SF OR NMBR OF SLABS)	RANDOM OR ADDITIONAL
0 2			
1 2	3 4 5 6 7 8	9 10 11 12 13	14

CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
0 3																		
0 3																		
0 3																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

CARD ID	SAMPLE UNIT ID NUMBER	SAMPLE SIZE (SF OR NMBR OF SLABS)	RANDOM OR ADDITIONAL
0 2			
1 2	3 4 5 6 7 8	9 10 11 12 13	14

CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
0 3																		
0 3																		
0 3																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

KEYPUNCH OPERATOR : PUNCH ONLY THOSE LINES THAT HAVE HANDWRITTEN DATA.

Figure B-3. Continuation Sheet

Guidelines for completing the forms are given in Tables B-1, B-2, and B-3.

Once the information on the input forms is keypunched, the input deck should be arranged in exactly the same order as the lines of information on the input forms, i.e.,

FEATURE IDENTIFICATION CARD (for 1st feature surveyed)
  SAMPLE UNIT IDENTIFICATION CARD (for 1st sample surveyed in feature)
  DISTRESS IDENTIFICATION CARD(S)*

  SAMPLE UNIT IDENTIFICATION CARD (for 2nd sample surveyed in feature)
  DISTRESS IDENTIFICATION CARD(S)

  SAMPLE UNIT IDENTIFICATION CARD (for 3rd sample surveyed in feature)
  DISTRESS IDENTIFICATION CARD(S)
  (ETC)

FEATURE IDENTIFICATION CARD (for 2nd feature surveyed)
  SAMPLE UNIT IDENTIFICATION CARD (for 1st sample surveyed in feature)
  DISTRESS IDENTIFICATION CARD(S)
  (ETC)

---

*More than one of these cards may be entered here depending on the number of distress type/severity combinations in the sample unit. If the sample unit has no distress, this card is omitted.

TABLE B-1. Input Format

Each line of information on the input forms is preceded by a preprinted card ID number. The instructions that follow are grouped according to card ID number. When completing the forms, the letter O should be written Ø to distinguish it from the number zero.

CARD ID # 01 - FEATURE IDENTIFICATION

Column Numbers	Format	Entry
1-2	numeric*	01 (preprinted)
3-27	alphanumeric**	Feature Name
28-33	alphanumeric	Date of survey (do not leave any of the columns blank)
34-41	numeric	Feature size in square feet for asphalt surface or number of slabs for jointed concrete surfaced pavement.
42-46	numeric	Total number of sample units in the feature.
47-49	numeric	Allowable error.
50	alphanumeric	R for rigid pavement. F for flexible pavement.

CARD ID # 02 - SAMPLE UNIT IDENTIFICATION

Column Numbers	Format	Entry
1-2	numeric	02 (preprinted)
3-8	alphanumeric	Sample unit identification number
9-13	numeric	Sample unit size in square feet for asphalt surfaced or number of slabs for jointed concrete surfaced pavement.
14	alphanumeric	R for random sample unit C for additional sample unit (if all sample units are surveyed, enter R)

TABLE B-1. Input Format (concluded)

CARD ID # 03 - DISTRESS IDENTIFICATION

Column Numbers	Format	Entry
1-2	numeric	03 (preprinted)
3-4	numeric	Distress code (see Tables B-2 & B-3)
5	alphanumeric	H, M, L, (severity of distress)+ H = high M = medium L = low
6-10	numeric	Quantity of distress in square feet or linear feet (asphalt surfaced) or number of slabs, (jointed concrete surface).++
11-12	numeric	Distress Code
13	alphanumeric	Severity
14-18	numeric	Quantity
19-20	numeric	Distress code
21	alphanumeric	Severity
22-26	numeric	Quantity

Repeat this information for distress type/severity combination found in the sample unit.

*numeric: numbers only, no decimal point. Right-justified.

**alphanumeric: any combination of letters, numbers, or symbols.

+For distress types with no severity levels, leave blank.

++For joint seal damage in concrete pavements (distress code 5), leave blank.

TABLE B-2. Distress Codes

Asphalt or Tar Surfaces (Flexible)

Code	Distress Type
01	Alligator Cracking
02	Bleeding
03	Block Cracking
04	Corrugation
05	Depression
06	Jet Blast Erosion
07	Joint Reflection Cracking (PCC)
08	Longitudinal & Transverse Cracking
09	Oil Spillage
10	Patching
11	Polished Aggregate
12	Ravelling/Weathering
13	Rutting
14	Shoving from PCC
15	Slippage Cracking
16	Swell

TABLE B-3. Distress Codes

Jointed Concrete Pavement (Rigid)

Code	Distress
01	Blow-up
02	Corner Breaks
03	Longitudinal/Transverse/Diagonal Cracking
04	Durability Cracking
05	Joint Seal Damage
06	Patching < 5 square feet
07	Patching/Utility Cut
08	Popouts
09	Pumping
10	Scaling/Map Cracking/Crazing
11	Settlement/Fault
12	Shattered Slab/Intersecting Cracks
13	Shrinkage Crack
14	Spalling, Joint
15	Spalling, Corner

4.0 EXAMPLE PROBLEM

Feature Name = Taxiway One, Home AFB, IL
Total Number of Sample Units = 15
Pavement Type = Jointed Concrete Surface
Samples Surveyed = 5
Date Surveyed = 01/02/77

The distress data for the feature were measured and are contained on the following survey data sheets (Figure B-4).

The information from the survey data sheets and the general information is transferred to the cards in the format shown in Section 3.0. The input for this problem is shown in Figure B-5. The output is shown in Figure B-6.

JOINTED CONCRETE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRFIELD HOME AFB, IL FEATURE TAXIWAY ONE

DATE 01/02/77 SAMPLE UNIT 2

SURVEYED BY J. D. SLAB SIZE 20 x 20

10	10L	13L 10L		
9	6L 10L	10L		
8	6L 10L	12M		
7	10L	10L		
6	3L 10L	3L 10L		
5	10L	3L 10L		
4	10L	3L 10L		
3	3L 10L	10L		
2	3L 10L	2L 10L		
1	2L 10L	2L 10L		
	1	2	3	4

1. Blow-Up
2. Corner Break
3. Longitudinal/ Transverse/ Diagonal Crack
4. "D" Crack
5. Joint Seal Damage
6. Patching, < 5 ft^2
7. Patching/ Utility Cut
8. Popouts
9. Pumping
10. Scaling/Map Crack/Crazing
11. Settlement/ Fault
12. Shattered Slab
13. Shrinkage Crack
14. Spalling -- Joints
15. Spalling -- Corner

DIST. TYPE	SEV.	NO. SLABS	% SLABS	DEDUCT VALUE
2	L	3		
3	L	6		
6	L	2		
10	L	19		
12	M	1		
13	L	1		
DEDUCT TOTAL				
CORRECTED DEDUCT VALUE (CDV)				

PCI = 100 − CDV = ______

RATING = ______

Figure B-4. Condition Survey Data Sheet

JOINTED CONCRETE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRFIELD HOME

FEATURE TAXIWAY ONE

DATE 01/02/77

SAMPLE UNIT 3

SURVEYED BY SK

SLAB SIZE 20 x 20

10	2L 10L	2L 10L		
9	2L 10L	12L		
8	2L 10L	12L 10L		
7	2L 10L	3H 10L		
6	3M 10L	3H 10L		
5	3M 10L	10L		
4	3M 10L	10L		
3	10L	10L		
2	10L	10L		
1	10L	3L 10L		
	1	2	3	4

1. Blow-Up
2. Corner Break
3. Longitudinal/Transverse/Diagonal Crack
4. "D" Crack
5. Joint Seal Damage
6. Patching, < 5 ft^2
7. Patching/Utility Cut
8. Popouts
9. Pumping
10. Scaling/Map Crack/Crazing
11. Settlement/Fault
12. Shattered Slab
13. Shrinkage Crack
14. Spalling -- Joints
15. Spalling -- Corner

DIST. TYPE	SEV.	NO. SLABS	% SLABS	DEDUCT VALUE
2	L	5		
3	L	1		
3	M	3		
3	H	2		
10	L	20		
12	L	2		

DEDUCT TOTAL

CORRECTED DEDUCT VALUE (CDV)

PCI = 100 − CDV = ______

RATING = ______

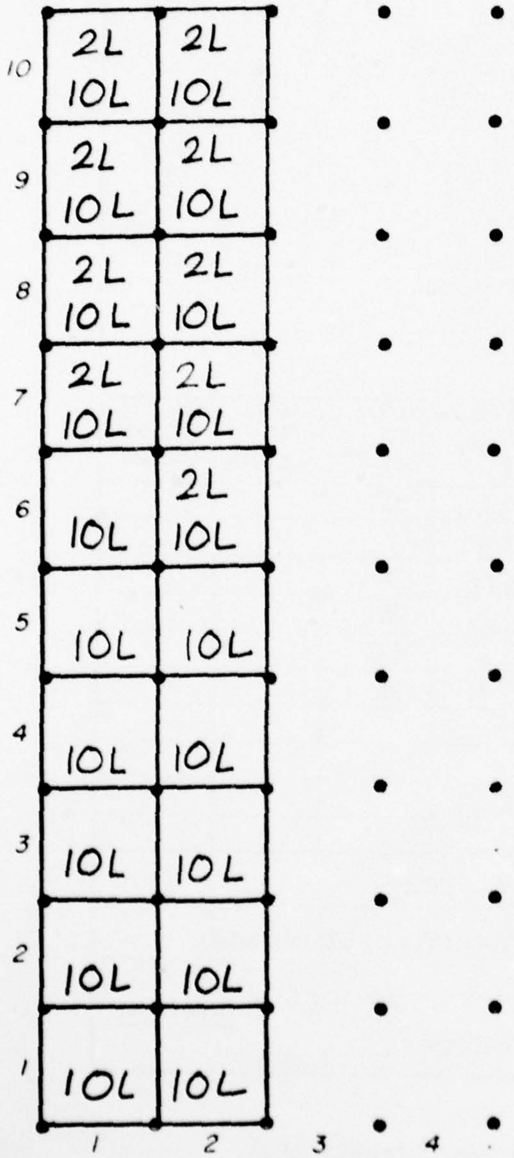
Figure B-4. Condition Survey Data Sheet (continued)

JOINTED CONCRETE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRFIELD HOME FEATURE TAXIWAY ONE

DATE 01/02/77 SAMPLE UNIT 5

SURVEYED BY SK SLAB SIZE 20 x 20



1. Blow-Up
2. Corner Break
3. Longitudinal/ Transverse/ Diagonal Crack
4. "D" Crack
5. Joint Seal Damage
6. Patching, < 5 ft^2
7. Patching/ Utility Cut
8. Popouts
9. Pumping
10. Scaling/Map Crack/Crazing
11. Settlement/ Fault
12. Shattered Slab
13. Shrinkage Crack
14. Spalling -- Joints
15. Spalling -- Corner

DIST. TYPE	SEV.	NO. SLABS	% SLABS	DEDUCT VALUE
2	L	9		
10	L	20		
DEDUCT TOTAL				
CORRECTED DEDUCT VALUE (CDV)				

PCI = 100 − CDV= ____

RATING = ____

Figure B-4. Condition Survey Data Sheet (continued)

JOINTED CONCRETE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRFIELD HOME

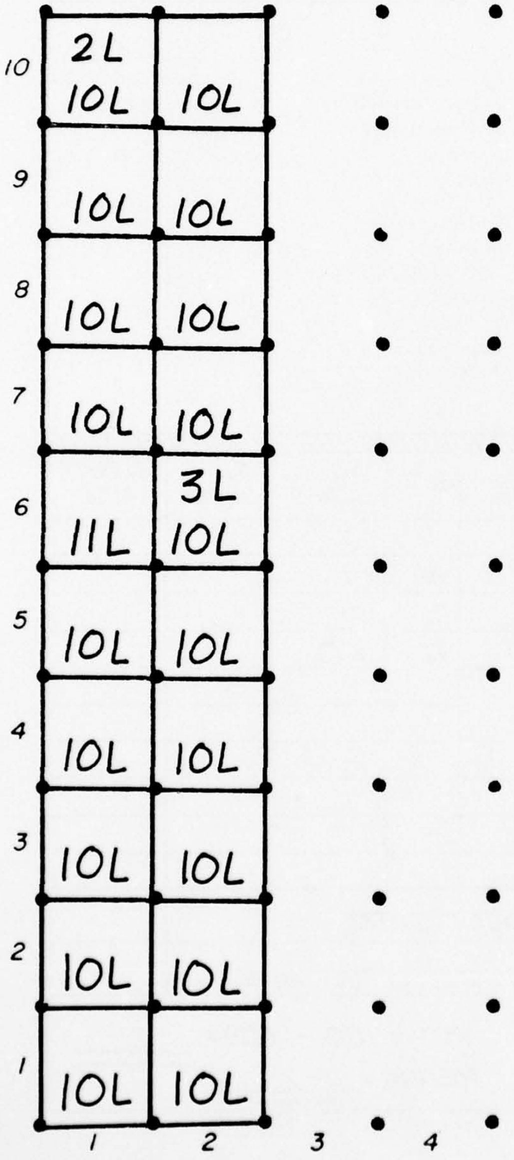
FEATURE TAXIWAY ONE

DATE 01/02/77

SAMPLE UNIT 7

SURVEYED BY SK

SLAB SIZE 20 x 20



	1	2	3	4
10	2L 10L	10L		
9	10L	10L		
8	10L	10L		
7	10L	10L		
6	11L	3L 10L		
5	10L	10L		
4	10L	10L		
3	10L	10L		
2	10L	10L		
1	10L	10L		

1. Blow-Up
2. Corner Break
3. Longitudinal/ Transverse/ Diagonal Crack
4. "D" Crack
5. Joint Seal Damage
6. Patching, < 5 ft^2
7. Patching/ Utility Cut
8. Popouts
9. Pumping
10. Scaling/Map Crack/Crazing
11. Settlement/ Fault
12. Shattered Slab
13. Shrinkage Crack
14. Spalling -- Joints
15. Spalling -- Corner

DIST. TYPE	SEV.	NO SLABS	% SLABS	DEDUCT VALUE
2	L	1		
3	L	1		
10	L	20		

DEDUCT TOTAL

CORRECTED DEDUCT VALUE (CDV)

PCI = 100 − CDV = ______

RATING = ______

Figure B-4. Condition Survey Data Sheet (continued)

JOINTED CONCRETE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRFIELD HOME FEATURE TAXIWAY ONE

DATE 01/02/77 SAMPLE UNIT 9

SURVEYED BY SK SLAB SIZE 20 x 20

10	2L 10L	2M 10L		
9	2L 10L	6L 10L		
8	10L	10L		
7	10L	10L		
6	10L	10L		
5	10L	10L		
4	10L	10L		
3	10L	10L		
2	10L	10L		
1	10L	10L		
	1	2	3	4

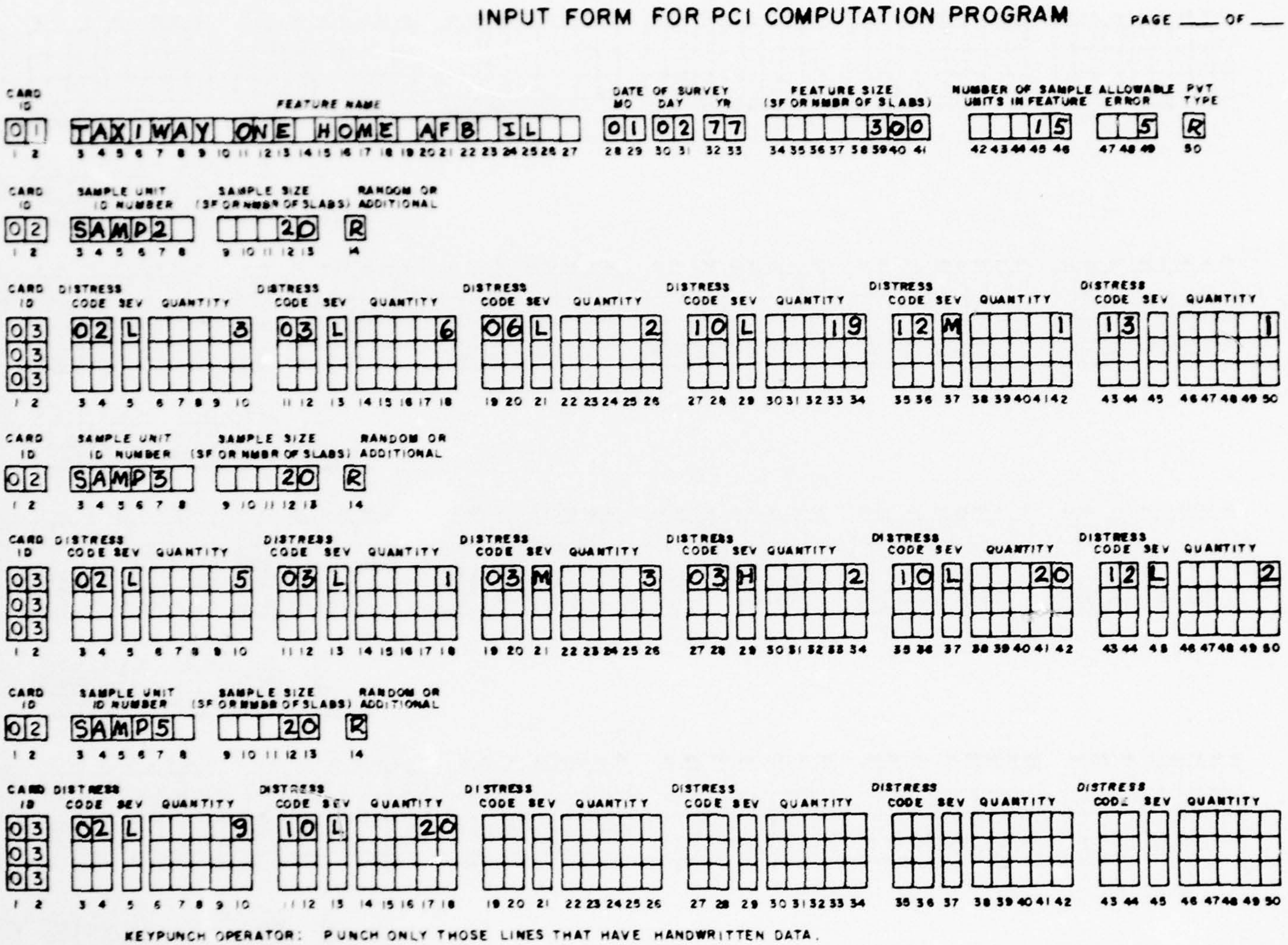
1. Blow-Up
2. Corner Break
3. Longitudinal/Transverse/Diagonal Crack
4. "D" Crack
5. Joint Seal Damage
6. Patching, < 5 ft^2
7. Patching/Utility Cut
8. Popouts
9. Pumping
10. Scaling/Map Crack/Crazing
11. Settlement/Fault
12. Shattered Slab
13. Shrinkage Crack
14. Spalling -- Joints
15. Spalling -- Corner

DIST. TYPE	SEV.	NO SLABS	% SLABS	DEDUCT VALUE
2	L	2		
2	M	1		
6	L	1		
10	L	20		
DEDUCT TOTAL				
CORRECTED DEDUCT VALUE (CDV)				

PCI = 100 – CDV = ______

RATING = ______

Figure B-4. Condition Survey Data Sheet (concluded)



INPUT FORM FOR PCI COMPUTATION PROGRAM PAGE ___ OF ___

CARD ID	FEATURE NAME	DATE OF SURVEY MO	DAY	YR	FEATURE SIZE (SF OR NMBR OF SLABS)	NUMBER OF SAMPLE UNITS IN FEATURE	ALLOWABLE ERROR	PVT TYPE
01	TAXIWAY ONE HOME AFB IL	01	02	77	300	15	5	R
1 2	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27	28 29	30 31	32 33	34 35 36 37 38 39 40 41	42 43 44 45 46	47 48 49	50

CARD ID	SAMPLE UNIT ID NUMBER	SAMPLE SIZE (SF OR NMBR OF SLABS)	RANDOM OR ADDITIONAL
02	SAMP2	20	R
1 2	3 4 5 6 7 8	9 10 11 12 13	14

CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
03	02	L	3	03	L	6	06	L	2	10	L	19	12	M	1	13		1
03																		
03																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

CARD ID	SAMPLE UNIT ID NUMBER	SAMPLE SIZE (SF OR NMBR OF SLABS)	RANDOM OR ADDITIONAL
02	SAMP3	20	R
1 2	3 4 5 6 7 8	9 10 11 12 13	14

CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
03	02	L	5	03	L	1	03	M	3	03	H	2	10	L	20	12	L	2
03																		
03																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

CARD ID	SAMPLE UNIT ID NUMBER	SAMPLE SIZE (SF OR NMBR OF SLABS)	RANDOM OR ADDITIONAL
02	SAMP5	20	R
1 2	3 4 5 6 7 8	9 10 11 12 13	14

CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
03	02	L	9	10	L	20												
03																		
03																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

KEYPUNCH OPERATOR: PUNCH ONLY THOSE LINES THAT HAVE HANDWRITTEN DATA.

Figure B-5. PCI-1 Program Input

CONTINUATION SHEET

PAGE ____ OF ____

CARD ID	SAMPLE UNIT ID NUMBER	SAMPLE SIZE (SF OR NMBR OF SLABS)	RANDOM OR ADDITIONAL
02	SAMP7	20	R
1 2	3 4 5 6 7 8	9 10 11 12 13	14

CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
03	02	L	1	03	L	1	10	L	20									
03																		
03																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

CARD ID	SAMPLE UNIT ID NUMBER	SAMPLE SIZE (SF OR NMBR OF SLABS)	RANDOM OR ADDITIONAL
02	SAMP9	20	R
1 2	3 4 5 6 7 8	9 10 11 12 13	14

CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
03	02	L	2	02	M		06	L	1	10	L	20						
03																		
03																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

CARD ID	SAMPLE UNIT ID NUMBER	SAMPLE SIZE (SF OR NMBR OF SLABS)	RANDOM OR ADDITIONAL
02			
1 2	3 4 5 6 7 8	9 10 11 12 13	14

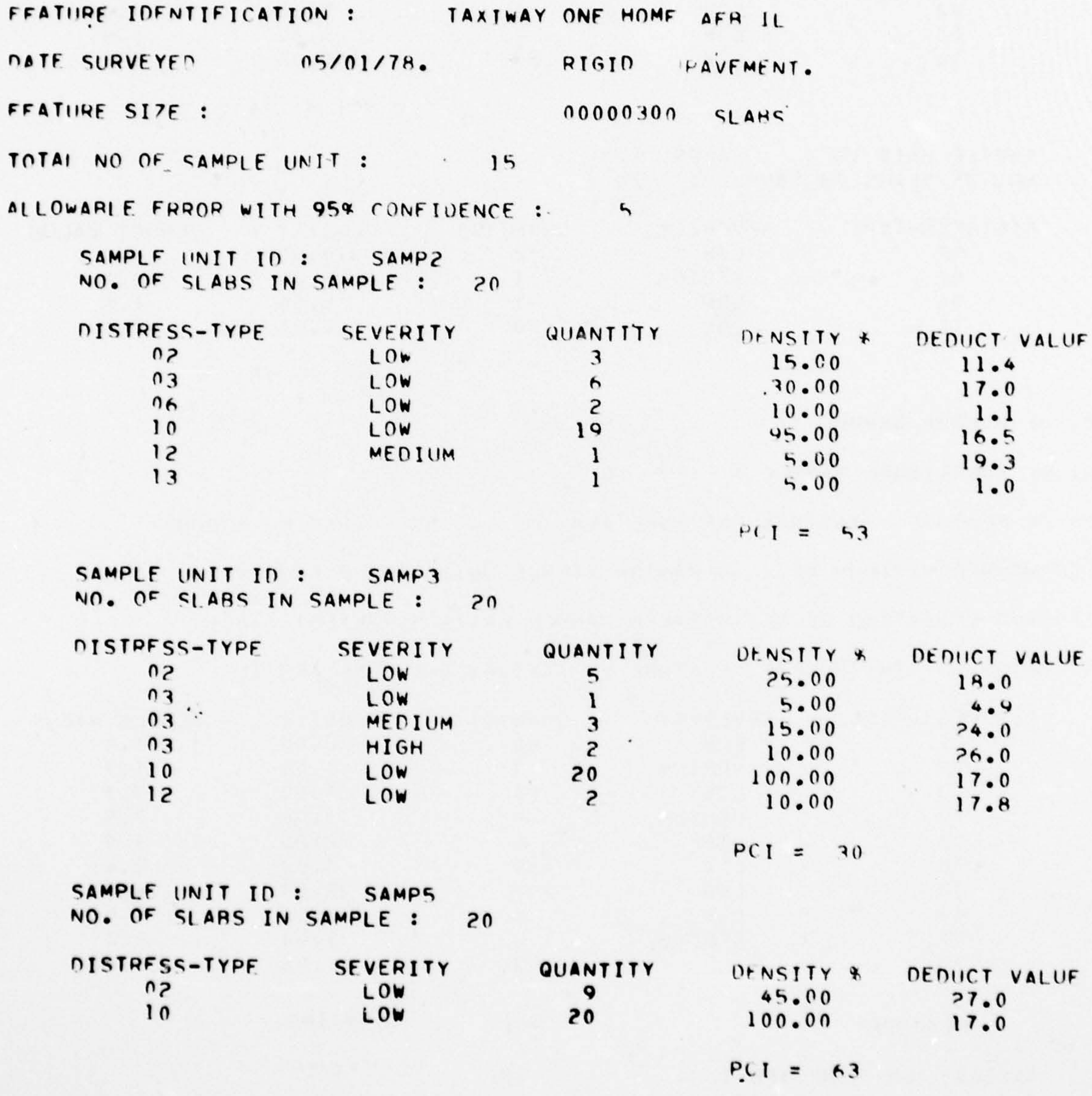
CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
03																		
03																		
03																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

CARD ID	SAMPLE UNIT ID NUMBER	SAMPLE SIZE (SF OR NMBR OF SLABS)	RANDOM OR ADDITIONAL
02			
1 2	3 4 5 6 7 8	9 10 11 12 13	14

CARD ID	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY	DISTRESS CODE	SEV	QUANTITY
03																		
03																		
03																		
1 2	3 4	5	6 7 8 9 10	11 12	13	14 15 16 17 18	19 20	21	22 23 24 25 26	27 28	29	30 31 32 33 34	35 36	37	38 39 40 41 42	43 44	45	46 47 48 49 50

KEYPUNCH OPERATOR : PUNCH ONLY THOSE LINES THAT HAVE HANDWRITTEN DATA.

Figure B-5. PCI Program Input (concluded)



```
FEATURE IDENTIFICATION :       TAXIWAY ONE HOME  AFB IL

DATE SURVEYED        05/01/78.          RIGID   PAVEMENT.

FEATURE SIZE :                          00000300   SLABS

TOTAL  NO OF SAMPLE UNIT :         15

ALLOWABLE ERROR WITH 95% CONFIDENCE :      5

     SAMPLE UNIT ID :     SAMP2
     NO. OF SLABS IN SAMPLE :    20

     DISTRESS-TYPE        SEVERITY        QUANTITY        DENSITY %     DEDUCT VALUE
          02                LOW               3             15.00           11.4
          03                LOW               6             30.00           17.0
          06                LOW               2             10.00            1.1
          10                LOW              19             95.00           16.5
          12                MEDIUM            1              5.00           19.3
          13                                  1              5.00            1.0

                                                          PCI =   53

     SAMPLE UNIT ID :     SAMP3
     NO. OF SLABS IN SAMPLE :    20

     DISTRESS-TYPE        SEVERITY        QUANTITY        DENSITY %     DEDUCT VALUE
          02                LOW               5             25.00           18.0
          03                LOW               1              5.00            4.9
          03                MEDIUM            3             15.00           24.0
          03                HIGH              2             10.00           26.0
          10                LOW              20            100.00           17.0
          12                LOW               2             10.00           17.8

                                                          PCI =   30

     SAMPLE UNIT ID :     SAMP5
     NO. OF SLABS IN SAMPLE :    20

     DISTRESS-TYPE        SEVERITY        QUANTITY        DENSITY %     DEDUCT VALUE
          02                LOW               9             45.00           27.0
          10                LOW              20            100.00           17.0

                                                          PCI =   63
```

Figure B-6. PCI-1 Program Output

```
    SAMPLE UNIT ID :     SAMP7
    NO. OF SLABS IN SAMPLE :   20

    DISTRESS-TYPE      SEVERITY        QUANTITY        DENSITY %   DEDUCT VALUE
        02               LOW               1              5.00          4.0
        03               LOW               1              5.00          4.9
        10               LOW              20            100.00         17.0

                                                       PCI =  74

    SAMPLE UNIT ID :     SAMP9
    NO. OF SLABS IN SAMPLE :   20

    DISTRESS-TYPE      SEVERITY        QUANTITY        DENSITY %   DEDUCT VALUE
        02               LOW               2             10.00          8.0
        02               MEDIUM            1              5.00          8.2
        06               LOW               1              5.00          0.6
        10               LOW              20            100.00         17.0

                                                       PCI =  75

NO. OF RANDOM SAMPLE :              5

NO. OF ADDITIONAL SAMPLE :          0

PCI OF FEATURE  -TAXIWAY ONE HOME AFB IL    =  59     RATING = GOOD

RECOMMENDED MINIMUM OF    14 RANDOM SAMPLE UNITS TO BE SURVEYED.

STANDARD DEVIATION OF PCI BETWEEN RANDOM UNITS SURVEYED:  18.5

ESTIMATED  DISTRESS  FOR  FEATURE :  TAXIWAY ONE HOME AFB IL

    DISTRESS-TYPE      SEVERITY        QUANTITY        DENSITY %   DEDUCT VALUE
        02               LOW              60             20.00         15.0
        02               MEDIUM            3              1.00          1.7
        03               LOW              24              8.00          7.1
        03               MEDIUM            9              3.00          7.5
        03               HIGH              6              2.00          8.0
        06               LOW               9              3.00          0.4
        10               LOW             297             99.00         16.9
        12               LOW               6              2.00          5.0
        12               MEDIUM            3              1.00          5.0
        13                                 3              1.00          0.4

         FEATURE                           PCI           RATING

    TAXIWAY ONE HOME AFB IL                59             GOOD
```

Figure B-6. PCI-1 Program Output (concluded)

INITIAL DISTRIBUTION

	COPIES
HQ USAF/PRE	1
HQ USAF/PREES	1
HQ USAF/PREM	1
HQ AFSC/DEM	5
HQ TAC/DEMM	26
HQ SAC/DEMM	10
HQ AFLC/DEMM	9
HQ ADCOM/DEMM	15
ADTC/DEE	1
AFATL/DLOSL	2
HQ ATC/DEMM	20
HQ DA/DAEN-FED-P	2
Dir, USAE WES	10
CERL/FOM	50
HQ AU/DE	2
HQ AAC/DEEE	5
AUL (AUL-LSE-070-239)	1
AFIT/DES	1
AFIT/Tech Library	1
HQ USAFE/DEMO	30
HQ PACAF/DEMM	16
HQ USAFA/DFDC	2
ASD/DEE	1
DDC/AF	2
HQ MAC/DEMU	25
HQ AFSC/DEE	2
HQ AFRES/DEMM	12
ANG/FSC/DE	8
University of New Mexico CERF	1
375 ABG/DEE	1
Civil Engineering Laboratory	1
AFCEC/DEM	15
Det 1 ADTC/PI T	1
FAA ARD-430	5
Commander, NAVFAC	5
ADTC/DEEE	1
AFIT/DE	3
HQ USAF/RDPQ	1
Det 1 ADTC/CNG	25
HQ SHAPE	5

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