Standard Test Method for Airport Pavement Condition Index Surveys[1]

This standard is issued under the fixed designation D5340; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of airport pavement condition through visual surveys of asphalt-surfaced pavements, including porous friction courses, and plain or reinforced jointed portland cement concrete pavements, using the Pavement Condition Index (PCI) method of quantifying pavement condition.

1.2 The PCI for airport pavements was developed by the US Army Corps of Engineers through the funding provided by the U.S. Air Force (**1**, **2**, **3**).[2] It is further verified and adopted by FAA (**4**), and the U.S. Naval Facilities Engineering Command (**5**).

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in Section 6.

2. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *additional sample*—a sample unit inspected in addition to the random sample units to include nonrepresentative sample units in the determination of the pavement condition. This includes very poor or excellent samples that are not typical of the section and sample units which contain an unusual distress such as a utility cut. If a sample unit containing an unusual distress is chosen at random, it should be counted as an additional sample unit and another random sample unit should be chosen. If every sample unit is surveyed, then there are no additional sample units.

2.1.2 *asphalt concrete (AC) surface*—aggregate mixture with an asphalt cement binder. This term also refers to surfaces constructed of coal tars and natural tars for purposes of this test method.

2.1.3 *pavement branch*—a branch is an identifiable part of the pavement network that is a single entity and has a distinct function. For example, each runway, taxiway, and apron areas are separate branches.

2.1.4 *pavement condition index (PCI)*—a numerical rating of the pavement condition that ranges from 0 to 100 with 0 being the worst possible condition and 100 being the best possible condition.

2.1.5 *pavement condition rating*—a verbal description of pavement condition as a function of the PCI value. Fig. 1 shows two examples of PCI rating scales.

2.1.6 *pavement distress*—external indicators of pavement deterioration caused by loading, environmental factors, or construction deficiencies, or a combination thereof. Typical distresses are cracks, rutting, and weathering of the pavement surface. Distress types and severity levels detailed in Appendix X1 for AC and Appendix X2 for PCC pavements must be used to obtain an accurate PCI value.

2.1.7 *pavement sample unit*—a subdivision of a pavement section that has a standard size range: 20 contiguous slabs (±8 slabs if the total number of slabs in the section is not evenly divided by 20, or to accommodate specific field condition) for PCC airfield pavement and 5000 contiguous square feet (± 2000 ft^2 (450 ± 180 m^2) if the pavement is not evenly divided by 5000, or to accommodate specific field condition) for AC airfield pavement and porous friction surfaces.

2.1.8 *pavement section*—a contiguous pavement area having uniform construction, maintenance, usage history, and condition. A section should also have the same traffic volume and load intensity.

2.1.9 *porous friction surfaces*—open-graded select aggregate mixture with an asphalt cement binder. This is a subset of asphalt concrete-surfaced pavements.

2.1.10 *portland cement concrete (PCC) pavement*—aggregate mixture with portland cement binder including nonreinforced and reinforced jointed pavement.

[1] This test method is under the jurisdiction of ASTM Committee E17 on Vehicle - Pavement Systems and is the direct responsibility of Subcommittee E17.42 on Pavement Management and Data Needs.

Current edition approved June 1, 2012. Published May 2013. Originally approved in 1998. Last previous edition approved in 2011 as D5340 – 11. DOI: 10.1520/D5340-12.

[2] The boldface numbers in parentheses refer to a list of references at the end of the text.

FIG. 1 Two Examples of Pavement Condition Index (PCI (trademarked)) Rating Scales

2.1.11 *random sample*—a sample unit of the pavement section selected for inspection by random sampling techniques, such as a random number table or systematic random procedure.

3. Summary of Test Method

3.1 The pavement is divided into branches that are divided into sections. Each section is divided into sample units. The type and severity of airport pavement distress is assessed by visual inspection of the pavement sample units. The quantity of the distress is measured as described in Appendix X1 and Appendix X2. The distress data are used to calculate the PCI for each sample unit. The PCI of the pavement section is determined based on the PCI of the inspected sample units within the section.

4. Significance and Use

4.1 The PCI is a numerical indicator that rates the surface condition of the pavement. The PCI provides a measure of the present condition of the pavement based on the distress observed on the surface of the pavement which also indicates the structural integrity and surface operational condition (localized roughness and safety). The PCI cannot measure the structural capacity, neither does it provide direct measurement of skid resistance or roughness. It provides an objective and rational basis for determining maintenance and repair needs and priorities. Continuous monitoring of the PCI is used to establish the rate of pavement deterioration, which permits early identification of major rehabilitation needs. The PCI provides feedback on pavement performance for validation or improvement of current pavement design and maintenance procedures.

5. Apparatus

5.1 *Data Sheets,* or other field recording instruments that record at a minimum the following information: date, location, branch, section, sample unit size, slab number and size, distress types, severity levels, quantities, and names of surveyors. Example data sheets for AC and PCC pavements are shown in Fig. 2 and Fig. 3.

5.2 *Hand Odometer Wheel,* that reads to the nearest 0.1 ft (30 mm).

5.3 *Straightedge or String Line* (AC only), 10 ft (3 m).

5.4 *Scale,* 12 in. (300 mm) that reads to ⅛ in. (3 mm) or better. Additional 12-in. (300-mm) ruler or straightedge is needed to measure faulting in PCC pavements.

5.5 *Layout Plan,* for airport to be inspected.

6. Hazards

6.1 Traffic is a hazard as inspectors must walk on the pavement to perform the condition survey. Inspection must be approved by and coordinated with the airport operational staff.

6.2 Noise from aircraft can be a hazard. Hearing protection must be available to the inspector at all times when airside inspections are being performed.

7. Sampling and Sample Units

7.1 Identify areas of the pavement with different uses such as runways, taxiways, and aprons on the airport layout plan.

7.2 Divide each single-use area into sections based on the pavement design, construction history, traffic, and condition.

7.3 Divide the pavement sections into sample units. If the pavement slabs in PCC have joint spacings greater than 25 ft (8 m), subdivide each slab into imaginary slabs. The imaginary slabs should all be less than or equal to 25 ft (8 m) in length, and the imaginary joints dividing the slabs are assumed to be in perfect condition. This is needed because the deduct values were developed for jointed concrete slabs less than or equal to 25 ft (8 m).

7.4 Individual sample units to be inspected should be marked or identified in a manner to allow inspectors and quality control personnel to easily locate them on the pavement surface. Paint marks along the edge and sketches with locations connected to physical pavement features are acceptable. The use of nails or other potential FOD sources is not recommended. It is necessary to be able to accurately relocate the sample units to allow verification of current distress data, to

AIRFIELD ASPHALT PAVEMENT CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT	SKETCH:
BRANCH ____________ SECTION ________ SAMPLE UNIT _________ SURVEYED BY __________ DATE _________ SAMPLE AREA _________	

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

DISTRESS SEVERITY	QUANTITY									TOTAL	DENSITY %	DEDUCT VALUE

FIG. 2 Flexible Pavement Condition Survey Data Sheet for Sample Unit

examine changes in condition with time of a particular sample unit, and to enable future inspections of the same sample unit if desired.

7.5 Select the sample units to be inspected. The number of sample units to be inspected may vary from all of the sample units in the section, a number of sample units that provides a 95 % confidence level, or a lesser number.

7.5.1 All sample units in the section may be inspected to determine the average PCI of the section. This is usually precluded for routine management purposes by available manpower, funds, and time. Total sampling, however, is desirable for project analysis to help estimate maintenance and repair quantities.

7.5.2 The minimum number of sample units (n) that must be surveyed within a given section to obtain a statistically adequate estimate (95 % confidence) of the PCI of the section is calculated using the following formula and rounding n to the next highest whole number (**1**).

$$n = \frac{Ns^2}{\left(\left(\frac{e^2}{4}\right)(N-1)+s^2\right)} \tag{1}$$

where:

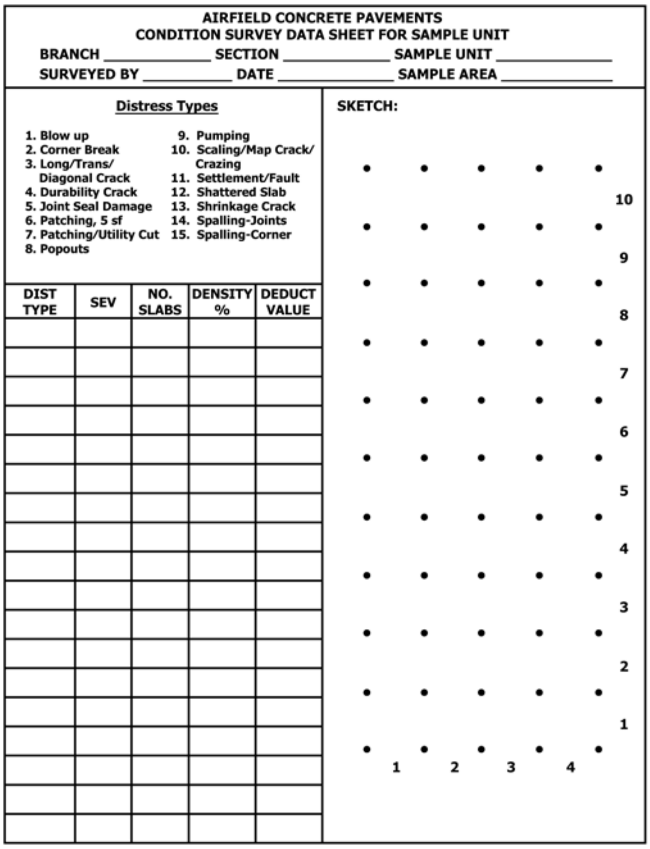
e = acceptable error in estimating the section PCI. Commonly, e = ±5 PCI points,

s = standard deviation of the PCI from one sample unit to another within the section. When performing the initial inspection, the standard deviation is assumed to be ten for AC pavements and 15 for PCC pavements. This assumption should be checked as described below after PCI values are determined. For subsequent inspections the standard deviation from the preceding inspection should be used to determine n, and

N = total number of sample units in the section.

7.5.2.1 If obtaining the 95 % confidence level is critical, the adequacy of the number of sample units surveyed must be confirmed. The number of sample units was estimated based on an assumed standard deviation. Calculate the actual standard deviation(s) as follows (**1**):

$$s = \sqrt{\sum_{i=1}^{n} \frac{(PCI_i - PCI_f)^2}{(n-1)}} \tag{2}$$


AIRFIELD CONCRETE PAVEMENTS
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

BRANCH ____________ SECTION ____________ SAMPLE UNIT ____________
SURVEYED BY ____________ DATE ____________ SAMPLE AREA ____________

Distress Types

1. Blow up
2. Corner Break
3. Long/Trans/Diagonal Crack
4. Durability Crack
5. Joint Seal Damage
6. Patching, 5 sf
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

SKETCH:

DIST TYPE	SEV	NO. SLABS	DENSITY %	DEDUCT VALUE

FIG. 3 Jointed Rigid Pavement Condition Survey Data Sheet for Sample Unit

where:

PCI_i = PCI of surveyed sample unit i,
PCI_f = mean PCI of surveyed sample units, and
n = total number of sample units surveyed.

7.5.2.2 Calculate the revised minimum number of sample units (Eq 1) to be surveyed using the calculated standard deviation (Eq 2). If the revised number of sample units to be surveyed is greater than the number of sample units already surveyed, select and survey additional random sample units. These sample units should be evenly spaced across the section. Repeat the process of checking the revised number of sample units and surveying additional random sample units until the total number of sample units surveyed equals or exceeds the minimum required sample units (n) in Eq 1, using the actual total sample standard deviation).

7.5.3 A lesser sampling rate than the above mentioned 95 % confidence level can be used based on the condition survey objective. As an example, one agency uses the following table for selecting the number of sample units to be inspected for other than project analysis:

Given	Survey
1 to 5 sample units	1 sample unit
6 to 10 sample units	2 sample units
11 to 15 sample units	3 sample units
16 to 40 sample units	4 sample units
over 40 sample units	10 %

7.6 Once the number of sample units to be inspected has been determined, compute the spacing interval of the units using systematic random sampling. Samples are equally spaced throughout the section with the first sample selected at random. The spacing interval (i) of the units to be sampled is calculated by the following formula rounded to the next lowest whole number:

$$i = \frac{N}{n} \tag{3}$$

where:

N = total number of sample units in the section, and
n = number of sample units to be inspected.

The first sample unit to be inspected is selected at random from sample units 1 through i. The sample units within a section that are successive increments of the interval i after the first randomly selected unit are also inspected.

7.7 Additional sample units are only to be inspected when nonrepresentative distresses are observed as defined in 2.1.1. These sample units are selected by the user.

8. Inspection Procedure

8.1 The definitions and guidelines for quantifying distresses for PCI determination are given in Appendix X1 for AC pavements. Other related references (**1**, **2**, **3**, **4**, **5**, **6**, **7**, **8**)are also available that discuss distress survey; however, when the material in these references conflict with the definitions included in this test method, the definitions in this test method are used.

8.2 *AC Surfaced Pavement, Including Porous Friction Surfaces*—Individually inspect each sample unit chosen. Sketch the sample unit, including orientation. Record the branch and section number, and number and type of the sample unit (random or additional). Record the sample unit size measured with the hand odometer. Conduct the distress inspection by walking over the sample unit being surveyed, measuring the quantity of each severity level of every distress type present, and recording the data. Distresses must correspond in types and severities to those described in Appendix X1. The method of measurement is included with each distress description. Measurements should be made to ±0.1 ft (30 mm) with the hand odometer. Summarize each distress type and severity level in either square feet or linear feet (square metres or linear metres), depending on the type of distress. Repeat this procedure for each sample unit to be inspected. A blank "Flexible Pavement Condition Survey Data Sheet for Sample Unit" is included in Appendix X5.

8.3 *PCC Pavements*—Individually inspect each sample unit chosen. Sketch the sample unit showing the location of the slabs. Record the sample unit size, branch and section number, number and type of the sample unit (random or additional), the number of slabs in the sample unit, and the slab size measured with the hand odometer. Perform the inspection by walking over each slab of the sample unit being surveyed and recording all distresses existing in the slab along with their severity level. The distress types and severities must correspond with those described in Appendix X2. Summarize the distress types, their severity levels, and the number of slabs in the sample unit containing each type and severity level. Repeat this procedure for each sample unit to be inspected. A blank "Jointed Rigid Pavement Condition Survey Data Sheet for Sample Unit" is included in Appendix X5.

9. Calculation of PCI for AC Pavement, Including Porous Friction Surfaces

9.1 Add up the total quantity of each distress type at each severity level, and record them in the "Total Severities" section. For example, Fig. 4 shows four entries for the Distress Type 8, "Longitudinal and Transverse Cracking:" 9M, 10L, 20L, and 15L. The distress at each severity level is summed and entered in the "Total Severity" section as 45 ft (14 m) of low severity, and 9 ft (3 m) of medium severity "Longitudinal and Transverse Cracking." The units for the quantities may be either in square feet (square metres), linear feet (metres), or number of occurrences, depending on the distress type.

9.2 Divide the total quantity of each distress type at each severity level from 9.1 by the total area of the sample unit and multiply by 100 to obtain the percent density of each distress type and severity.

9.3 Determine the deduct value (DV) for each distress type and severity level combination from the distress deduct value curves in Appendix X3.

9.4 Determine the maximum corrected deduct value (CDV):

9.4.1 If none or only one individual DV is greater than five, the total value is used in place of the maximum CDV in determining PCI; otherwise, maximum CDV must be determined using the procedure described in this section. The procedure for determining maximum CDV from individual DVs is identical for both AC and PCC pavement types.

9.5 *PCI Calculation:*

9.5.1 If none or only one individual DV is greater than five, use the total DV in place of the maximum CDV in determining PCI; otherwise use the following procedure to determine Max CDV:

9.5.1.1 Determine m, the maximum allowable number of distresses, as follows:

$$m = 1 + (9/95)\,(100 - HDV) \leq 10 \tag{4}$$

$$m = 1 + (9/95)\,(100 - 27) = 7.92 \tag{5}$$

AIRFIELD ASPHALT PAVEMENT CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

SKETCH:

BRANCH ______ **SECTION** ______ **SAMPLE UNIT** ______
SURVEYED BY ______ **DATE** ______ **SAMPLE AREA** *5000 S.F.*

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

DISTRESS SEVERITY	QUANTITY									TOTAL	DENSITY %	DEDUCT VALUE
8 L	*10*	*20*	*15*							*45*	*0.90*	*4.8*
8 M	*9*									*9*	*0.18*	*4.9*
1 L	*50*									*50*	*1.00*	*21.0*
13 L	*200*	*175*								*375*	*7.50*	*27.0*
13 M	*25*									*25*	*0.50*	*20.0*
5 L	*15*									*15*	*0.30*	*2.0*
5 M	*20*									*20*	*0.40*	***9.0***
10 L	***50***									***50***	***1.00***	***4.0***

FIG. 4 Example of a Flexible Pavement Condition Survey Data Sheet

$$HDV = \text{highest individual DV} \quad (6)$$

9.5.1.2 Enter m largest DVs on Line 1 of the following table, including the fraction obtained by multiplying the last DV by the fractional portion of m. If less than m DVs are available, enter all of the DVs.

9.5.1.3 Sum the DVs and enter it under "Total." Count the number of DVs greater than 5.0 and enter it under "q."

9.5.1.4 Look up the appropriate correction curve (AC or PCC) with "Total" and "q" to determine CDV.

9.5.1.5 Copy DVs on current line to the next line, changing the smallest DV greater than five to five. Repeat 9.5.1.3 and 9.5.1.4 until "q" = 1.

9.5.1.6 Maximum CDV is the largest value in the "CDV" column.

9.5.2 List the individual DVs in descending order. For example in Fig. 4 this will be: 27.0, 21.0, 20.0, 9.0, 4.9, 4.8, 4.0, and 2.0.

9.5.3 Determine the allowable number of deducts, m, from Fig. 5, or using the following formulas:

$$m = 1 + (9/95)(100 - HDV) \quad (7)$$

where:

m = allowable number of deducts including fractions (must be less than or equal to ten), and
HDV = highest individual DV.

For the example in Fig. 4:

$$m = 1 + (9/95)(100 - 27.0) = 7.92 \quad (8)$$

9.5.4 The number of individual DVs is reduced to the m largest DVs, including the fractional part. For example, for the values in Fig. 4, the values are: 27.0, 21.0, 20.0, 9.0, 4.9, 4.8, 4.0, and 1.8 (the 1.8 was obtained by multiplying 2.0 by (7.92 – 7 = 0.92)). If less than m DVs are available, all of the DVs are used.

9.5.5 Determine maximum CDV iteratively as follows: (see Fig. 6):

9.5.5.1 Determine the total DV by summing individual DVs. The total DV is obtained by adding the individual DVs in 9.5.4, that is 92.5.

9.5.5.2 Determine q; q is the number of deducts with a value greater than 5.0. For the example in Fig. 4, q = 4.

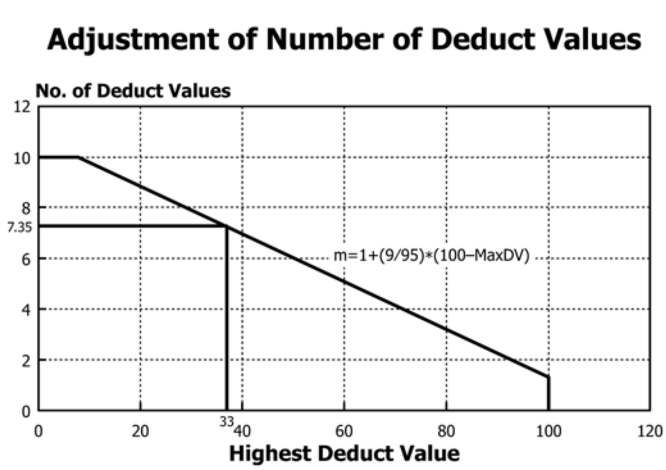


FIG. 5 Adjustment of Number of DVs

#	Deduct Values										Total	q	CDV
1	27.0	21.0	20.0	9.0	4.9	4.8	4.0	1.8			92.5	4	50.0
2	27.0	21.0	20.0	5.0	4.9	4.8	4.0	1.8			38.5	3	56.0
3	27.0	21.0	5.0	5.0	4.9	4.8	4.0	1.8			73.5	2	51.0
4	27.0	5.0	5.0	5.0	4.9	4.8	4.0	1.8			57.5	1	57.5
5													
6													
7													
8													
9													
10													

Max CDV = 57.5

PCI = 100 – Max CDV = 42.5

RATING = FAIR

NOTE 1—Fig. 4 contains both low and high severity depression, long/trans cracking, and rutting distresses. Using the algorithm in 9.6.2 it was verified that no correction is needed for any of the distress types.

FIG. 6 Calculation of Corrected PCI Value—Flexible Pavement

9.5.5.3 Determine the CDV from q and total DV determined in 9.5.5.1 and 9.5.5.2 by looking up the appropriate correction curve for AC pavements in Fig. X3.20 in Appendix X3.

9.5.5.4 Reduce the smallest individual DV greater than 5.0 to 5.0 and repeat 9.5.5.1 – 9.5.5.4 until q = 1.

9.5.5.5 Maximum CDV is the largest of the CDVs determined in 9.5.5.1 – 9.5.5.4.

9.6 Calculating the PCI

9.6.1 Calculate the PCI by subtracting the maximum CDV from 100: PCI = 100-max CDV.

9.6.2 PCI correction if there is a distress with multiple severities.

9.6.2.1 *Two Severity Case:*
When there are two severities of one distress in the same sample unit, the calculations need to be computed as seen below.

x_1 = distress percent of lower severity

x_2 = distress percent of higher severity

$X_2 = x_1 + x_2$

The value of PCI (x_1, x_2) should be higher when compared with PCI (0, X_2) since PCI (0, X_2) has more distress percentage of higher severity. So if this not the case, the PCI of the sample unit will be computed based on X_2 and not x_1 and x_2.

9.6.2.2 *Three Severity Case:*
When there are three severities of one distress in the same sample unit, the calculations need to be computed as seen below.

l or L = percent density of low severity distress percent

m or M = percent density of medium severity distress percent *h or H* = percent density of high severity distress percent

PCI (l, m, h) = PCI of the section with distress quantities of *l, m, h*

	Distresses	PCI Value
Start with:	*l, m, h*	→ PCI (*l, m, h*)
Set *(l + m) = M*	→*0, M, h*	→ PCI (*0, M, h*)
Set *(m + h) = H*	→*l, 0, H*	→ PCI (*l, 0, H*)
Set *(l + h) = H*	→ *0, m, H*	→ PCI (*0, m, H*)
Set *(l + m + h) = H*	→ *0, 0, H*	→ PCI (*0, 0, H*)

The value of PCI (*l, m, h*) should be higher when compared with PCI (*0, M, h*), PCI (*l, 0, H*), PCI (*m, H*), or PCI (*H*). So the correct or new PCI of the sample unit should be based on the combination that provides the highest PCI.

9.7 Fig. 6 shows a summary of PCI calculation for the example AC pavement data in Fig. 4. A blank PCI calculation form is included in Appendix X5.

10. Calculation of PCI for PCC Pavement

10.1 For each unique combination of distress type and severity level, add up the total number of slabs in which they occur. For example in Fig. 7, there are two slabs containing low-severity corner break.

10.2 Divide the number of slabs from 10.1 by the total number of slabs in the sample unit and multiply by 100 to obtain the percent density of each distress type and severity combination.

10.3 *PCI Calculation:*

AIRFIELD CONCRETE PAVEMENTS
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

BRANCH ______ **SECTION** ______ **SAMPLE UNIT** ______
SURVEYED BY *LMB* **DATE** *18 JAN 92* **SAMPLE AREA** *12.5' × 2.5'*

Distress Types

1. Blow up
2. Corner Break
3. Long/Trans/ Diagonal Crack
4. Durability Crack
5. Joint Seal Damage
6. Patching, 5 sf
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	DENSITY %	DEDUCT VALUE
5	H	20	100	12.0
2	L	2	10	8.0
2	M	1	5	9.0
3	L	3	15	11.0
3	M	5	25	32.0
15	L	3	15	6.0
14	L	2	10	3.0
12	L	1	5	10.0

SKETCH:

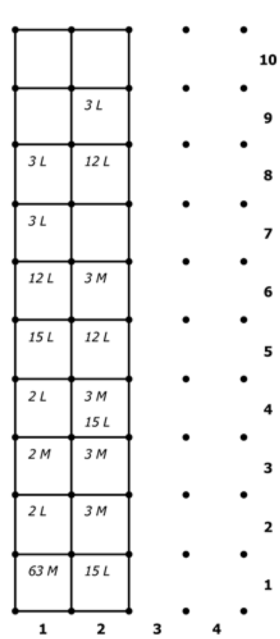


FIG. 7 Example of a Jointed Rigid Pavement Condition Survey Data Sheet

10.3.1 If none or only one individual DV is greater than five, use the total DV in place of the maximum CDV in determining PCI; otherwise use the following procedure to determine max CDV:

10.3.1.1 Determine *m*, the maximum allowable number of distresses, as follows:

$$m = 1 + (9/95)\,(100 - HDV) \leq 10 \tag{9}$$

$$m = 1 + (9/95)\,(100 - 32.0) = 7.44 \tag{10}$$

$$\text{HDV} = \text{highest individual DV} \tag{11}$$

10.3.1.2 Enter *m* largest DVs on Line 1 of the following table, including the fraction obtained by multiplying the last DV by the fractional portion of *m*. If less than *m* DVs are available, enter all of the DVs.

10.3.1.3 Sum the DVs and enter it under "Total." Count the number of DVs greater than 5.0 and enter it under "*q*."

10.3.1.4 Look up the appropriate correction curve (AC or PCC) with "Total" and "q" to determine CDV.

10.3.1.5 Copy DVs on current line to the next line, changing the smallest DV greater than five to five. Repeat 10.3.1.3 and 10.3.1.4 until "*q*" = 1.

10.3.1.6 Maximum CDV is the largest value in the "CDV" column.

10.4 Determine the DVs for each distress type severity level combination using the corresponding deduct curve in Appendix X4.

10.5 Determine PCI by following the procedures in 9.5 and 9.6, using the correction curve for PCC pavements (see Fig. X4.17) in place of the correction curve for AC pavements in 9.5.5.3.

10.6 Fig. 8 shows a summary of PCI calculation for the example PCC pavement distress data in Fig. 7.

11. Determination of Section PCI

11.1 If all surveyed sample units are selected randomly, then the PCI of the section (PCI_s) is calculated as the area weighted PCI of the randomly surveyed sample units $(\overline{PCI_r})$ using Eq 12:

$$PCI_S = \overline{PCI_r} = \frac{\sum_{i=1}^{n} (PCI_{ri} \cdot A_{ri})}{\sum_{i=1}^{n} A_{ri}} \tag{12}$$

where:

$\overline{PCI_r}$ = area weighted PCI of randomly surveyed sample units,
PCI_{ri} = PCI of random sample unit *i*,
A_{ri} = area of random sample unit *i*,
n = number of random sample units surveyed.

If additional sample units, as defined in 2.1.1, are surveyed, the area weighted PCI of the surveyed additional units $(\overline{PCI_a})$ is calculated using Eq 13. The PCI of the pavement section is calculated using Eq 14.

$$\overline{PCI_a} = \frac{\sum_{i=1}^{m} (PCI_{ai} \cdot A_{ai})}{\sum_{i=1}^{m} A_{ai}} \tag{13}$$

#	Deduct Values										Total	q	CDV
1	32.0	12.0	11.0	10.0	9.0	8.0	6.0	1.3			89.3	7	56.0
2	32.0	12.0	11.0	10.0	9.0	8.0	5.0	1.3			88.3	6	58.0
3	32.0	12.0	11.0	10.0	9.0	5.0	5.0	1.3			85.3	5	58.0
4	32.0	12.0	11.0	10.0	5.0	5.0	5.0	1.3			81.3	4	58.0
5	32.0	12.0	11.0	5.0	5.0	5.0	5.0	1.3			76.3	3	57.0
6	32.0	12.0	5.0	5.0	5.0	5.0	5.0	1.3			70.3	2	61.0
7	32.0	5.0	5.0	5.0	5.0	5.0	5.0	1.3			63.3	1	63.3
8													
9													
10													

Max CDV = 63.3

PCI = 100 – Max CDV = 36.7

RATING = POOR

NOTE 1—Fig. 7 contains both low and medium severity longitudinal/ transverse/ diagonal cracking. Using the algorithm in 9.6.2 it was verified that no correction is needed.

FIG. 8 Calculation of Corrected PCI Value—Jointed Rigid Pavement

$$PCI_s = \frac{\overline{PCI}_r\left(A - \sum_{i=1}^{m} A_{ai}\right) + \overline{PCI}_a\left(\sum_{i=1}^{m} A_{ai}\right)}{A} \quad (14)$$

$\overline{PCI}_a$ = area weighted PCI of additional sample units,
PCI_{ai} = PCI of additional sample unit i,
A_{ai} = area of additional sample unit i,
A = area of section,
m = number of additional sample units surveyed, and
PCI_s = area weighted PCI of the pavement section.

11.2 Determine the overall condition rating of the section by using the section PCI and the condition rating scale in Fig. 1.

12. Report

12.1 Develop a summary report for each section. The summary lists section location, size, total number of sample units, the sample units inspected, the PCIs obtained, the average PCI for the section, and the section condition rating.

13. Precision and Bias

13.1 *Precision*—At this time, no precision estimate has been obtained from statistically designed tests. This statement is subject to change in the next five years (see Note 1).

13.2 *Bias*—No statement concerning the bias of the test method can be established at this time.

NOTE 1—Using this test method, inspectors should identify distress types accurately 95 % of the time. Linear measurements should be considered accurate when they are within 10 % if remeasured, and area measurements should be considered accurate when they are within 20 % if remeasured.

APPENDIXES

(Nonmandatory Information)

X1. PAVEMENT CONDITION INDEX (PCI) AC AIRFIELDS

NOTE X1.1—The sections in this appendix are arranged in the following order:

X1.1 Distresses in Asphalt Pavement— Sixteen distress types for AC pavements are listed alphabetically. During the field condition surveys and the validation of the PCI, several questions were often asked regarding the identification and measurement of some of the distresses. The answers to most of these questions are included under the section "How To Measure" for each distress. For convenience, however, the items that are frequently referenced are listed as follows:

X1.1.1 Spalling as used in this test method is the further breaking of pavement or loss of materials around cracks or joints.

X1.1.2 A crack filler is in satisfactory condition if it is intact. An intact filler prevents water and incompressibles from entering the crack.

X1.1.3 If a 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. If however, the different levels of severity in a portion of a crack cannot be easily divided, that portion should be rated at the highest severity level present.

X1.1.4 If "alligator cracking" and "rutting" occur in the same area, each is recorded at its respective severity level.

X1.1.5 If "bleeding" is counted, "polished aggregate" is not counted in the same area.

X1.1.6 "Block cracking" includes all of the "longitudinal and transverse cracking" within the area; however, "joint reflection cracking" is recorded separately.

X1.1.7 Any distress, including cracking, found in a patched area is not recorded; however, its effect on the patch is considered in determining the severity level of the patch.

X1.1.8 A significant amount of polished aggregate should be present before it is counted.

X1.1.9 Conducting a PCI survey immediately after the application of surface treatment is not meaningful, because surface treatments mask existing distresses.

X1.1.10 A surface treatment that is coming off should be counted as "raveling."

X1.1.11 A distress is said to have "foreign object damage" (FOD) potential when surficial material is in a broken or loose state, such that the possibility of ingestion of the material into an engine is present, or the potential for freeing the material due to trafficking is present.

X1.1.12 Sections X1.1.1 – X1.1.11 are not intended to be a complete list. To properly measure each distress type, the inspector must be familiar with its individual measurement criteria.

X1.2 *Alligator or Fatigue Cracking:*

X1.2.1 *Description*—Alligator or fatigue cracking is a series of interconnecting cracks caused by fatigue failure of the AC surface under repeated traffic loading. The cracking initiates at the bottom of the AC surface (or stabilized base) where tensile stress and strain are 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 ft (0.6 m) on the longest side.

X1.2.2 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 that occurs over an entire area that is not subjected to loading is rated as block cracking, that is, not a load-associated distress.)

X1.2.3 Alligator cracking is considered a major structural distress.

X1.2.4 *Severity Levels:*

X1.2.4.1 *L (Low)*—Fine, longitudinal hairline cracks running parallel to one another with none or only a few interconnecting cracks. The cracks are not spalled (see Figs. X1.1-X1.3).

X1.2.4.2 *M (Medium)*—Further development of light alligator cracking into a pattern or network of cracks that may be lightly spalled. Medium-severity alligator cracking is defined by a well-defined pattern of interconnecting cracks, where all pieces are securely held in place (good aggregate interlock between pieces) (see Figs. X1.4-X1.8).

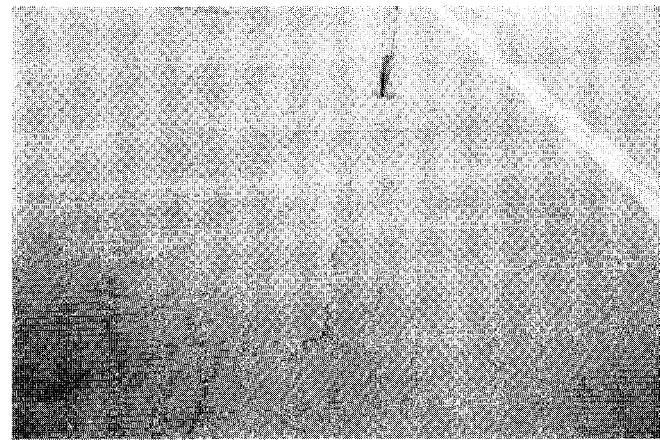


FIG. X1.1 Low-Severity Alligator Cracking

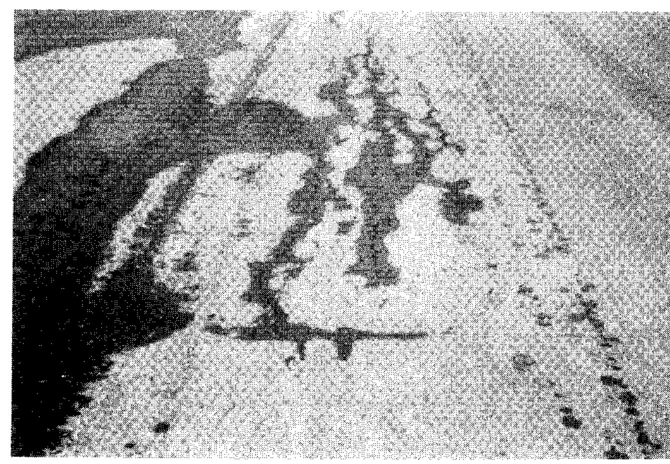


FIG. X1.2 Low-Severity Alligator Cracking

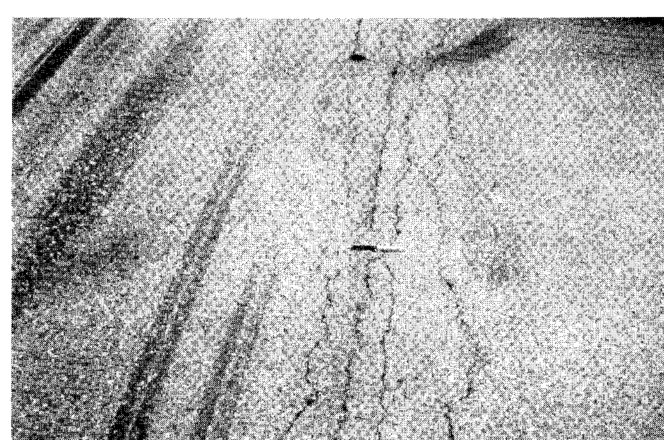


FIG. X1.3 Low-Severity Alligator Cracking, Approaching Medium Severity

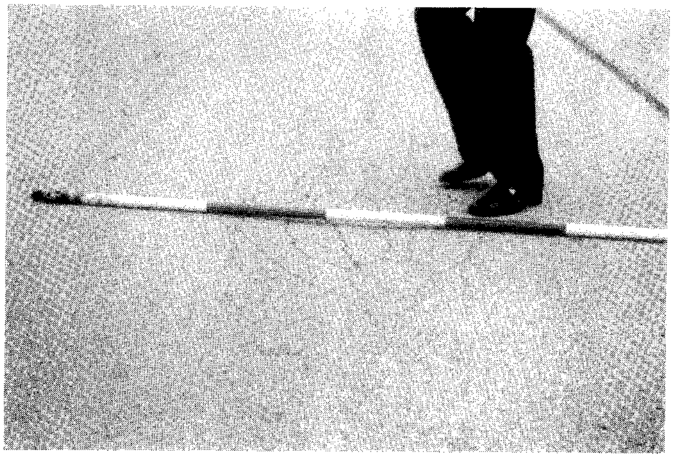


FIG. X1.4 Medium-Severity Alligator Cracking (Note the Depression Occurring with the Cracking)

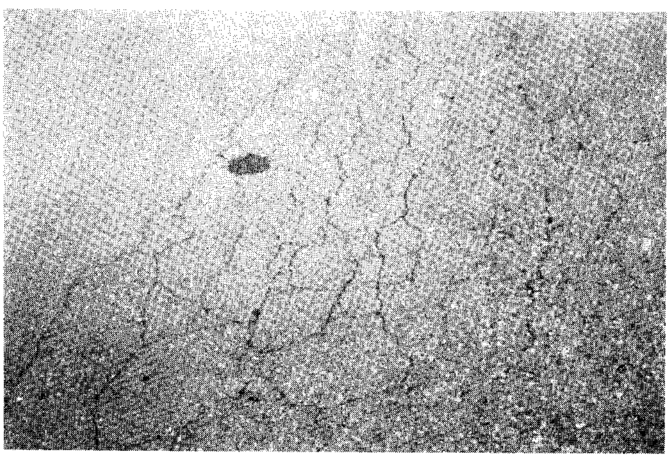


FIG. X1.5 Medium-Severity Alligator Cracking

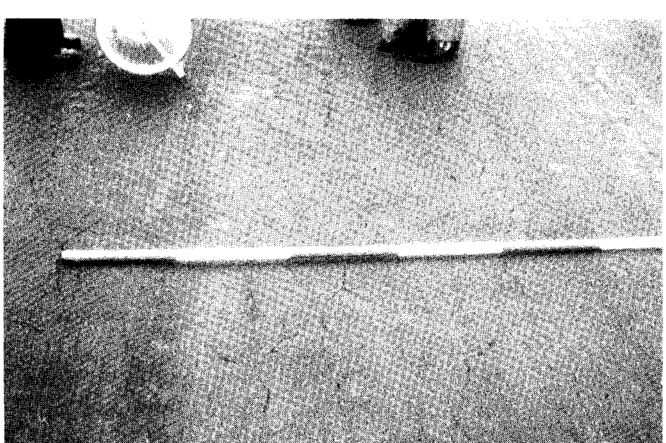


FIG. X1.6 Medium-Severity Alligator Cracking

X1.2.4.3 *H (High)*—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 and may cause FOD potential (see Fig. X1.9).

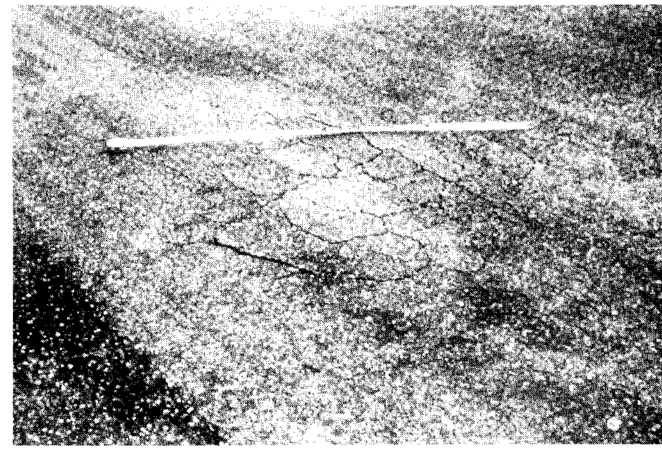


FIG. X1.7 Medium-Severity Alligator Cracking, Approaching High Severity (Example 1)

FIG. X1.8 Medium-Severity Alligator Cracking, Approaching High Severity (Example 2)

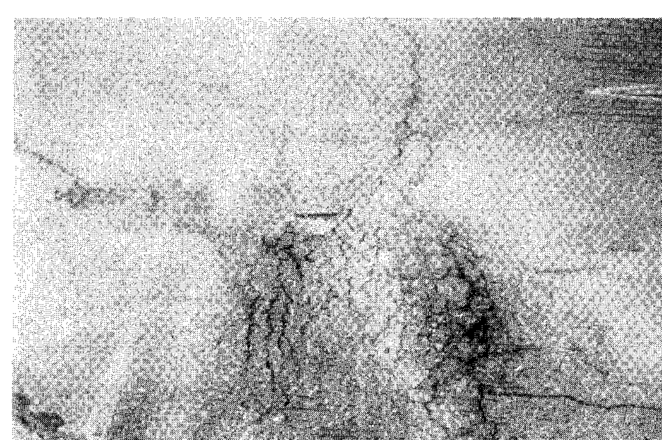


FIG. X1.9 High-Severity Alligator Cracking

X1.2.5 *How to Measure*—Alligator cracking is measured in square feet (square metres) 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 one another, 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. If alligator cracking and rutting occur in the same area, each is recorded separately as its respective severity level.

X1.3 *Bleeding:*

X1.3.1 *Description*—Bleeding is a film of bituminous material on the pavement surface that creates a shiny, glass-like, reflecting surface that usually becomes quite sticky. Bleeding is caused by excessive amounts of asphaltic cement or tars in the mix or low-air void content, or both. 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.

X1.3.2 *Severity Levels*—No degrees of severity are defined (see Fig. X1.10 and Fig. X1.11).

X1.3.3 *How to Measure*—Bleeding is measured in square feet (square metres) of surface area.

X1.4 *Block Cracking:*

X1.4.1 *Description*—Block cracks are interconnected cracks that divide the pavement into approximately rectangular pieces. The blocks may range in size from approximately 1 by 1 ft to 10 by 10 ft (0.3 by 0.3 m to 3 by 3 m). Block cracking is caused mainly by shrinkage of the AC and daily temperature cycling (that 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 portion of pavement area, but sometimes will occur only in nontraffic areas. This type of distress differs from alligator cracking in that the 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 (that is, wheel paths).

X1.4.2 *Severity Levels:*

X1.4.2.1 *L*—Blocks are defined by cracks that are nonspalled (sides of the crack are vertical) or lightly spalled, causing no FOD potential. Nonfilled cracks have ¼ in. (6 mm) or less mean width and filled cracks have filler in satisfactory condition (see Figs. X1.12-X1.15).

X1.4.2.2 *M*—Blocks are defined by either: filled or nonfilled cracks that are moderately spalled (some FOD potential); nonfilled cracks that are not spalled or have only minor spalling

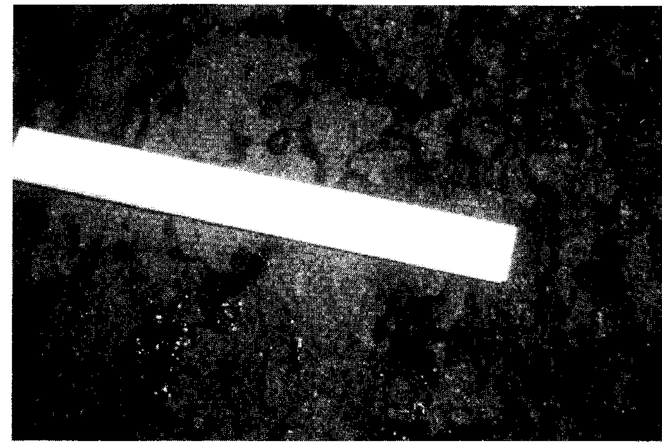


FIG. X1.11 Close-Up of Fig. X1.10

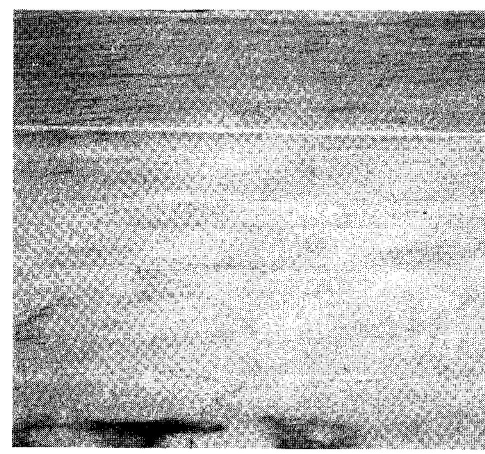


FIG. X1.12 Low-Severity Block Cracking

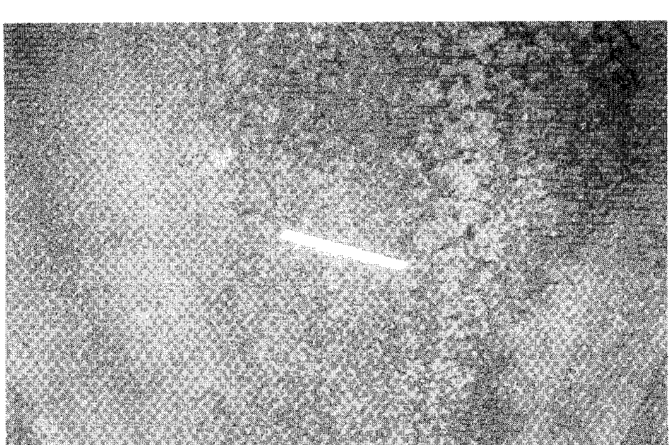


FIG. X1.10 Bleeding

FIG. X1.13 Low-Severity Block Cracking, Filled Cracks

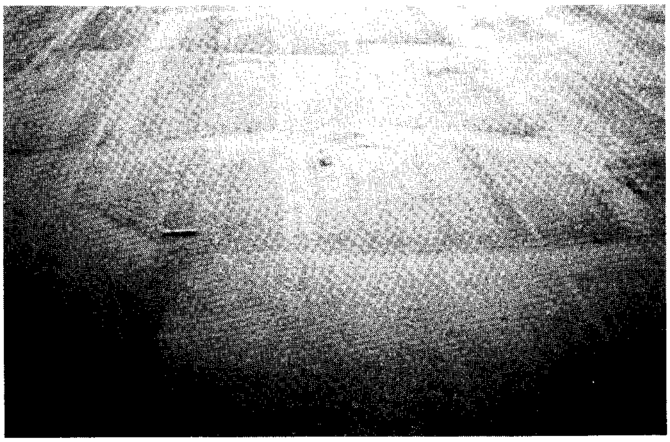


FIG. X1.14 Low-Severity Block Cracking, Filled Cracks

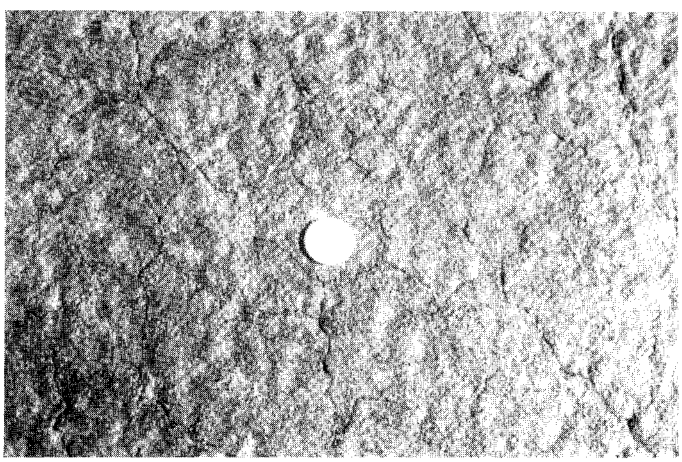


FIG. X1.15 Low-Severity Block Cracking, Small Blocks Defined by Hairline Cracks

(some FOD potential), but have a mean width greater than approximately ¼ in. (6 mm); or filled cracks greater than ¼ in. that are not spalled or have only minor spalling (some FOD potential), but have filler in unsatisfactory condition (see Fig. X1.16 and Fig. X1.17).

FIG. X1.16 Medium-Severity Block Cracking

FIG. X1.17 Medium-Severity Block Cracking

X1.4.2.3 *H*—Blocks are well defined by cracks that are severely spalled, causing a definite FOD potential (see Figs. X1.18-X1.20).

X1.4.3 *How to Measure*—Block cracking is measured in square feet (square metres) of surface area, and 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. For asphalt pavements, not including AC over PCC, if block cracking is recorded, no longitudinal and transverse cracking should be recorded in the same area. For asphalt overlay over concrete, block cracking, joint reflection cracking, and longitudinal and transverse cracking reflected from old concrete should all be recorded separately.

X1.5 *Corrugation:*

X1.5.1 *Description*—Corrugation is a series of closely spaced ridges and valleys (ripples) occurring at fairly regular intervals (usually less than 5 ft) (1.5 m) 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.

X1.5.2 *Severity Levels:*

FIG. X1.18 High-Severity Block Cracking

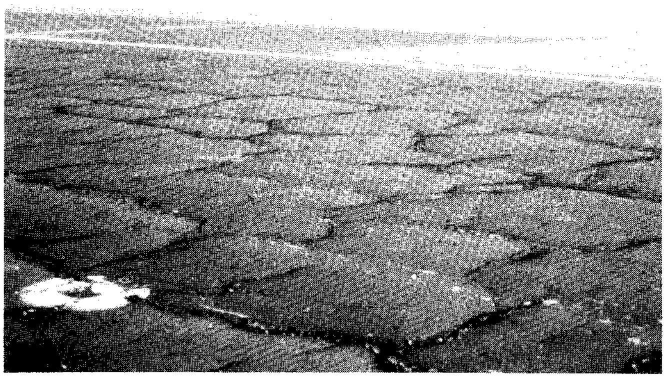


FIG. X1.19 High-Severity Block Cracking

FIG. X1.20 High-Severity Block Cracking

X1.5.2.1 *L*—Corrugations are minor and do not significantly affect ride quality (see measurement criteria below) (see Fig. X1.21).

X1.5.2.2 *M*—Corrugations are noticeable and significantly affect ride quality (see measurement criteria below) (see Fig. X1.22).

X1.5.2.3 *H*—Corrugations are easily noticed and severely affect ride quality (see measurement criteria below) (see Fig. X1.23).

X1.5.3 *How to Measure*—Corrugation is measured in square feet (square metres) 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-ft (3-m) straightedge should be placed perpendicular to the corrugations so that the depth of the valleys can be measured in inches (millimetres). The mean depth is calculated from five such measurements.

Severity	Runways and High-Speed Taxiways	Taxiways and Aprons
L	< ¼ in. (6 mm)	< ½ in. (13 mm)
M	¼ to ½ in. (6 to 13 mm)	½ to 1 in. (13 to 25 mm)
H	> ½ in. (13 mm)	> 1 in. (25 mm)

X1.6 *Depression:*

X1.6.1 *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 during construction. Depressions cause roughness and, when filled with water of sufficient depth, could cause hydroplaning of aircraft.

X1.6.2 *Severity Levels:*

X1.6.2.1 *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) (see Fig. X1.24).

X1.6.2.2 *M*—The depression can be observed, moderately affects pavement riding quality, and causes hydroplaning potential on runways (see measurement criteria below) (see Fig. X1.25 and Fig. X1.26).

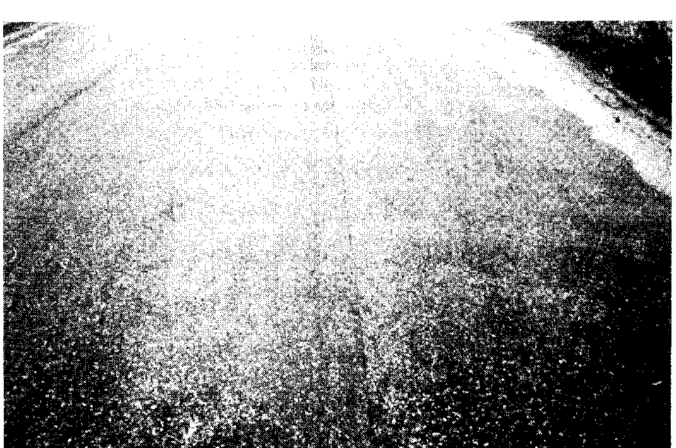


FIG. X1.21 Low-Severity Corrugation in the Foreground, Changing to Medium and High in the Background

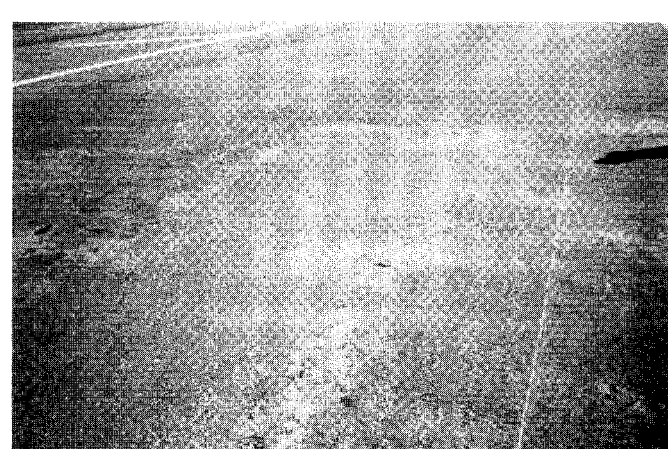


FIG. X1.22 Medium-Severity Corrugation

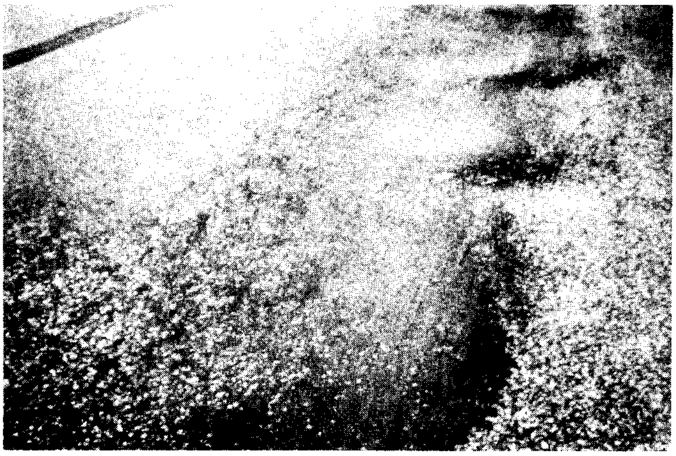


FIG. X1.23 High-Severity Corrugation

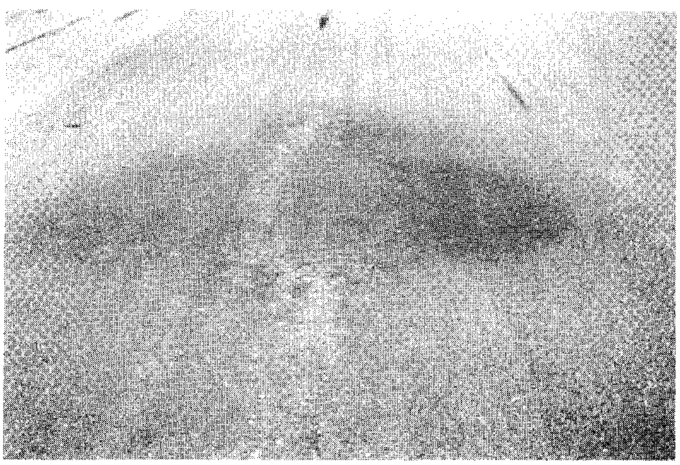


FIG. X1.24 Low-Severity Depression

FIG. X1.25 Medium-Severity Depression (1½ in. (37.5 mm))

X1.6.2.3 *H*—The depression can be readily observed, severely affects pavement riding quality, and causes definite hydroplaning potential (see measurement criteria below) (see Fig. X1.27).

FIG. X1.26 Medium-Severity Depression

FIG. X1.27 High-Severity Depression (2 in. (50 mm))

X1.6.3 *How to Measure*—Depressions are measured in square feet (square metres) of surface area. The maximum depth of the depression determines the level of severity. This depth can be measured by placing a 10-ft (3-m) straightedge across the depressed area and measuring the maximum depth in inches (millimetres). Depressions larger than 10 ft (3 m) across must be measured by using a stringline:

Severity	Maximum Depth of Depression	
	Runways and High-Speed Taxiways	Taxiways and Aprons
L	⅛ to ½ in. (3 to 13 mm)	½ to 1 in. (13 to 25 mm)
M	½ to 1 in. (13 to 25 mm)	1 to 2 in. (25 to 51 mm)
H	> 1 in. (> 25 mm)	> 2 in. (> 51 mm)

X1.7 *Jet-Blast Erosion:*

X1.7.1 *Description*—Jet-blast erosion causes darkened areas on the pavement surface where bituminous binder has been burned or carbonized. Localized burned areas may vary in depth up to approximately ½ in. (13 mm).

X1.7.2 *Severity Levels*—No degrees of severity are defined. It is sufficient to indicate that jet-blast erosion exists (see Fig. X1.28 and Fig. X1.29).

X1.7.3 *How to Measure*—Jet-blast erosion is measured in square feet (square metres) of surface area.

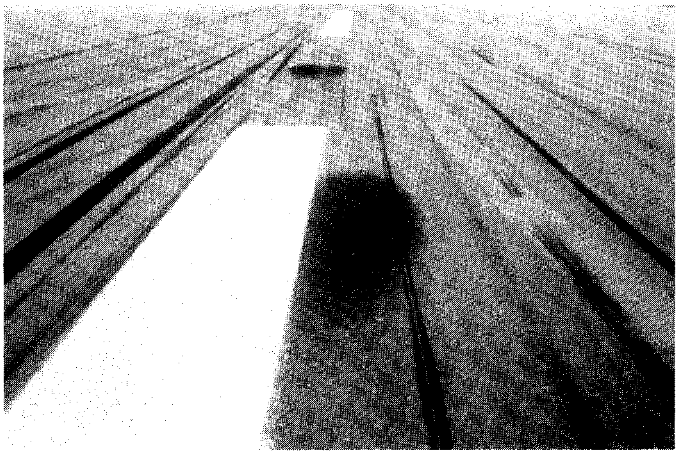


FIG. X1.28 Jet-Blast Erosion

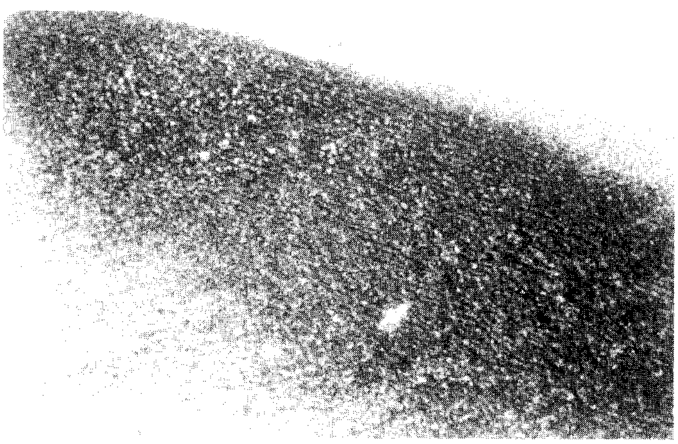


FIG. X1.29 Jet-Blast Erosion

FIG. X1.30 Low-Severity Joint Reflection Cracking

X1.8 *Joint Reflection Cracking From PCC (Longitudinal and Transverse):*

X1.8.1 *Description*—This distress occurs only on pavements having an asphalt or tar surface over a PCC slab. This category does not include reflection cracking from any other type of base (that is, 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 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.

X1.8.2 *Severity Levels:*

X1.8.2.1 *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 ¼ in. (6 mm) or less; filled cracks are of any width, but their filler material is in satisfactory condition (see Figs. X1.30-X1.32).

X1.8.2.2 *M*—One of the following conditions exists: cracks are moderately spalled (some FOD potential) and can be either filled or nonfilled of any width; filled cracks are not spalled or are lightly spalled, but filler is in unsatisfactory condition; nonfilled cracks are not spalled or are only lightly spalled, but the mean crack width is greater than ¼ in. (6 mm); or light random cracking exists near the crack or at the corners of intersecting cracks (see Figs. X1.33-X1.35).

X1.8.2.3 *H*—Cracks are severely spalled with pieces loose or missing causing definite FOD potential. Cracks can be either filled or nonfilled of any width (see Fig. X1.36).

X1.8.3 *How to Measure*—Joint reflection cracking is measured in linear feet (metres). 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 ft (15 m) long may have 10 ft (3 m) of a high severity, 20 ft (6 m) of a medium severity, and 20 ft (6 m) of a light severity. These would all be recorded separately. If the different levels of severity in a portion of a crack cannot be easily divided, that portion should be rated at the highest severity present.

X1.9 *Longitudinal and Transverse Cracking (Non-PCC Joint Reflective):*

FIG. X1.31 Low-Severity Joint Reflection Cracking, Filled Crack

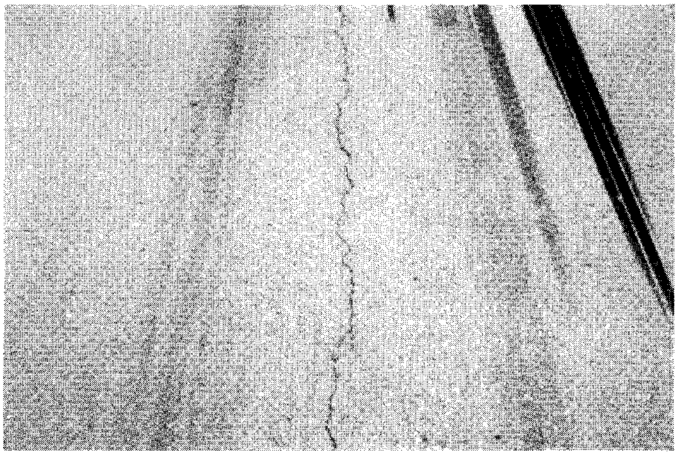


FIG. X1.32 Low-Severity Joint Reflection Cracking, Nonfilled Crack

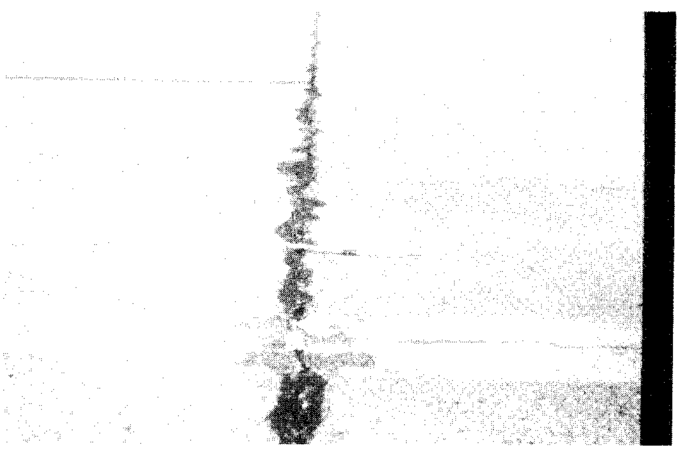


FIG. X1.33 Medium-Severity Joint Reflection Cracking

FIG. X1.34 Medium-Severity Joint Reflection Cracking

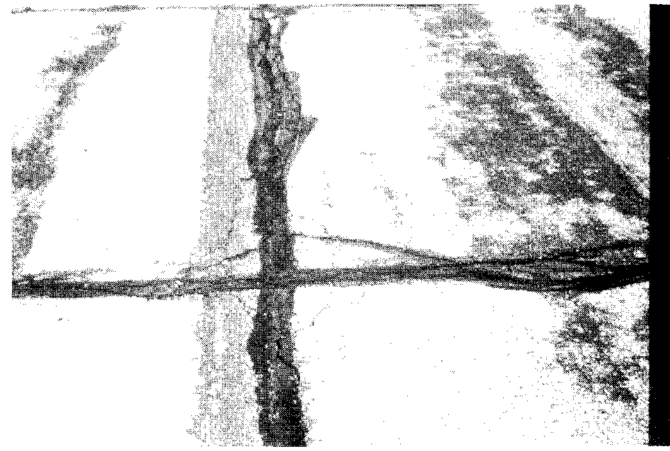


FIG. X1.35 Medium-Severity Joint Reflection Cracking

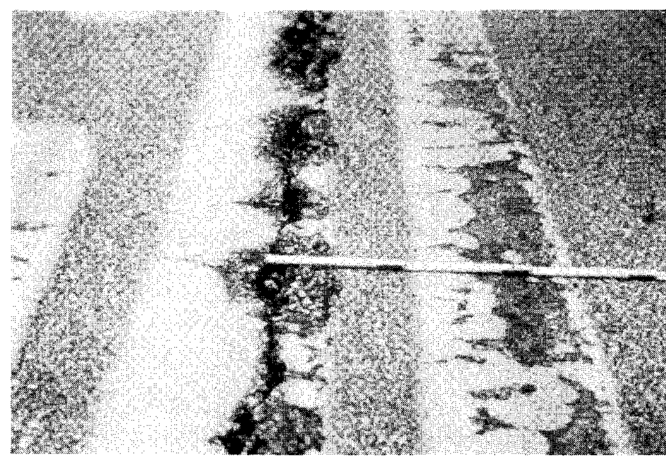


FIG. X1.36 High-Severity Joint Reflection Cracking

X1.9.1 *Description*—Longitudinal cracks are parallel to the pavement's center line 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's center line or direction of laydown. They may be caused by (*2*) or (*3*). These types of cracks are not usually load associated. If the pavement is fragmented along a crack, the crack is said to be spalled.

X1.9.2 *Severity Levels:*

X1.9.2.1 *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 ¼ in. (6 mm) or less; filled cracks are of any width, but their filler material is in satisfactory condition (see Fig. X1.37 and Fig. X1.38).

X1.9.2.2 *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 lightly spalled, but filler is in unsatisfactory condition; (*3*) nonfilled cracks are not spalled or are only lightly spalled, but the mean crack width is greater than ¼ in. (6 mm), or (*4*) light random cracking exists near the crack or at the corners of intersecting cracks (see Figs. X1.39-X1.41).

X1.9.2.3 *H*—Cracks are severely spalled and pieces are loose or missing causing definite FOD potential. Cracks can be either filled or nonfilled of any width (see Fig. X1.42).

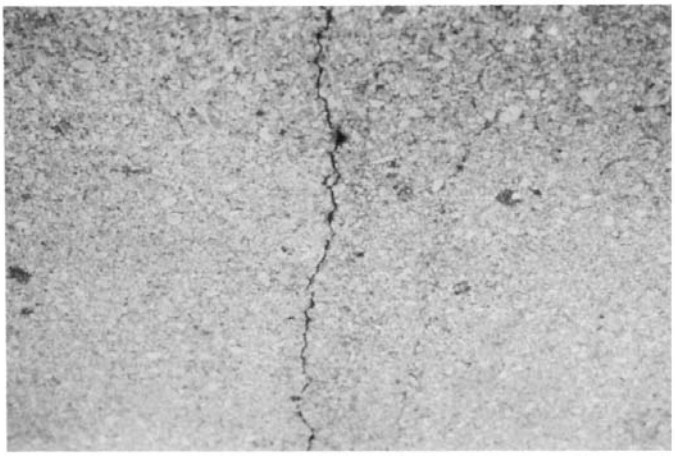


FIG. X1.37 Low-Severity Longitudinal Crack

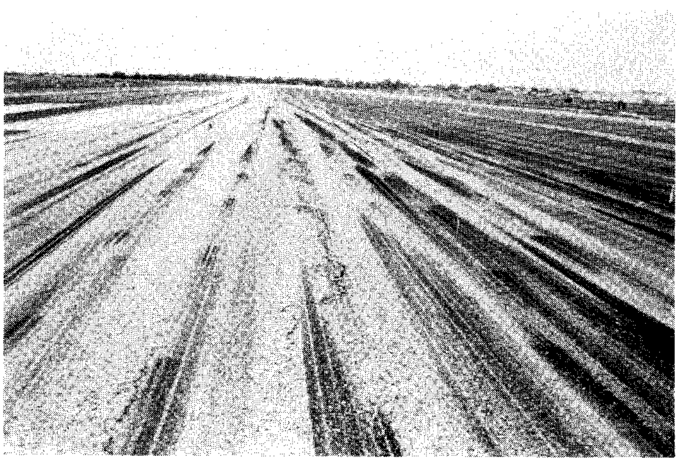


FIG. X1.38 Low-Severity Longitudinal Cracks, Approaching Medium

FIG. X1.39 Medium-Severity Longitudinal Construction Joint Crack

FIG. X1.40 Medium-Severity Longitudinal Crack (Note the Crack is Reflective But Not at the Joint of Slab)

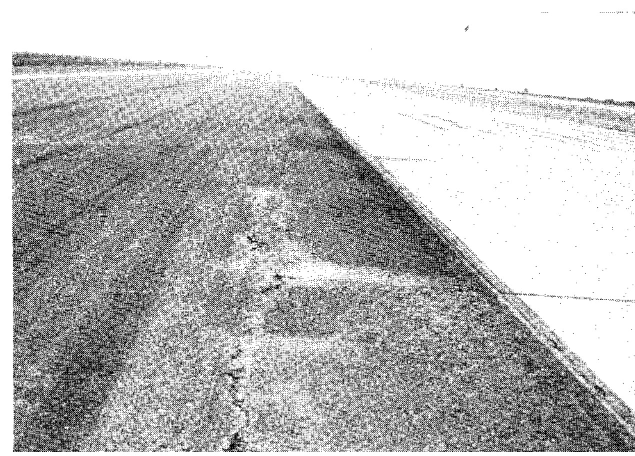


FIG. X1.41 Medium-Severity Longitudinal Crack

FIG. X1.42 High-Severity Longitudinal Crack

X1.9.3 *Porous Friction Courses: Severity Levels:*

X1.9.3.1 *L*—Average raveled area around the crack is less than ¼ in. (6 mm) wide (see Fig. X1.43).

X1.9.3.2 *M*—Average raveled area around the crack is between ¼ to 1 in. (6 to 25 mm) wide (see Fig. X1.44).

X1.9.3.3 *H*—Average raveled area around the crack is greater than 1 in. (25 mm) wide (see Fig. X1.45).

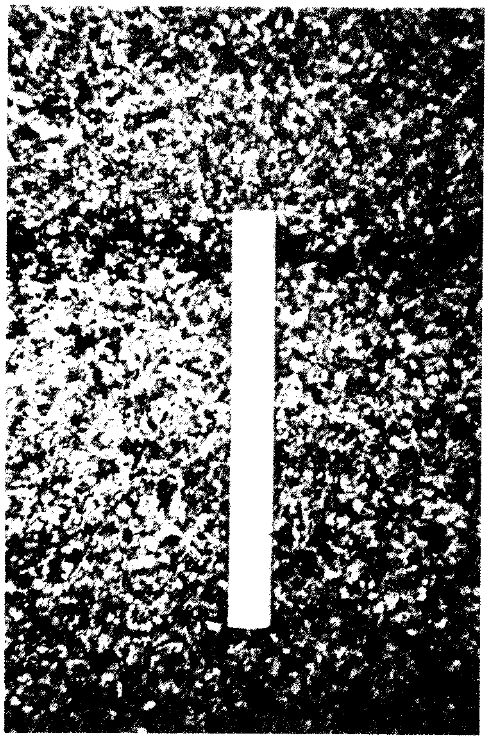


FIG. X1.43 Low-Severity Crack in Porous Friction Course

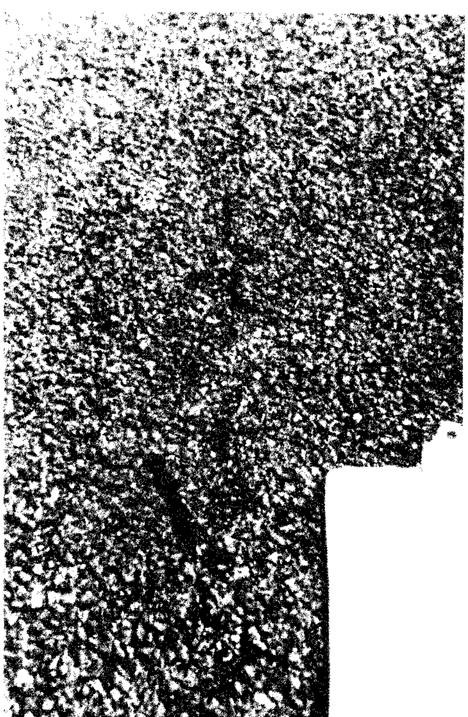


FIG. X1.44 Medium-Severity Crack in Porous Friction Course

X1.9.4 *How to Measure*—Longitudinal and transverse cracks are measured in linear feet (metres). 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." If block cracking is recorded, longitudinal and transverse cracking is not recorded in the same area.

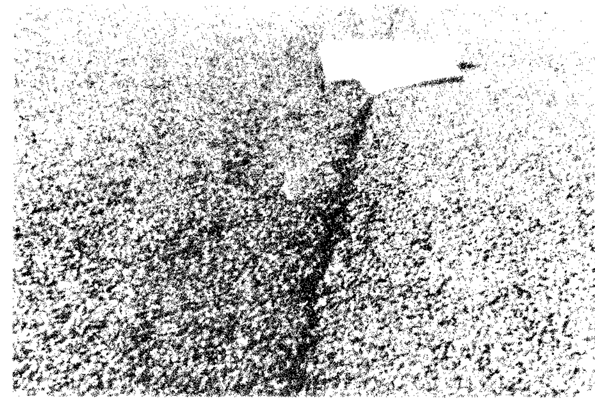


FIG. X1.45 High-Severity Crack in Porous Friction Course

X1.10 *Oil Spillage:*

X1.10.1 *Description*—Oil spillage is the deterioration or softening of the pavement surface caused by the spilling of oil, fuel, or other solvents.

X1.10.2 *Severity Levels*—No degrees of severity are defined. It is sufficient to indicate that oil spillage exists (see Fig. X1.46 and Fig. X1.47).

X1.10.3 *How to Measure*—Oil spillage is measured in square feet (square metres) of surface area. A stain is not a distress unless material has been lost or binder has been softened. If hardness is approximately the same as on surrounding pavement, and if no material has been lost, do not record as a distress.

X1.11 *Patching and Utility Cut Patch:*

X1.11.1 *Description*—A patch is considered a defect, no matter how well it is performing.

X1.11.2 *Severity Levels:*

X1.11.2.1 *L*—Patch is in good condition and is performing satisfactorily (see Figs. X1.48-X1.50).

FIG. X1.46 Oil Spillage

FIG. X1.47 Oil Spillage

FIG. X1.48 Low-Severity Patch

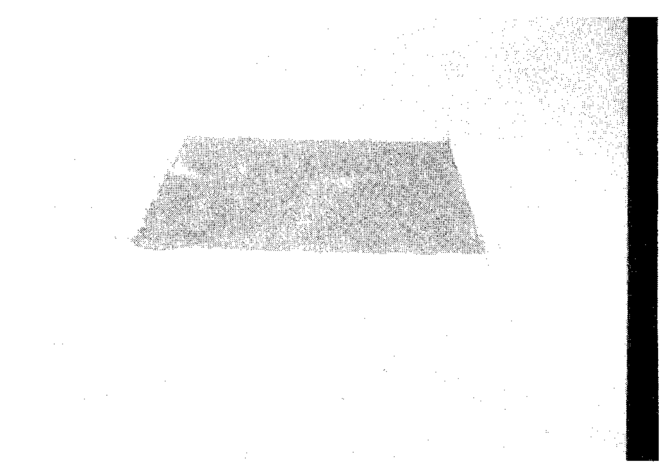


FIG. X1.49 Low-Severity Patch

X1.11.2.2 *M*—Patch is somewhat deteriorated and affects ride quality to some extent. Moderate amount of distress is present within the patch or has FOD potential, or both. (see Fig. X1.51).

FIG. X1.50 Low-Severity Patch with Medium-Severity Portion

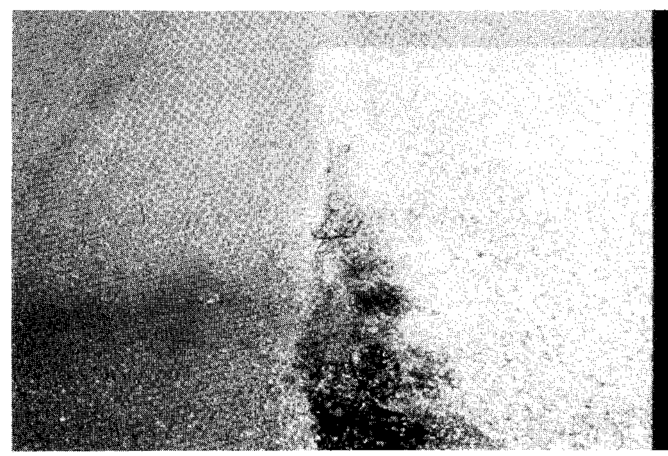


FIG. X1.51 Medium-Severity Patch

FIG. X1.52 High-Severity Patch

X1.11.2.3 *H*—Patch is badly deteriorated and affects ride quality significantly or has high FOD potential. Patch soon needs replacement.

X1.11.3 *Porous Friction Courses*—The use of dense-graded AC patches in porous friction surfaces causes a water damming effect at the patch which contributes to differential skid

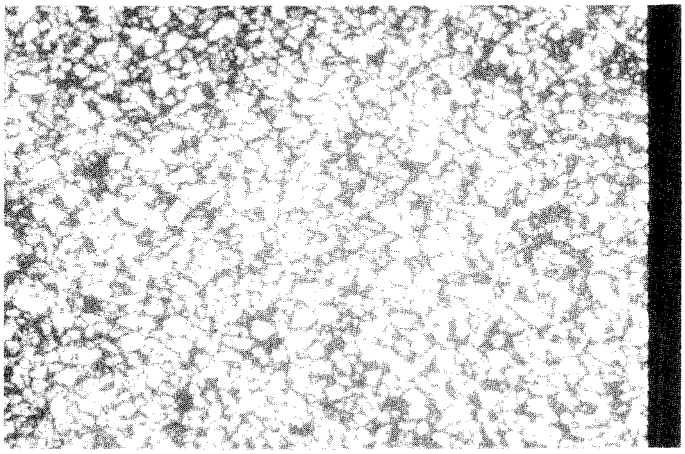


FIG. X1.53 Polished Aggregate

resistance of the surface. Low-severity dense-graded patches should be rated as medium severity due to the differential friction problem. Medium- and high-severity patches are rated the same as above.

X1.11.4 *How to Measure:*

X1.11.4.1 Patching is measured in square feet (square metres) 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-ft^2 (2.5-m^2) patch may have 10 ft^2 (1 m^2) of medium severity and 15 ft^2 (1.5 m^2) of low severity. These areas should be recorded separately. Any distress found in a patched area will not be recorded; however, its effect on the patch will be considered when determining the patch's severity level.

X1.11.4.2 A very large patch, (area > 2500 ft^2 (230 m^2)) or feathered-edge pavement, may qualify as an additional sample unit or as a separate section.

X1.12 *Polished Aggregate:*

X1.12.1 *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.

X1.12.2 *Severity Levels*—No degrees of severity are defined. However, the degree of polishing should be clearly evident in the sample unit, in that the aggregate surface should be smooth to the touch.

X1.12.3 *How to Measure*—Polished aggregate is measured in square feet (square metres) of surface area. Polished aggregate areas should be compared visually with adjacent nontraffic areas. If the surface texture is substantially the same in both traffic and nontraffic areas, polished aggregate should not be counted.

X1.13 *Raveling:*

X1.13.1 *Description*—Raveling is the dislodging of coarse aggregate particles from the pavement surface.

X1.13.2 *Dense Mix Severity Levels*—As used herein, coarse aggregate refers to predominant coarse aggregate sizes of the asphalt mix. Aggregate clusters refer to when more than one adjoining coarse aggregate piece is missing. If in doubt about a severity level, three representative areas of one square yard each (one square meter) should be examined and the number of missing coarse aggregate particles counted.

X1.13.2.1 *L*—(*1*) In a square yard (square meter) representative area, the number of coarse aggregate particles missing is between 5 and 20, and/or (*2*) missing aggregate clusters are less than 2 percent of the examined square yard (square meter) area. In low severity raveling, there is little or no FOD potential (see Figs. X1.54 and X1.55).

X1.13.2.2 *M*—(*1*) In a square yard (square meter) representative area, the number of coarse aggregate particles missing is between 21 and 40, and/or (*2*) missing aggregate clusters are between 2 and 10 percent of the examined square yard (square meter) area. In medium severity raveling, there is some FOD potential (see Fig. X1.56).

X1.13.2.3 *H*—(*1*) In a square yard (square meter) representative area, the number of coarse aggregate particles missing is over 40, and/or (*2*) missing aggregate clusters are more than 10 percent of the examined square yard (square meter) area. In high severity raveling, there is significant FOD potential (see Fig. X1.57).

X1.13.3 *Slurry Seal/Coal Tar Over Dense Mix Severity Levels*

X1.13.3.1 *L*—(*1*) The scaled area is less than 1 %. (*2*) In the case of coal tar where pattern cracking has developed, the surface cracks are less than ¼ in. (6 mm) wide (see Fig. X1.58).

X1.13.3.2 *M*—(*1*) The scaled area is between 1 and 10 %. (*2*) In the case of coal tar where pattern cracking has developed, the cracks are ¼ in. (6 mm) wide or greater (see Fig. X1.59).

X1.13.3.3 *H*—(*1*) The scaled area is over 10 %. (*2*) In the case of coal tar the surface is peeling off (see Fig. X1.60).

X1.13.4 *Porous Friction Course Severity Levels (see Figs. X1.61-X1.65):*

FIG. X1.54 Low-Severity Raveling, Dense Mix

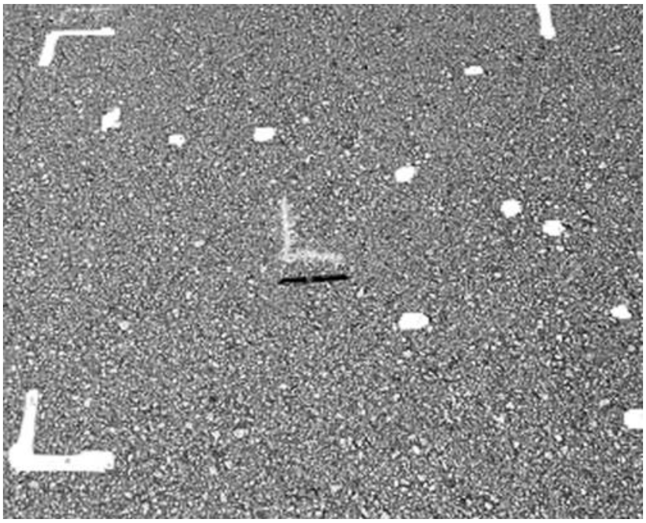


FIG. X1.55 Low-Severity Raveling, Dense Mix

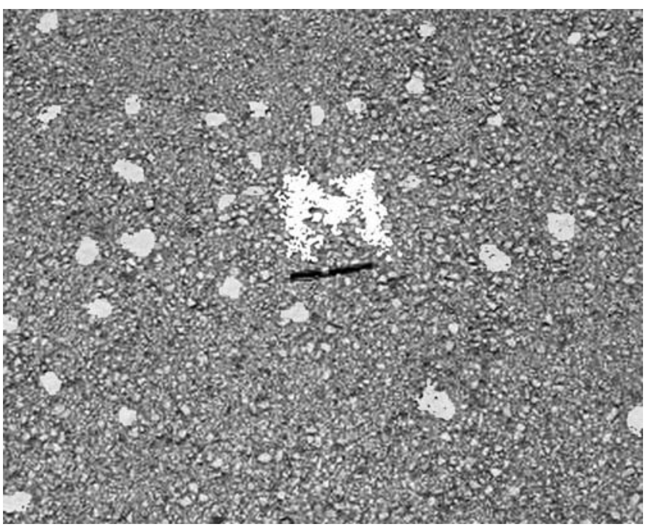


FIG. X1.56 Medium-Severity Raveling, Dense Mix

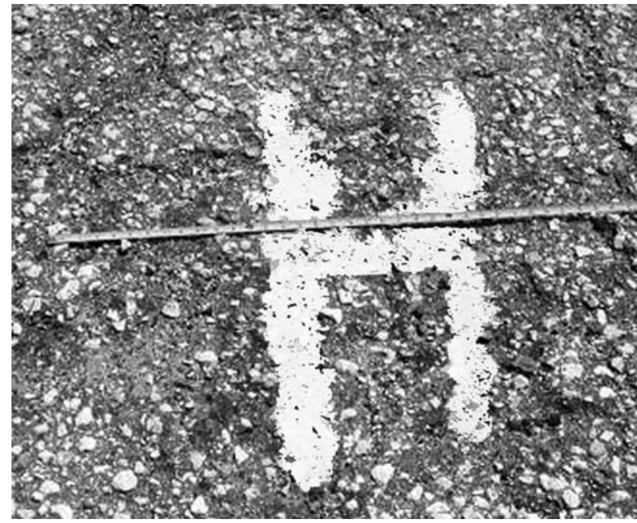


FIG. X1.57 High-Severity Raveling, Dense Mix

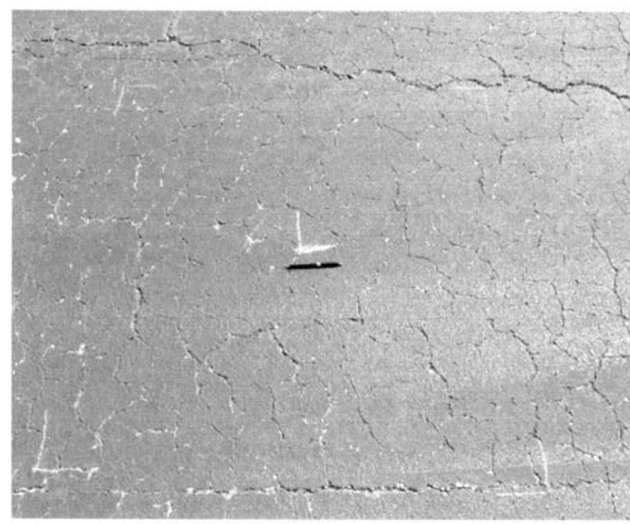


FIG. X1.58 Low-Severity Raveling, Cold Tar

X1.13.4.1 *L*—(*1*) In a square foot (1⁄10 square meter) representative sample, the number of aggregate pieces missing is between 5 and 20 and/or the number of missing aggregate clusters does not exceed 1 (see Fig. X1.63).

X1.13.4.2 *M*—(*1*) In a square foot (1⁄10 square meter) representative sample, the number of aggregate pieces missing is between 21 and 40 and/or the number of missing aggregate clusters is greater than 1 but does not exceed 25 % of the area (see Fig. X1.64).

X1.13.4.3 *H*—(*1*) In a square foot (1⁄10 square meter) representative sample, the number of aggregate pieces missing is over 40 and/or the number of missing aggregate clusters is greater than 25 % of the area (see Fig. X1.65).

X1.13.5 *How to Measure*—Raveling is measured in square feet (square metres) of surface area. Mechanical damage caused by hook drags, tire rims, or snowplows is counted as areas of high severity raveling.

X1.14 *Rutting:*

X1.14.1 *Description*—A rut is a surface depression in the wheel path. 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.

X1.14.2 *Severity Levels:*

Severity	Mean Rut Depth Criteria All Pavement Sections	Figure
L	¼ to ½ in. (< 6 to 13 mm)	Fig. X1.66 and Fig. X1.67
M	> ½ to 1 in. (> 13 to < 25 mm)	Fig. X1.68
H	> 1 in. (> 25 mm)	Fig. X1.69 and Fig. X1.70

X1.14.3 *How to Measure*—Rutting is measured in square feet (square metres) of surface area, and its severity is determined by the mean depth of the rut. To determine the mean depth, a straightedge should be laid across the rut and the

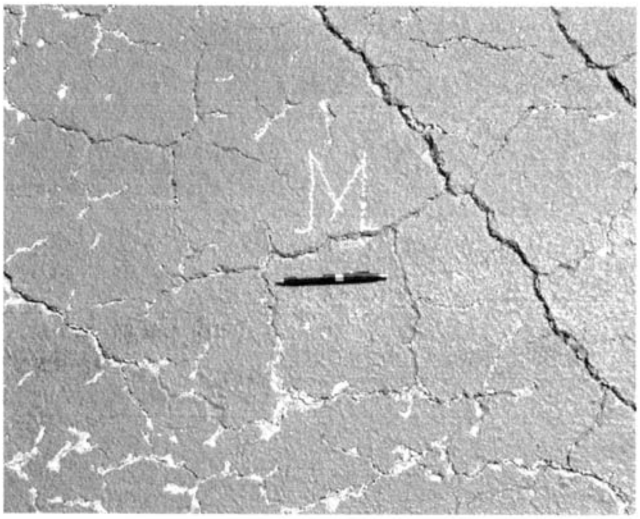


FIG. X1.59 Medium-Severity Raveling, Cold Tar

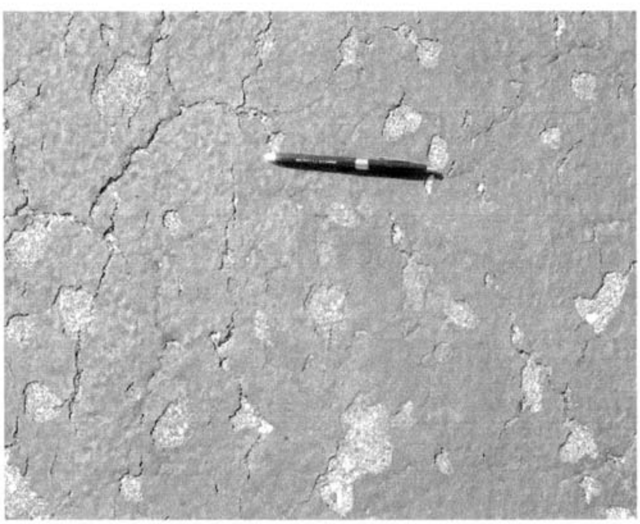


FIG. X1.60 High-Severity Raveling, Cold Tar

depth measured. The mean depth in inches (millimetres) should be computed from measurements taken along the length of the rut. If alligator cracking and rutting occur in the same area, each is recorded at the respective severity level.

X1.15 *Shoving of Asphalt Pavement by PCC Slabs:*

X1.15.1 *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.

X1.15.2 *Severity Level:*

Severity	Height Differential
L	< ¾ in. (< 20 mm)
M	¾ to 1½ in. (> 20 to 40 mm)
H	> 1½ in. (> 40 mm)

FIG. X1.61 Typical Porous Friction Course Surface with No Raveling

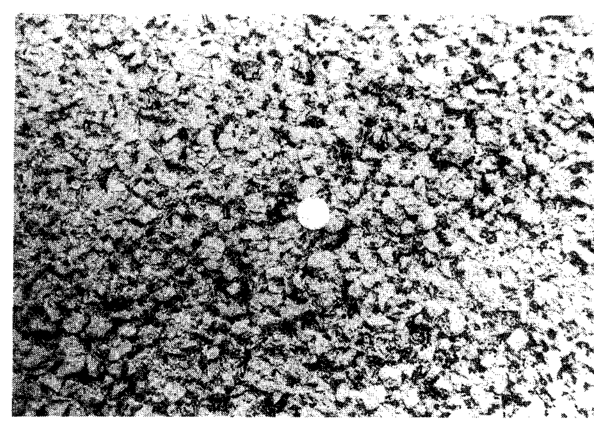


FIG. X1.62 Typical Porous Friction Course Surface with No Raveling

NOTE X1.2—As a guide, the swell table (above) may be used to determine the severity levels of shoving. At the present time, no significant research has been conducted to quantify levels of severity of shoving.

X1.15.2.1 *L*—A slight amount of shoving has occurred and no breakup of the asphalt pavement (see Fig. X1.71).

X1.15.2.2 *M*—A significant amount of shoving has occurred, causing moderate roughness and little or no breakup of the asphalt pavement (see Fig. X1.71).

X1.15.2.3 *H*—A large amount of shoving has occurred, causing severe roughness or breakup of the asphalt pavement (see Fig. X1.72).

X1.15.2.4 *How to Measure*—Shoving is measured by determining the area in square feet (square metres) of the swell caused by shoving.

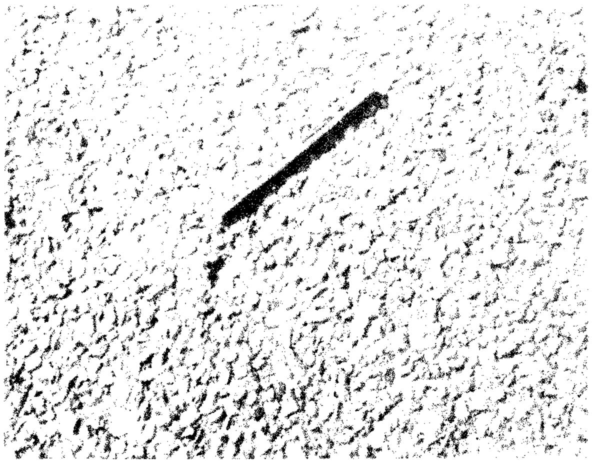


FIG. X1.63 Low-Severity Raveling on a Porous Friction Course Surface

FIG. X1.64 Medium-Severity Raveling on a Porous Friction Course Surface

X1.16 *Slippage Cracking:*

X1.16.1 *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.

X1.16.2 *Severity Levels*—No degrees of severity are defined. It is sufficient to indicate that a slippage crack exists (see Fig. X1.73 and Fig. X1.74).

X1.16.3 *How to Measure*—Slippage cracking is measured in square feet (square metres) of surface area.

X1.17 *Swell-Distress:*

X1.17.1 *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.

FIG. X1.65 High-Severity Raveling on a Porous Friction Course Surface

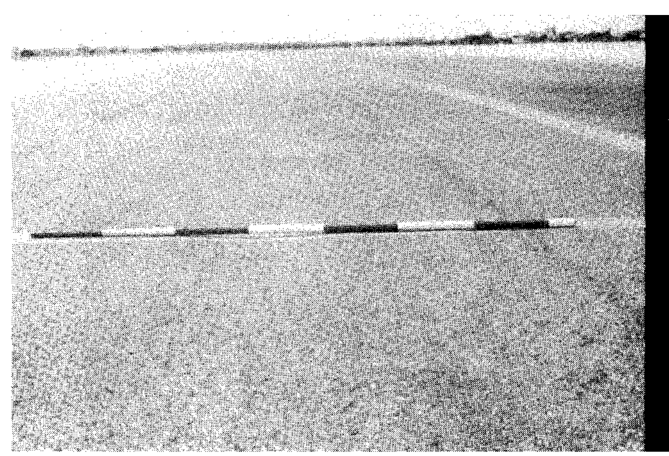


FIG. X1.66 Low-Severity Rutting

X1.17.2 *Severity Levels:*

X1.17.2.1 *L*—Swell is barely visible and has a minor effect on the pavement's ride quality. (Low-severity swells may not always be observable, but their existence can be confirmed by driving a vehicle over the section. An upward acceleration will occur if the swell is present) (see Fig. X1.75).

X1.17.2.2 *M*—Swell can be observed without difficulty and has a significant effect on the pavement's ride quality (see Fig. X1.76).

X1.17.2.3 *H*—Swell can be readily observed and severely affects the pavement's ride quality (see Fig. X1.77 and Fig. X1.78).

X1.17.3 *How to Measure:*

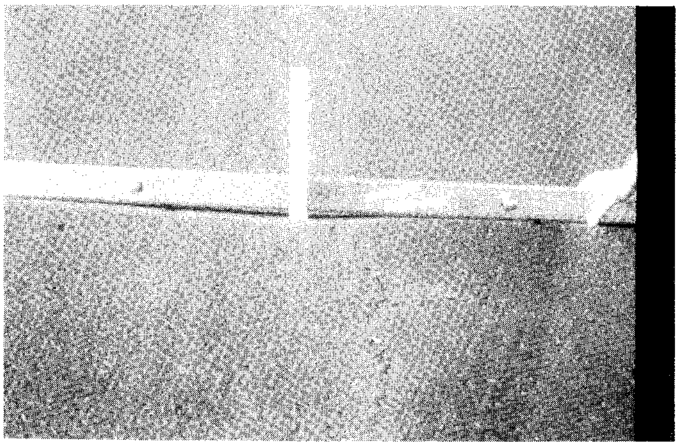


FIG. X1.67 Low-Severity Rutting

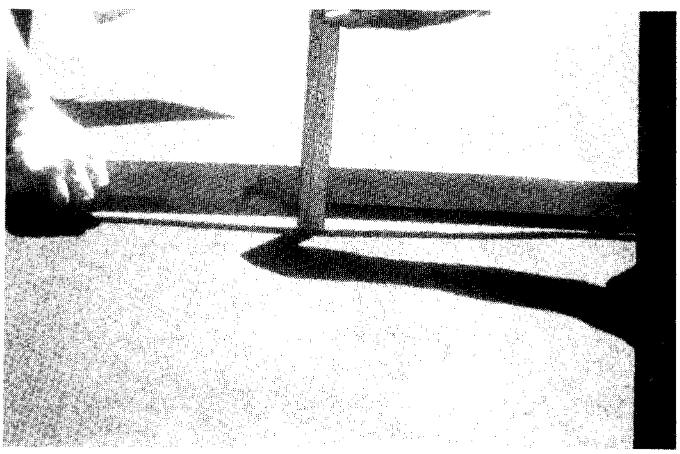


FIG. X1.68 Medium-Severity Rutting

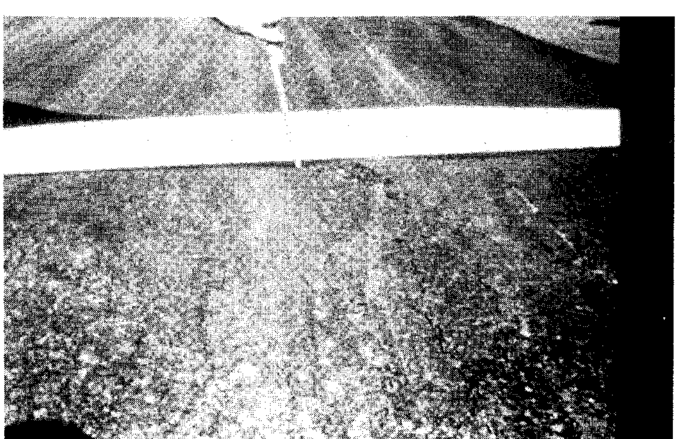


FIG. X1.69 High-Severity Rutting (Note Alligator Cracking Associated With Rutting)

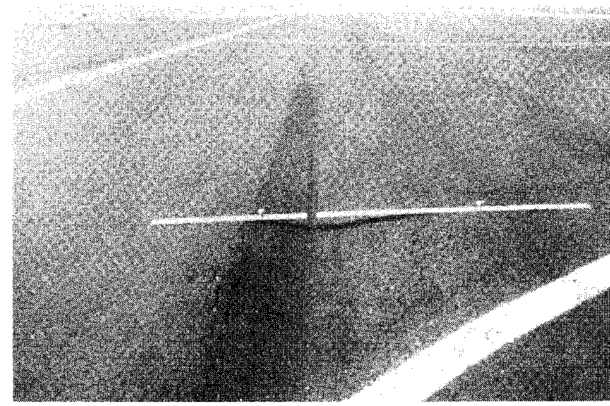


FIG. X1.70 High-Severity Rutting

FIG. X1.71 Shove of Low Severity on the Outside and Medium Severity in the Middle

FIG. X1.72 High-Severity Shoving

X1.17.3.1 The surface area of the swell is measured in square feet (square metres). The severity rating should consider the type of pavement section (that is, 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 an apron or taxiway where the normal aircraft operating speeds are much lower.

FIG. X1.73 Slippage Cracking

FIG. X1.74 Slippage Cracking

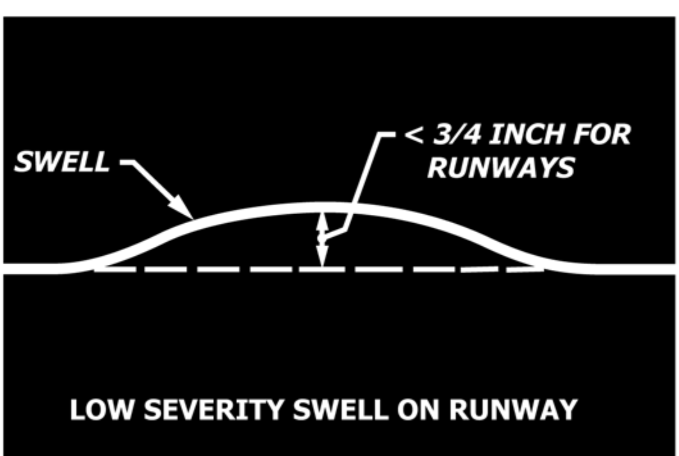


FIG. X1.75 Low-Severity Swell

X1.17.3.2 For short wavelengths, locate the highest point of the swell. Rest at 10-ft (3-m) straightedge on that point so that both ends are equal distance above pavement. Measure this distance to establish severity rating.

X1.17.3.3 The following guidance is provided for runways:

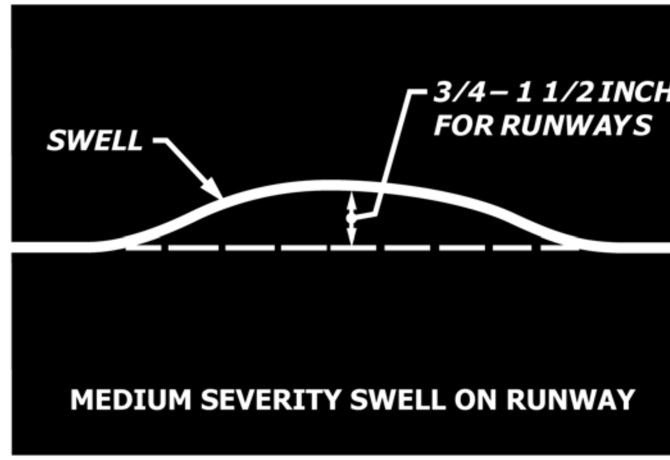


FIG. X1.76 Medium-Severity Swell

FIG. X1.77 High-Severity Swell

FIG. X1.78 High-Severity Swell

Severity	Height Differential
L	< ¾ in. (20 mm)
M	¾ to 1½ in. (20 to 40 mm)
H	> 1½ in. (40 mm)

Rate severity on high-speed taxiways using measurement criteria provided above. Double the height differential criteria for other taxiways and aprons.

X1.18 *Weathering (Surface Wear)—Dense Mix Asphalt*

X1.18.1 *Description*—The wearing away of the asphalt binder and fine aggregate matrix from the pavement surface.

X1.18.2 *Severity Levels:*

X1.18.2.1 *L*—Asphalt surface beginning to show signs of aging which may be accelerated by climatic conditions. Loss is the fine aggregate matrix is noticeable and may be accompanied by fading of the asphalt color. Edges of the coarse aggregates are beginning to be exposed (less than 1 mm or 0.05 inches). Pavement may be relatively new (as new as 6 months old) (see Fig. X1.79).

X1.18.2.2 *M*—Loss of fine aggregate matrix is noticeable and edges of coarse aggregate have been exposed up to ¼ width (of the longest side) of the coarse aggregate due to the loss of fine aggregate matrix (see Fig. X1.80).

X1.18.2.3 *H*—Edges of coarse aggregate have been exposed greater than ¼ width (of the longest side) of the coarse aggregate. There is considerable loss of fine aggregate matrix leading to potential or some loss of coarse aggregate (see Fig. X1.81).

FIG. X1.79 Low-Severity Weathering (Surface Wear)

FIG. X1.80 Medium-Severity Weathering (Surface Wear)

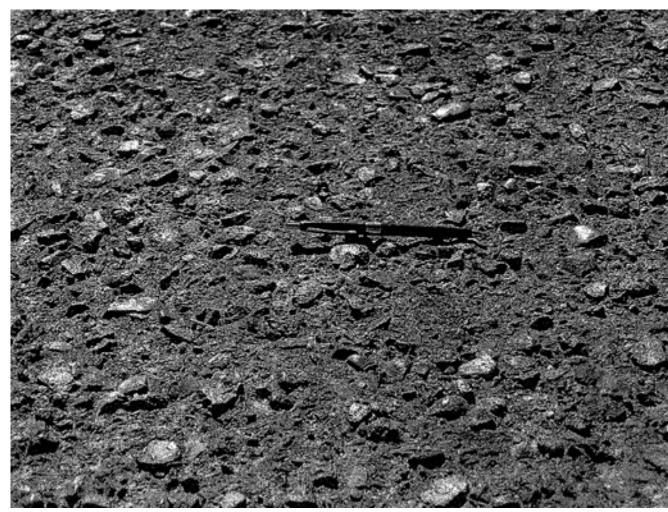


FIG. X1.81 High-Severity Weathering (Surface Wear)

X1.18.3 *How to Measure*—Surface wear is measured in square feet (square meters). Surface wear is not recorded if medium or high severity raveling is recorded.

X2. PCI CONCRETE-SURFACED AIRFIELDS

NOTE X2.1—The sections in this appendix are arranged in the following order:

	Section
Distresses in Jointed Concrete Pavement	X2.1
Blowup	X2.2
Corner Break	X2.3
Cracks; Longitudinal, Transverse, and Diagonal	X2.4
Durability ("D") Cracking	X2.5
Joint Seal Damage	X2.6
Patching, Small	X2.7
Patching, Large and Utility Cuts	X2.8
Popouts	X2.9
Pumping	X2.10
Scaling	X2.11
Settlement or Faulting	X2.12
Shattered Slab/Intersecting Cracks	X2.13
Shrinkage Cracking	X2.14
Spalling (Longitudinal and Transverse Joint)	X2.15
Spalling (Corner)	X2.16
Alkali Silica Reaction (ASR)	X2.17

X2.1 *Distresses in Jointed Concrete Pavement:*

X2.1.1 Fifteen distress types for jointed concrete pavements are listed alphabetically. The distress definitions apply to both plain and reinforced jointed concrete pavements, with the exception of linear cracking distress, that is defined separately for plain and reinforced jointed concrete pavements.

X2.1.2 During field condition surveys and validation of the PCI, several questions were often asked regarding the identification and counting method of some of the distresses. The answers to most of these questions are included under the section "How to Count" for each distress. For convenience, however, the items that are frequently referenced are listed as follows:

X2.1.2.1 Spalling as used in this test method is the further breaking of the pavement or loss of materials around cracks and joints.

X2.1.2.2 The cracks in reinforced concrete slabs that are less than ⅛ in. (3 mm) wide are counted as "shrinkage cracks." The "shrinkage cracks" should not be counted in determining whether or not the slab is broken into four or more pieces (or "shattered").

X2.1.2.3 Crack widths should be measured between the vertical walls, not from the edge of spalls. Spalling and associated FOD potential are considered in determining the severity level of cracks, but they should not influence the crack width measurements.

X2.1.2.4 A crack filler is in satisfactory condition if it prevents water and incompressibles from entering the crack or joint.

X2.1.2.5 "Joint seal damage" is not counted on a slab-by-slab basis. Instead, the severity level is assigned based on the overall condition of the joint seal in the sample unit.

X2.1.2.6 Do not count a joint as spalled if it can be filled with joint filler.

X2.1.2.7 A premolded joint sealant is in satisfactory condition if it is pliable, firmly against the joint wall, and not extruded.

X2.1.2.8 A fragmented crack is actually two or more cracks in close proximity that meet below the surface forming a single channel to subbase. The multiple cracks are interconnected to form small fragments, or pieces, of pavement.

X2.1.2.9 A crack wider than 3 in. (75 mm) rates at high severity regardless of filler condition.

X2.1.2.10 A spalled or chipped crack edge is defined by secondary cracks, with or without missing pieces, nearly parallel to the primary crack. Individual stones or particles that are dislodged do not constitute spalling.

X2.1.2.11 Little, light, or minor crack edge spalling is defined by secondary cracks typically less than 6 in. (150 mm) long and affecting less than 10 % of the crack length.

X2.1.2.12 Moderate spalling means secondary cracks can be of any length but both ends must intersect the primary crack. Individual pieces wider than 3 in. (75 mm) are not cracked and broken. Some loose particles means loose pieces can be of any length but must be less than 3 in. wide (75 mm) (chips). Missing pieces wider than 3 in. (75 mm) must affect less than 10 % of the crack length.

X2.1.2.13 A distress is said to have FOD potential when surficial material is in a broken or loose state, such that the possibility of ingestion of the material into an engine is present, or the potential for freeing the material due to trafficking is present.

X2.1.3 Sections X2.1.2.1 – X2.1.2.13 are not intended to be a complete list. To properly count each distress type, the inspector must be familiar with its individual counting criteria.

X2.2 *Blowup:*

X2.2.1 *Description*—Blowups 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 inflation 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. Blowups 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 blowups are included here is for reference when closed sections are being evaluated for reopening.

X2.2.2 *Severity Levels:*

X2.2.2.1 At the present time, no significant research has been conducted to quantify severity levels for blowups. Future research may provide measurement guidelines:

	Difference in Elevation	
	Runways and High-Speed Taxiways	Aprons and Other Taxiways
L	< ½ in. (< 13 mm)	¼ < 1 in. (6 to 25 mm)
M	½ to 1 in. (13 to 25 mm)	1 to 2 in. (25 to 51 mm)
H	inoperable	inoperable

NOTE X2.2—The elevations are twice the heights used for settlement/faulting. These are preliminary elevations, and subject to change.

X2.2.2.2 *L (Low)*—Buckling or shattering has not rendered the pavement inoperable, and only a slight amount of roughness exists (see Fig. X2.1).

X2.2.2.3 *M (Medium)*—Buckling or shattering has not rendered the pavement inoperable, but a significant amount of roughness exists (see Fig. X2.2).

X2.2.2.4 *H (High)*—Buckling or shattering has rendered the pavement inoperable (see Fig. X2.3).

X2.2.2.5 For the pavement to be considered operational, all foreign material caused by the blowup must have been removed.

X2.2.3 *How to Count:*

X2.2.3.1 A blowup usually occurs at a transverse crack or joint. At a crack, it is counted as being in one slab, but at a

NOTE 1—This would only be considered low severity if the shattering in the foreground was the only part existing and the foreign material removed.

FIG. X2.1 Low-Severity Blowup

FIG. X2.2 Medium-Severity Blowup

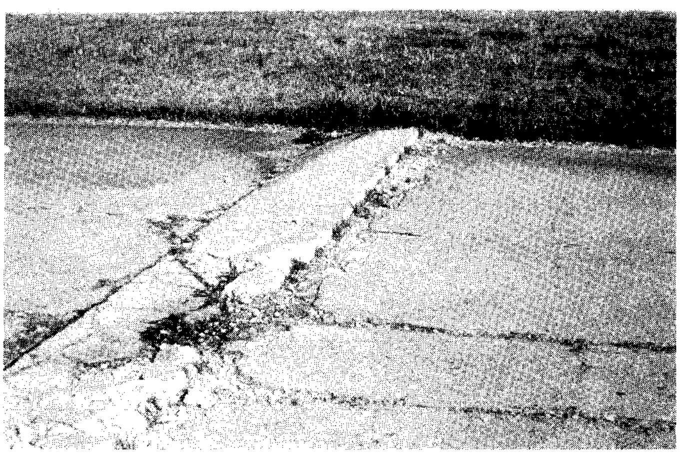


FIG. X2.3 High-Severity Blowup

joint, two slabs are affected and the distress should be recorded as occurring in two slabs.

X2.2.3.2 Record blowup on a slab only if the distress is evident on that slab. Severity may be different on adjacent slabs. If blowup has been repaired by patching, establish severity by determining the difference in elevation between the two slabs.

X2.3 *Corner Break:*

X2.3.1 *Description*—A corner break is a crack that intersects the joints at a distance less than or equal to one half of the slab length on both sides, measured from the corner of the slab. For example, a slab with dimensions of 25 by 25 ft (7.5 by 7.5 m) that has a crack intersecting the joint 5 ft (1.5 m) from the corner on one side and 17 ft (5 m) on the other side is not considered a corner break; it is a diagonal crack. However, a crack that intersects 7 ft (2 m) on one side and 10 ft (3 m) 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 cause corner breaks.

X2.3.2 *Severity Levels:*

X2.3.2.1 *L*—Crack has little or minor spalling (no FOD potential). If nonfilled, it has a mean width less than approximately ⅛ in. (3 mm). 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 (see Fig. X2.4 and Fig. X2.5).

X2.3.2.2 *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 ⅛ and 1 in. (3 and 25 mm); (*3*) a filled crack is not spalled or only lightly spalled, but the filler is in unsatisfactory condition; or (*4*) the area between the corner break and the joints is lightly cracked (see Fig. X2.6 and Fig. X2.7). Lightly cracked means one low-severity crack dividing the corner into two pieces.

X2.3.2.3 *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 in. (25 mm), creating a tire damage potential; or (*3*) the area between the corner break and the joints is severely cracked (see Fig. X2.8).

X2.3.3 *How to Count:*

X2.3.3.1 A distress slab is recorded as one slab if it contains a single corner break, contains more than one break of a particular severity, or 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. Crack widths should be measured between vertical walls, not in spalled areas of the crack.

X2.3.3.2 If the corner break is faulted ⅛ in. (3 mm) or more, increase severity to the next higher level. If the corner is faulted more than ½ in. (13 mm), rate the corner break at high severity. If faulting in corner is incidental to faulting in the slab, rate faulting separately.

X2.3.3.3 The angle of crack into the slab is usually not evident at low severity. Unless the crack angle can be determined, to differentiate between the corner break and corner spall, use the following criteria. If the crack intersects both joints more than 2 ft (600 mm) from the corner, it is a

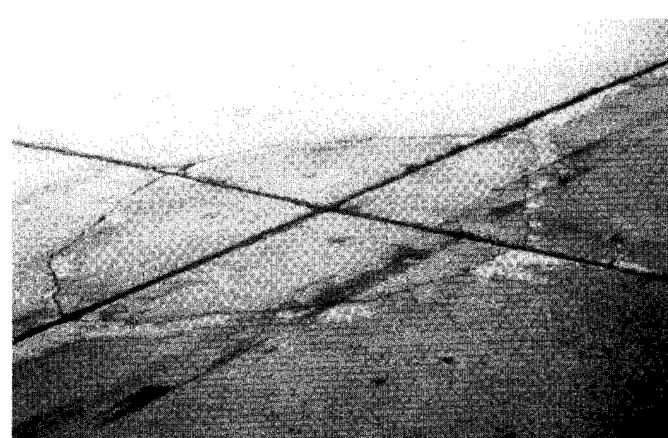


FIG. X2.4 Low-Severity Corner Break

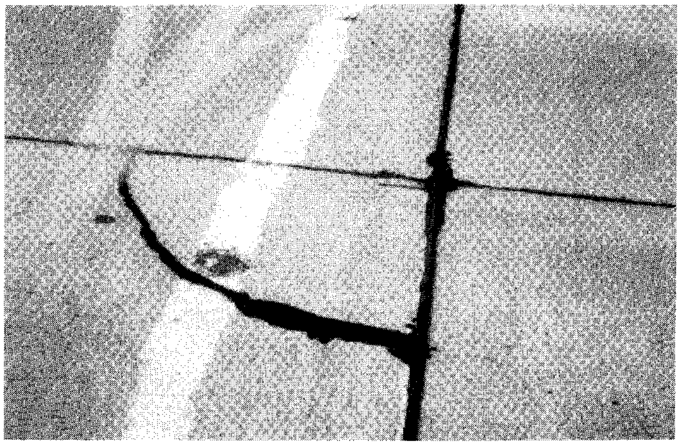


FIG. X2.5 Low-Severity Corner Break

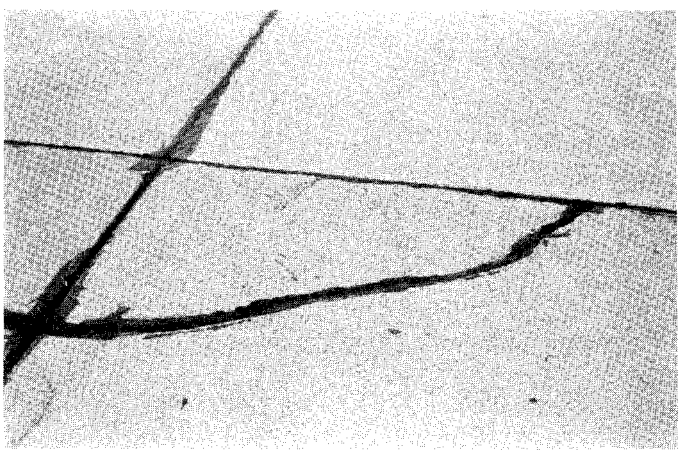


FIG. X2.6 Medium-Severity Corner Break (Area Between the Corner Break and the Joints is Lightly Cracked)

FIG. X2.7 Medium-Severity Corner Break

corner break. If it is less than 2 ft, unless you can verify the crack is vertical, call it a spall.

X2.4 *Longitudinal, Transverse, and Diagonal Cracks:*

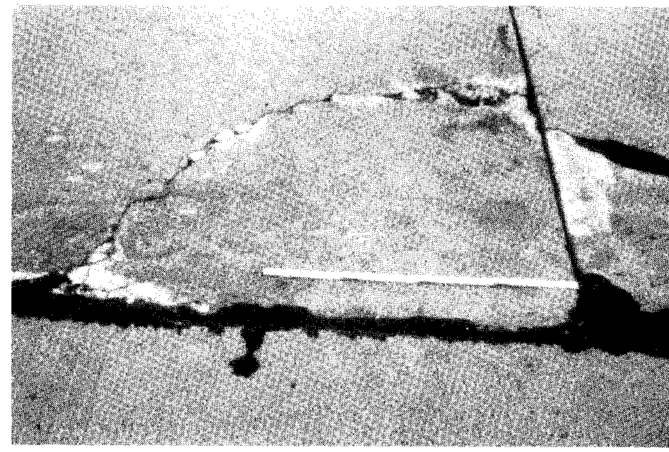


FIG. X2.8 High-Severity Corner Break

FIG. X2.9 Low-Severity Longitudinal Crack

X2.4.1 *Description*—These cracks, that 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 X2.13.) 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 X2.3—Hairline cracks that are only a few feet long and do not extend across the entire slab are rated as shrinkage cracks.

X2.4.2 *Severity Levels:*

X2.4.2.1 *L*—Crack has little or minor spalling (no FOD potential). If nonfilled, it has a mean width less than approximately ⅛ in. (3 mm). A filled crack can be of any width, but the filler material must be in satisfactory condition; or the slab is divided into three pieces by low-severity cracks (see Figs. X2.9-X2.11).

X2.4.2.2 *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 ⅛ and 1 in. (3 and 25 mm); (*3*) a filled crack is not spalled or only lightly spalled, but the filler is in unsatisfactory condition; or

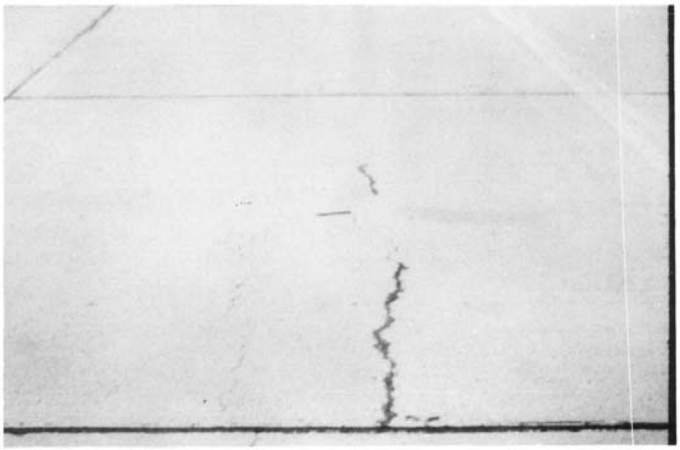


FIG. X2.10 Low-Severity Filled Longitudinal Cracks

FIG. X2.11 Low-Severity Diagonal Crack

FIG. X2.12 Medium-Severity Longitudinal Crack

FIG. X2.13 Medium-Severity Transverse Crack

(*4*) the slab is divided into three pieces by two or more cracks, one of which is at least medium severity (see Figs. X2.12-X2.14).

X2.4.2.3 *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 in. (25 mm), creating a tire damage potential; or (*3*) the slab is divided into three pieces by two or more cracks, one of which is at least high severity (see Figs. X2.15-X2.17).

X2.4.3 *How to Count:*

X2.4.3.1 Once the severity has been identified, the distress is recorded as one slab. If the slab is divided into four or more pieces by cracks, refer to the distress type given in X2.13.

X2.4.3.2 Cracks used to define and rate corner breaks, "D" cracks, patches, shrinkage cracks, and spalls are not recorded as L/T/D cracks.

X2.5 *Durability ("D") Cracking:*

X2.5.1 *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 ft (0.3 to 0.6 m) of the joint or crack.

X2.5.2 *Severity Levels:*

X2.5.2.1 *L*—"D" cracking is defined by hairline cracks occurring in a limited area of the slab, such as one or two corners or along one joint. Little or no disintegration has occurred. No FOD potential (see Fig. X2.18 and Fig. X2.19).

FIG. X2.14 Medium-Severity Transverse Crack

FIG. X2.15 High-Severity Crack

FIG. X2.16 High-Severity Longitudinal Cracks

FIG. X2.17 High-Severity Crack

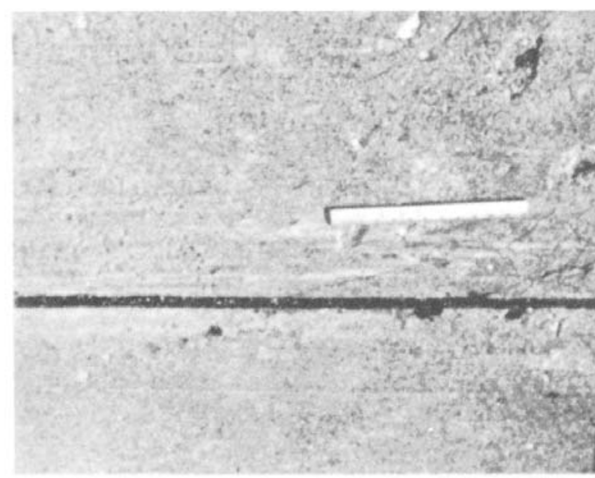


FIG. X2.18 Low-Severity "D" Cracking

NOTE 1—Slab is beginning to break up near corner.

FIG. X2.19 Low-Severity "D" Cracking Approaching Medium Severity

X2.5.2.2 *M*—"D" cracking has developed over a considerable amount of slab area with little or no disintegration or FOD potential; or "D" cracking has occurred in a limited area of the slab, such as one or two corners or along one joint, but pieces are missing and disintegration has occurred. Some FOD potential (see Fig. X2.20 and Fig. X2.21).

X2.5.2.3 *H*—"D" cracking has developed over a considerable amount of slab area with disintegration or FOD potential (see Fig. X2.22 and Fig. X2.23).

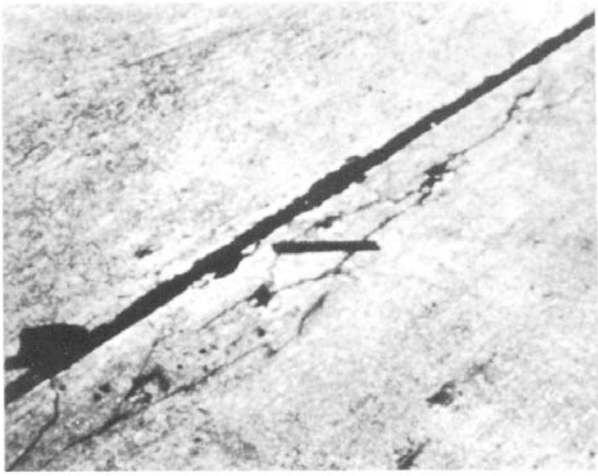


FIG. X2.20 Medium-Severity "D" Cracking

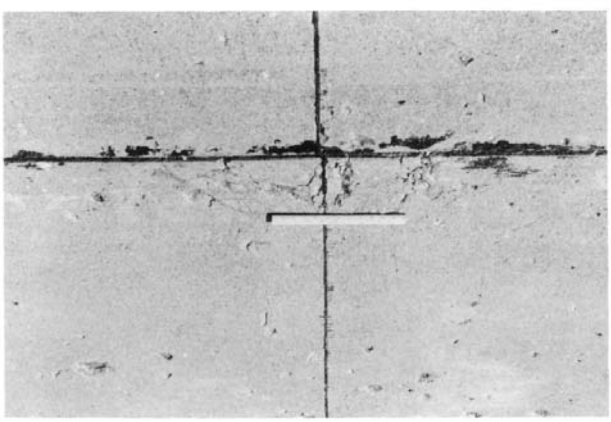
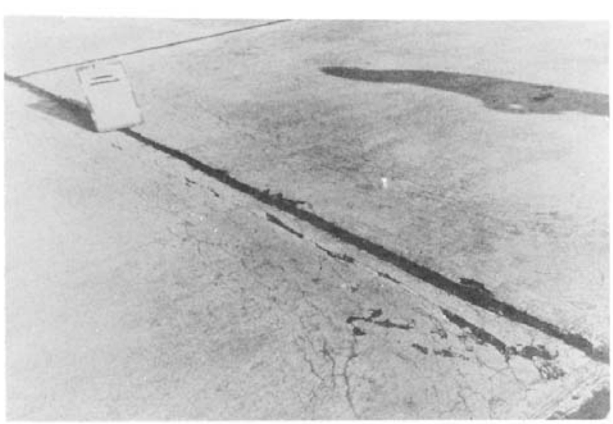


FIG. X2.21 Medium-Severity "D" Cracking Occurring in Limited Area of Slab



NOTE 1—The "D" cracking occurs over more than one joint with some disintegration.

FIG. X2.22 High-Severity "D" Cracking

X2.5.3 *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 low- and medium-durability cracking are located on one slab, the slab is counted as having medium only. If "D" cracking is counted, scaling on the same slab should not be recorded.

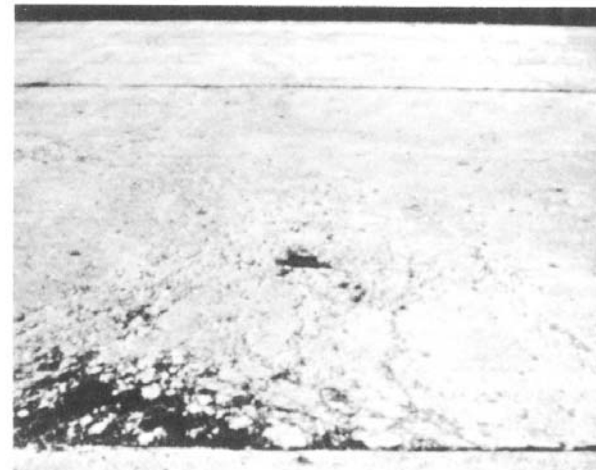


FIG. X2.23 High-Severity "D" Cracking

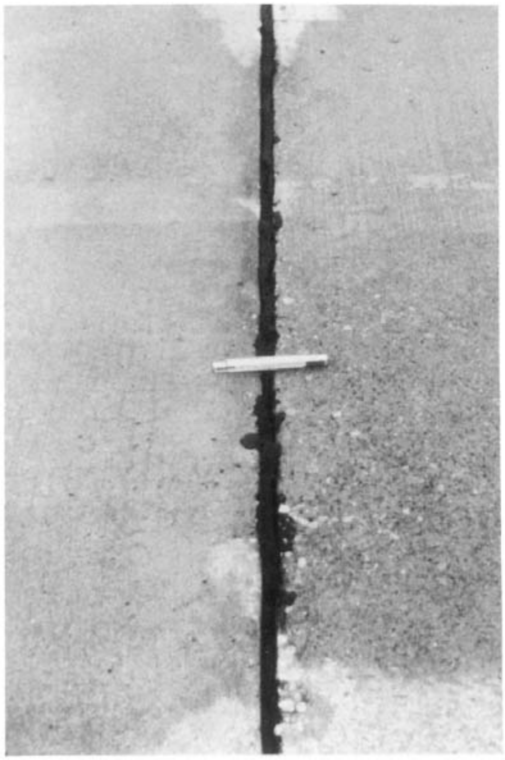
X2.6 *Joint Seal Damage:*

X2.6.1 *Description*—Joint seal damage is any condition that 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.

X2.6.2 *Severity Levels:*

X2.6.2.1 *L*—Joint sealer is in generally good condition throughout the sample. Sealant is performing well with only a minor amount of any of the above types of damage present (see Fig. X2.24). Joint seal damage is at low severity if a few of the joints have sealer which has debonded from, but is still in contact with, the joint edge. This condition exists if a knife blade can be inserted between sealer and joint face without resistance.

X2.6.2.2 *M*—Joint sealer is in generally fair condition over the entire surveyed sample with one or more of the above types of damage occurring to a moderate degree. Sealant needs replacement within two years (see Fig. X2.25). Joint seal damage is at medium severity if a few of the joints have any of the following conditions: (*1*) joint sealer is in place, but water access is possible through visible openings no more than ⅛ in. (3 mm) wide. If a knife blade cannot be inserted easily between sealer and joint face, this condition does not exist; (*2*) pumping debris are evident at the joint; (*3*) joint sealer is oxidized and "lifeless" but pliable (like a rope), and generally fills the joint opening; or (*4*) vegetation in the joint is obvious, but does not obscure the joint opening.



NOTE 1—This condition existed on only a few joints in the pavement section. If all joint sealant were as shown, it would have been rated medium.

FIG. X2.24 Low-Severity Joint Seal Damage

FIG. X2.25 Medium-Severity Joint Seal Damage (Note that Sealant has Lost Bond and is Highly Oxidized)

X2.6.2.3 *H*—Joint sealer is in generally poor condition over the entire surveyed sample with one or more of the above types of damage occurring to a severe degree. Sealant needs immediate replacement (see Fig. X2.26 and Fig. X2.27). Joint seal damage is at high severity if 10 % or more of the joint sealer exceeds limiting criteria listed above, or if 10 % or more of sealer is missing.

X2.6.3 *How to Count:*

X2.6.3.1 Joint seal damage is not counted on a slab-by-slab basis, but is rated based on the overall condition of the sealant in the sample unit.

X2.6.3.2 Joint sealer is in satisfactory condition if it prevents entry of water into the joint, it has some elasticity, and if there is no vegetation growing between the sealer and joint face.

X2.6.3.3 Premolded sealer is rated using the same criteria as above except as follows: (*1*) premolded sealer must be elastic and must be firmly pressed against the joint walls; and (*2*) premolded sealer must be below the joint edge. If it extends above the surface, it can be caught by moving equipment such as snow plows or brooms and be pulled out of the joint. Premolded sealer is recorded at low severity if any part is visible above joint edge. It is at medium severity if 10 % or more of the length is above joint edge or if any part is more than ½ in. (12 mm) above joint edge. It is at high severity if 20 % or more is above joint edge or if any part is more than 1 in. (25 mm) above joint edge, or if 10 % or more is missing.

X2.6.3.4 Rate joint sealer by joint segment. Sample unit rating is the same as the most severe rating held by at least 20 % of segments rated.

X2.6.3.5 Rate only the left and upstation joints along sample unit boundaries.

X2.6.3.6 In rating oxidation, do not rate on appearance. Rate on resilience. Some joint sealer will have a very dull surface, and may even show surface cracks in the oxidized layer. If the sealer is performing satisfactorily and has good characteristics beneath the surface, it is satisfactory.

X2.7 *Patching, Small (Less Than 5 ft^2 (0.5 m^2)):*

X2.7.1 *Description*—A patch is an area where the original pavement has been removed and replaced by a filler material.

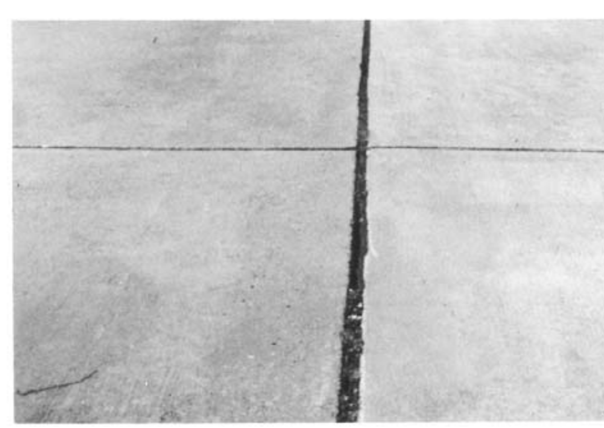


FIG. X2.26 High-Severity Joint Seal Damage (Complete Loss of Sealant; Joint is Filled with Incompressible Material)

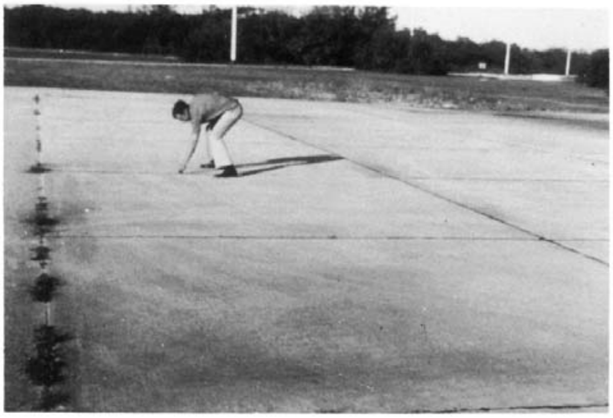


FIG. X2.27 High-Severity Joint Seal Damage (Extensive Amount of Weed Growth)

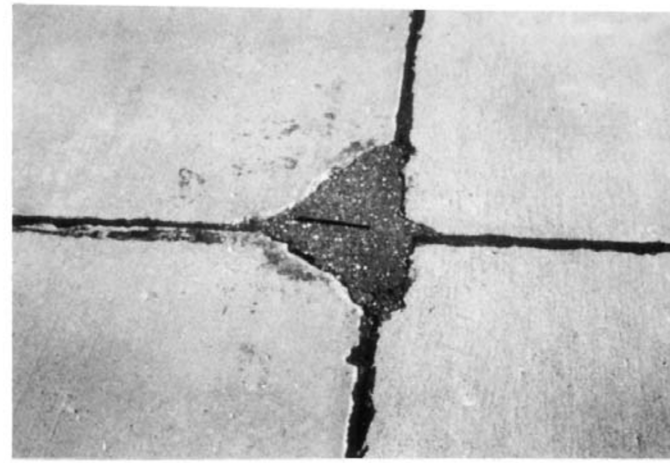


FIG. X2.29 Low-Severity Small Patch

FIG. X2.28 Low-Severity Small Patch

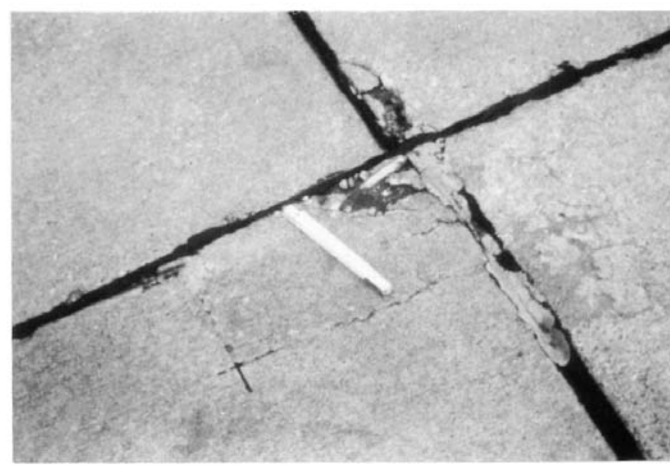


FIG. X2.30 Medium-Severity Small Patch

For condition evaluation, patching is divided into two types: small (less than 5 ft^2 (0.5 m^2)) and large (over 5 ft^2). Large patches are described in the next section.

X2.7.2 *Severity Levels:*

X2.7.2.1 *L*—Patch is functioning well with little or no deterioration (see Fig. X2.28 and Fig. X2.29).

X2.7.2.2 *M*—Patch that has deterioration or moderate spalling, or both, can be seen around the edges. Patch material can be dislodged with considerable effort (minor FOD potential) (see Fig. X2.30 and Fig. X2.31).

X2.7.2.3 *H*—Patch deterioration, either by spalling around the patch or cracking within the patch, to a state that warrants replacement (see Fig. X2.32).

X2.7.3 *How to Count:*

X2.7.3.1 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.

X2.7.3.2 If a crack is repaired by a narrow patch (that is, 4 to 10 in. (102 to 254 mm) wide), only the crack and not the patch should be recorded at the appropriate severity level.

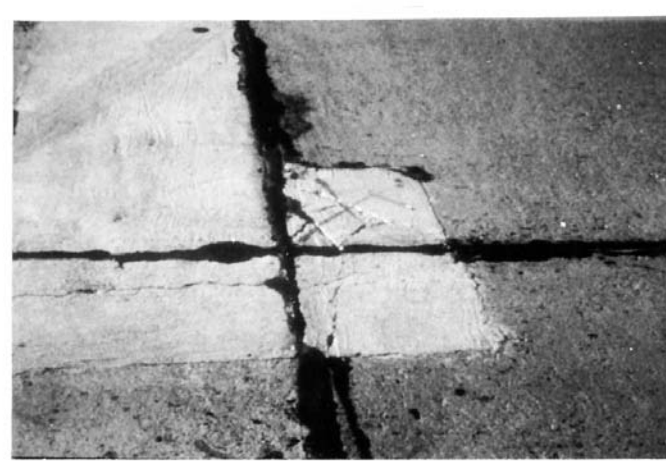


FIG. X2.31 Medium-Severity Small Patch

X2.8 *Patching, Large (Over 5 ft^2 (0.5 m^2)) and Utility Cut:*

X2.8.1 *Description*—Patching is the same as defined in the previous section. A utility cut is a patch that has replaced the

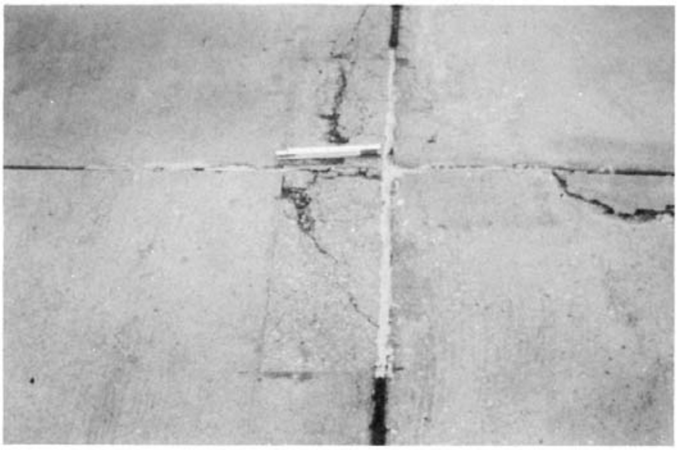


FIG. X2.32 High-Severity Small Patch

original pavement because of placement of underground utilities. The severity levels of a utility cut are the same as those for regular patching.

X2.8.2 *Severity Levels:*

X2.8.2.1 *L*—Patch is functioning well with very little or no deterioration (see Figs. X2.33-X2.35).

X2.8.2.2 *M*—Patch deterioration or moderate spalling, or both, can be seen around the edges. Patch material can be dislodged with considerable effort, causing some FOD potential (see Fig. X2.36).

X2.8.2.3 *H*—Patch has deteriorated to a state that causes considerable roughness or high FOD potential, or both. The extent of the deterioration warrants replacement of the patch (see Fig. X2.37).

X2.8.3 *How to Count*—The criteria are the same as for small patches.

X2.9 *Popouts:*

X2.9.1 *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

FIG. X2.33 Low-Severity Patch

FIG. X2.34 Low-Severity Patch

FIG. X2.35 Low-Severity Utility Cut

FIG. X2.36 Medium-Severity Utility Cut

from approximately 1 to 4 in. (25 to 100 mm) in diameter and from ½ to 2 in. (13 to 51 mm) deep.

X2.9.2 *Severity Levels*—No degrees of severity are defined for popouts. However, popouts must be extensive before they

FIG. X2.37 High-Severity Patch

FIG. X2.38 Popouts

are counted as a distress; that is, average popout density must exceed approximately three popouts per square yard (per square metre) over the entire slab area (see Fig. X2.38).

X2.9.3 *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 (per square metre), at least three random 1-yd^2 (1-m^2) areas should be checked. When the average is greater than this density, the slab is counted.

X2.10 *Pumping:*

X2.10.1 *Description*—Pumping is the ejection of material by water through joints or cracks caused by deflection of the slab under passing loads. As 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. The joint seal must be identified as defective before pumping can be said to exist. Pumping can occur at cracks as well as joints.

X2.10.2 *Severity Levels*—No degrees of severity are defined. It is sufficient to indicate that pumping exists (see Figs. X2.39-X2.42).

X2.10.3 *How to Count*—Slabs are counted as follows: (see Fig. X2.43) 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.

X2.11 *Scaling:*

X2.11.1 *Description*—Surface deterioration caused by construction defects, material defects and environmental factors. Generally scaling is exhibited by delamination or disintegration of paste on the slab surface to the depth of the defect. Construction defects include: over-finishing, addition of water to the pavement surface during finishing, lack of curing, attempted surface repairs of fresh concrete with mortar. Generally this occurs over a portion of a slab. Material defects include: inadequate air entrainment for the climate. Generally this occurs over several slabs that were affected by the concrete batches. Environmental factors: freezing of concrete before adequate strength gained or thermal cycles from certain aircraft. Generally over a large area for freezing, and isolated areas for thermal effects. Typically, the FOD from scaling is removed by sweeping, but the concrete will continue to scale until the affected depth is removed or expended.

X2.11.2 *Severity Levels:*

X2.11.2.1 *L*—Minimal loss of surface paste that poses no FOD hazard, limited to less than 1% of the slab area. No FOD potential (see Fig. X2.44).

X2.11.2.2 *M*—The loss of surface paste that poses some FOD potential including isolated fragments of loose mortar, exposure of the sides of coarse aggregate (Less than ¼ of the width of coarse aggregate), or evidence of coarse aggregate coming loose from the surface (see Fig. X2.45). Surface paste loss is greater than 1% of the slab area but less than 10%.

X2.11.2.3 *H*—High severity is associated with low durability concrete that will continue to pose a high FOD hazard; normally the layer of surface mortar is observable at the perimeter of the scaled area, and is likely to continue to

FIG. X2.39 Pumping (Note Fine Material on Surface That has Been Pumped Out Causing Corner Break)

FIG. X2.40 Pumping (Note Stains on Pavement)

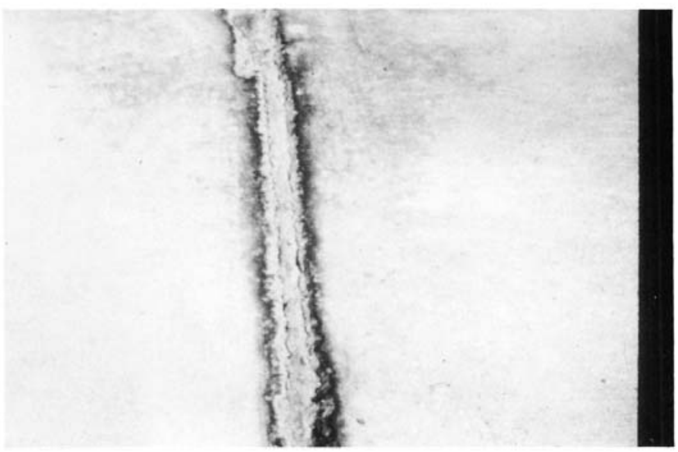


FIG. X2.41 Pumping (Close-Up of Fine Materials Collecting in the Joint)

FIG. X2.42 Pumping

delaminate or disintegrate due to environmental or other factors. Routine sweeping is not sufficient to avoid FOD issues, is an indication that high FOD hazard is present. Surface paste loss is greater than 10% of the slab area (see Figs. X2.46 and X2.47).

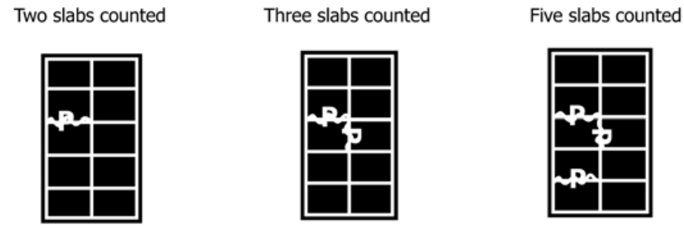


FIG. X2.43 Slab Counting Procedure for Distresses

FIG. X2.44 Low-Severity Scaling

FIG. X2.45 Medium-Severity Scaling

X2.11.3 *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. If "D" cracking is counted, scaling is not counted.

X2.12 *Settlement or Faulting:*

X2.12.1 *Description*—Settlement or faulting is a difference of elevation at a joint or crack caused by upheaval or consolidation.

FIG. X2.46 High-Severity Scaling

FIG. X2.47 Close-Up of High-Severity Scaling

X2.12.2 *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	Figures
L	< ¼ in. (6 mm)	⅛ < ½ in. (3 to 13 mm)	Fig. X2.48 and Fig. X2.49
M	¼ to ½ in. (6 to 13 mm)	½ to 1 in. (13 to 25 mm)	Fig. X2.50
H	> ½ in. (13 mm)	> 1 in. (25 mm)	Fig. X2.51 and Fig. X2.52

X2.12.3 *How to Count:*

X2.12.3.1 In counting settlement, a fault between two slabs is counted as one slab. A straightedge or level should be used to aid in measuring the difference in elevation between the two slabs.

X2.12.3.2 Construction-induced elevation differential is not rated in PCI procedures. Where construction differential exists, it can often be identified by the way the high side of the joint was rolled down by finishers (usually within 6 in. (150 mm) of the joint) to meet the low-slab elevation.

X2.13 *Shattered Slab/Intersecting Cracks:*

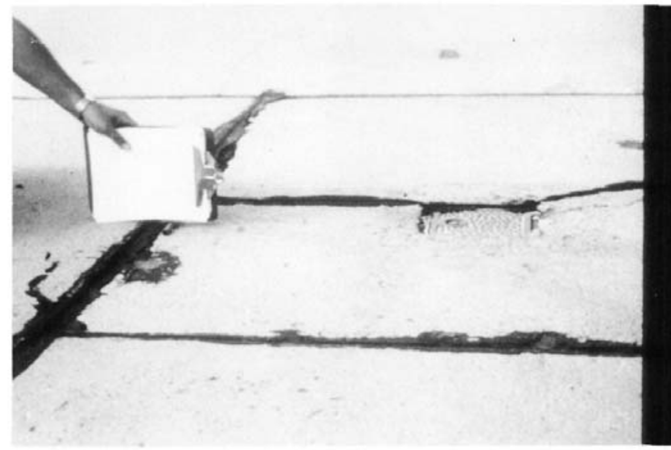


FIG. X2.48 Low-Severity Settlement (⅜ in. (9 mm)) on Apron

FIG. X2.49 Low-Severity Settlement on Apron

FIG. X2.50 Medium-Severity Settlement on Apron (>½ in. (13 mm))

X2.13.1 *Description*—Intersecting cracks are cracks that break the slab into four or more pieces due to overloading or inadequate support, or both. The high-severity level of this distress type, as defined as follows, is referred to as shattered

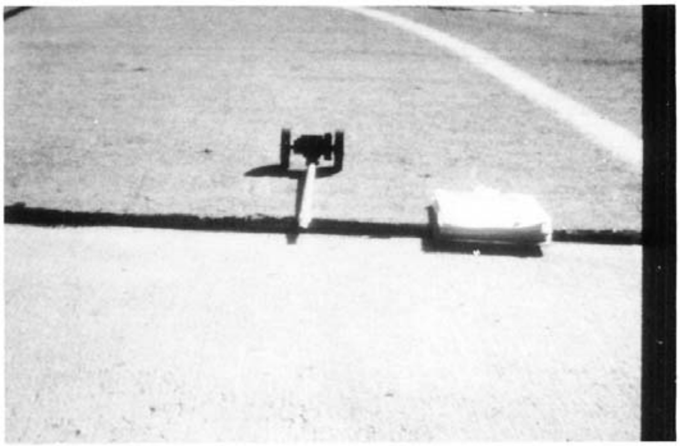


FIG. X2.51 High-Severity Settlement on Taxiway/Runway (3⁄4 in. (18 mm))

FIG. X2.52 High-Severity Settlement

slab. If all pieces or cracks are contained within a corner break, the distress is categorized as a severe corner break.

X2.13.2 *Severity Levels:*

X2.13.2.1 *L*—Slab is broken into four or five pieces predominantly defined by low-severity cracks (see Fig. X2.53 and Fig. X2.54).

X2.13.2.2 *M*—Slab is broken into four or five pieces with over 15 % of the cracks of medium severity (no high-severity cracks); slab is broken into six or more pieces with over 85 % of the cracks of low severity (see Fig. X2.55 and Fig. X2.56).

X2.13.2.3 *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; or (*2*) slab is broken into six or more pieces with over 15 % of the cracks of medium or high severity (see Fig. X2.57).

X2.13.3 *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 substantially. Shrinkage cracks should not be counted in determining whether or not the slab is broken into four or more pieces.

X2.14 *Shrinkage Cracking:*

X2.14.1 *Description*—Shrinkage cracking is typically categorized in two forms; drying shrinkage that occurs over time as moisture leaves the pavement and plastic shrinkage that occurs shortly after the pavement is placed and rapid drying of the surface occurs while the pavement is still plastic. Drying shrinkage cracks occur when a hardened pavement continues to shrink as excess water not needed for cement hydration evaporates. They form when subsurface resistance to the shrinkage is present and may extend through the entire depth of the slab. Plastic shrinkage occurs when there is a rapid loss of water in the surface of a recently placed pavement caused by evaporation. High winds, low humidity, and/or high ambient and/or concrete temperatures are contributing factors to evaporation. These cracks can appear as a series of parallel cracks, usually 1 to 3 feet (.3 to .9 meters) apart and do not extend very deep into the pavement's surface. Another form of plastic shrinkage occurs while a pavement is still plastic and can result from overfinishing/overworking the pavement during construction or finishing the pavement while bleed water is on the surface. This results in an increase in mortar and fines and higher water content at the surface, making the immediate surface weak and susceptible to shrinkage. These shrinkage

FIG. X2.53 Low-Severity Intersecting Cracks

FIG. X2.54 Low-Severity Intersecting Cracks

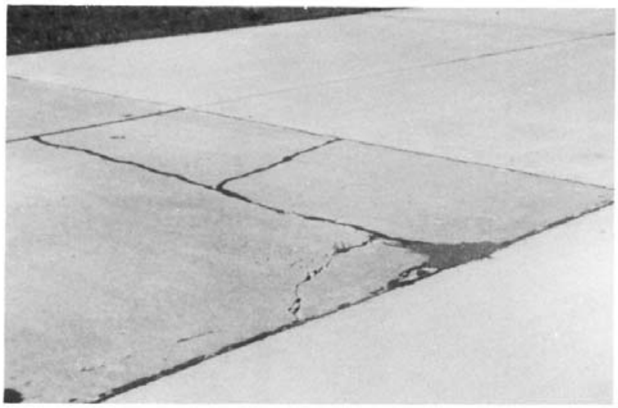


FIG. X2.55 Medium-Severity Intersecting Cracks

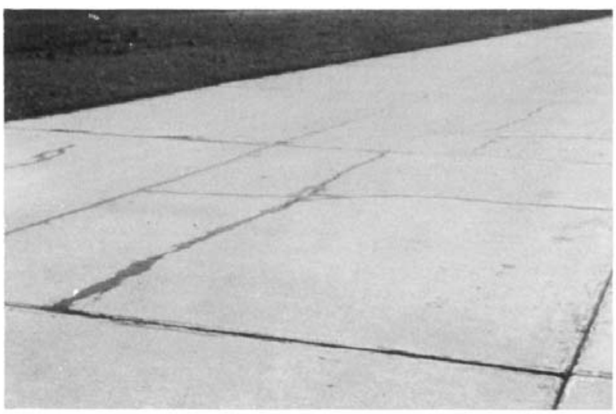


FIG. X2.56 Medium-Severity Intersecting Cracks

FIG. X2.57 Shattered Slab

cracks appear as a series of inter-connected hairline cracks, or pattern cracking, and are often observed over a majority of the slab surface. This condition is also referred to as map cracking or crazing.

X2.14.2 *Severity Levels*—No degrees of severity are defined. It is sufficient to indicate that shrinkage cracking exists (see Figs. X2.58-X2.60).

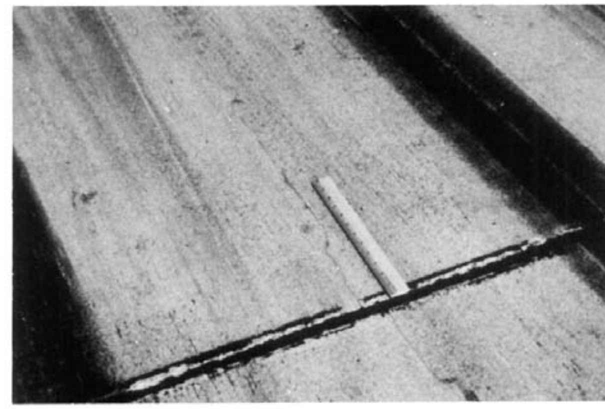


FIG. X2.58 Shrinkage Crack

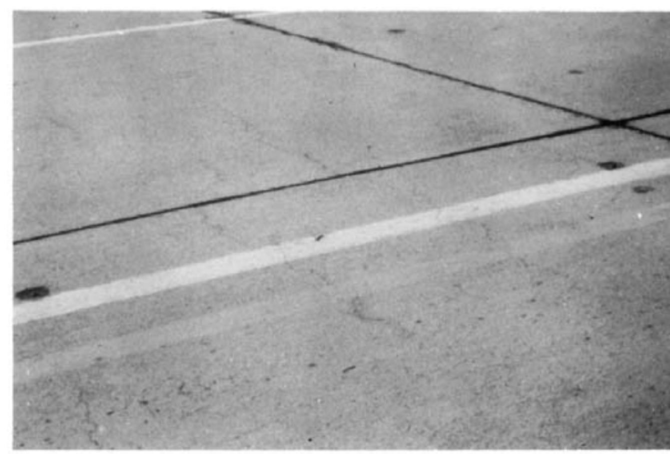


FIG. X2.59 Shrinkage Cracks

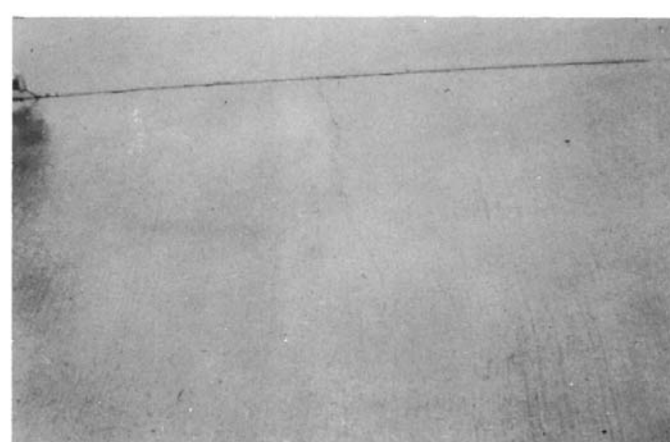


FIG. X2.60 Shrinkage Cracks

X2.14.3 *How to Count*—If one or more shrinkage cracks or area of pattern cracking (map cracking) exist on one particular slab, and a FOD hazard or potential is not present, the slab is counted as one slab with shrinkage cracking.

X2.15 *Spalling (Transverse and Longitudinal Joint):*

X2.15.1 *Description*—Joint spalling is the breakdown of the slab edges within 2 ft (0.6 m) 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.

NOTE X2.4—Frayed condition as used in this test method indicates material is no longer in place along a joint or crack. Spalling indicates material may or may not be missing along a joint or crack.

X2.15.2 *Severity Levels:*

X2.15.2.1 *L*—Spall over 2 ft (0.6 m) 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 (see Fig. X2.61 and Fig. X2.62). Spall less than 2 ft long is broken into pieces or fragmented with little FOD or tire damage potential exists (see Fig. X2.63).

X2.15.2.2 Lightly frayed means the upper edge of the joint is broken away leaving a spall no wider than 1 in. (25 mm) and no deeper than ½ in. (13 mm). The material is missing and the joint creates little or no FOD potential.

X2.15.2.3 *M*—Spall over 2 ft (0.6 m) 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 (see Fig. X2.64). Spall less than 2 ft long: spall is broken into pieces or fragmented with some of the pieces loose or absent, causing considerable FOD or tire damage potential (see Fig. X2.65).

X2.15.2.4 Moderately frayed means the upper edge of the joint is broken away leaving a spall wider than 1 in. (25 mm) or deeper than ½ in. (13 mm). The material is mostly missing with some FOD potential.

X2.15.2.5 *H*—Spall over 2 ft (0.6 m) long: (*1*) spall is broken into more than three pieces defined by one or more

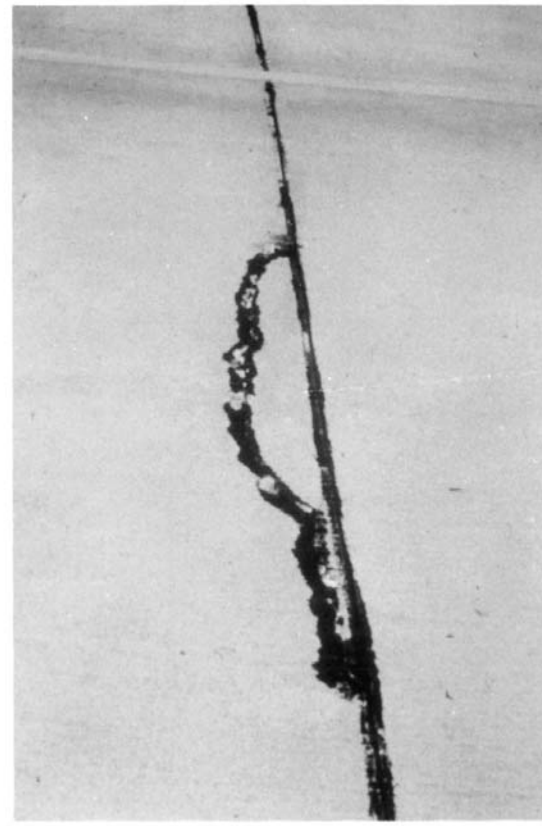


FIG. X2.62 Low-Severity Joint Spall

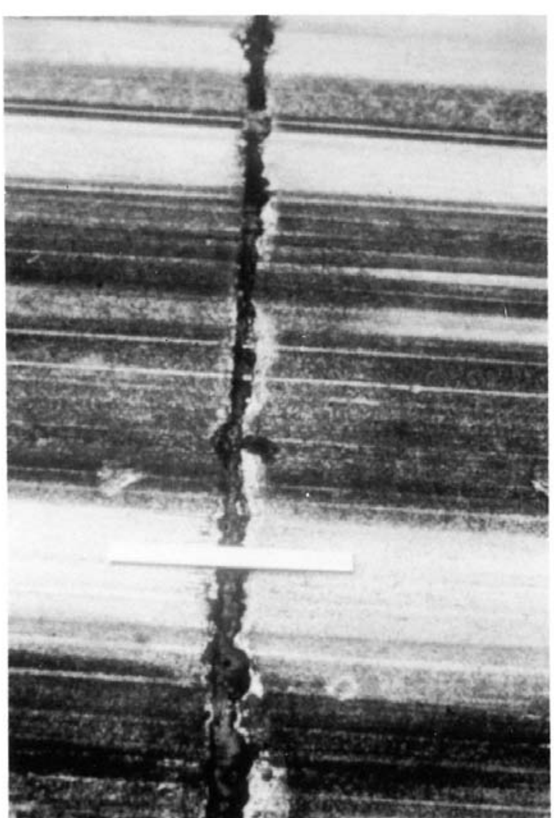


FIG. X2.61 Low-Severity Joint Spalling (If the Frayed Area was Less Than 2 ft (0.6 m) Long it Would not be Counted)

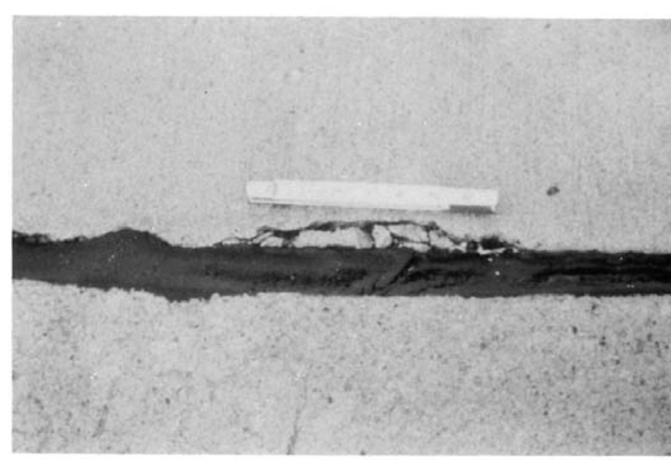


FIG. X2.63 Low-Severity Joint Spall

FIG. X2.64 Medium-Severity Joint Spall

FIG. X2.65 Medium-Severity Joint Spall

high-severity cracks with high FOD potential and high possibility of the pieces becoming dislodged, or (*2*) joint is severely frayed with high FOD potential (see Fig. X2.66 and Fig. X2.67).

FIG. X2.66 High-Severity Joint Spall

FIG. X2.67 High-Severity Joint Spall

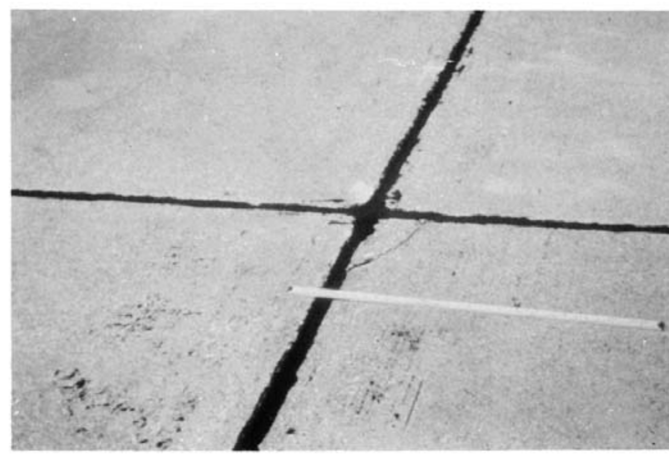


FIG. X2.68 Low-Severity Corner Spall

X2.15.3 *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. If a joint spall is small enough, less than 3 in. (76 mm) wide, to be filled during a joint seal repair, it should not be recorded.

NOTE X2.5—If less than 2 ft (0.6 m) of the joint is lightly frayed, the spall should not be counted.

X2.16 *Spalling (Corner):*

X2.16.1 *Description*—Corner spalling is the raveling or breakdown of the slab within approximately 2 ft (0.6 m) of the corner. A corner spall differs from a corner break in that the spall usually angles downward to intersect the joint, while a break extends vertically through the slab.

X2.16.2 *Severity Levels:*

X2.16.2.1 *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) (see Fig. X2.68 and Fig. X2.69).

X2.16.2.2 *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 (see Fig. X2.70 and Fig. X2.71).

X2.16.2.3 *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 (see Fig. X2.72 and Fig. X2.73).

X2.16.3 *How to Count:*

X2.16.3.1 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.

X2.16.3.2 A corner spall smaller than 3 in. (76 mm) wide, measured from the edge of the slab, and filled with sealant is not recorded.

X2.17 *Alkali Silica Reaction (ASR)*

X2.17.1 *Description*—ASR is caused by chemical reaction between alkalis and certain reactive silica minerals which form a gel. The gel absorbs water, causing expansion which may damage the concrete and adjacent structures. Alkalis are most often introduced by the portland cement within the pavement. ASR cracking may be accelerated by chemical pavement deicers. Visual indicators that ASR may be present include:

(1) Cracking of the concrete pavement (often in a map pattern)

(2) White, brown, gray or other colored gel or staining may be present at the crack surface

(3) Aggregate popouts

FIG. X2.69 Low-Severity Corner Spall

FIG. X2.70 Medium-Severity Corner Spall

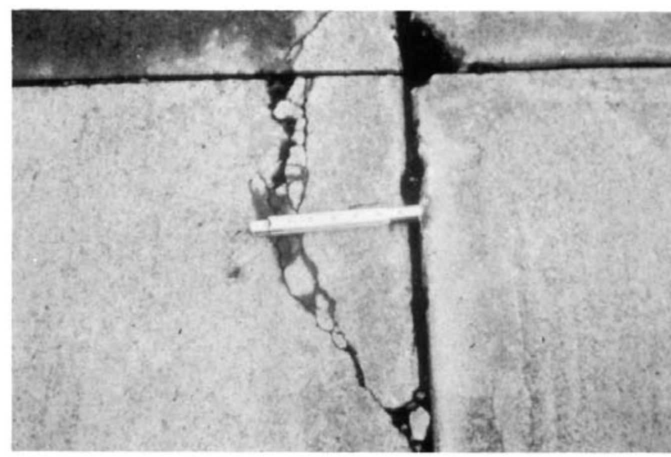


FIG. X2.71 Medium-Severity Corner Spall

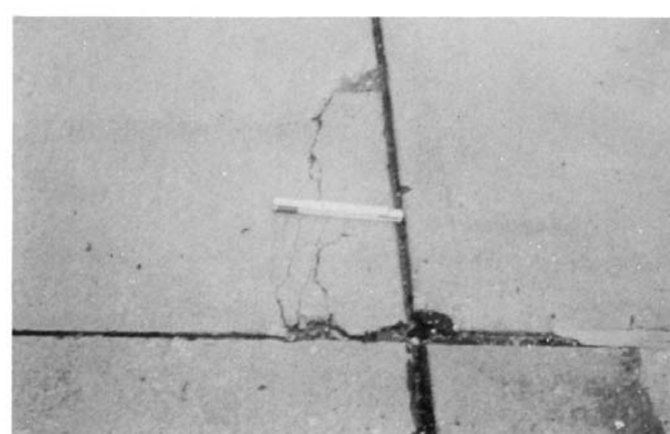


FIG. X2.72 High-Severity Corner Spall

(4) Increase in concrete volume (expansion) that may result in distortion of adjacent or integral structures or physical elements. Examples of expansion include shoving of asphalt pavements, light can tilting, slab faulting, joint misalignment, and extrusion of joint seals or expansion joint fillers.

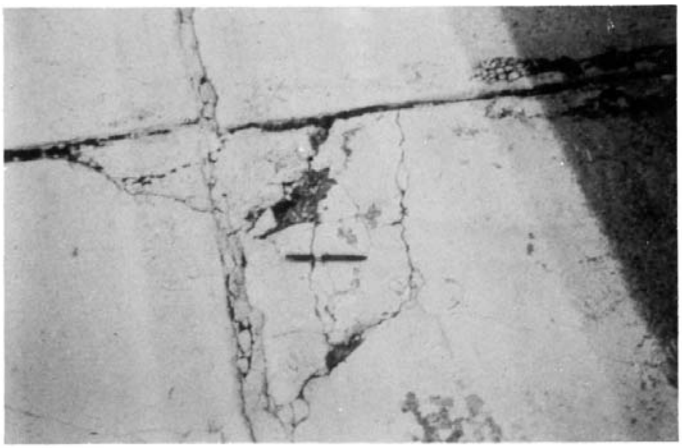


FIG. X2.73 High-Severity Corner Spall

Because ASR is material-dependent, ASR is generally present throughout the pavement section. Coring and concrete petrographic analysis is the only definitive method to confirm the presence of ASR. The following should be kept in mind when identifying the presence of ASR through visual inspection:

(1) Generally ASR distresses are not observed in the first few years after construction. In contrast, plastic shrinkage cracking can occur the day of construction and is apparent within the first year.

(2) ASR is differentiated from D-Cracking by the presence of cracking perpendicular to the joint face. D-Cracking predominantly develops as a series of parallel cracks to joint faces and linear cracking within the slab.

(3) ASR is differentiated from Map Cracking/Scaling by the presence of visual signs of expansion.

X2.17.2 *Severity Levels:*

X2.17.2.1 *L*—Minimal to no FOD potential from cracks, joints or ASR-related popouts; cracks at the surface are tight (predominantly 1.0 mm or less). Little to no evidence of movement in pavement or surrounding structures or elements (see Fig. X2.74).

X2.17.2.2 *M*—Some FOD potential; but increased sweeping or other FOD removal methods may be required. May be evidence of slab movement or some damage (or both) to adjacent structures or elements. Medium ASR distress is differentiated from low by having one or more of the following: increased FOD potential, crack density increases, some fragments along cracks or at crack intersections present, surface popouts of concrete may occur, pattern of wider cracks (predominantly 1.0 mm or wider) that may be subdivided by tighter cracks (see Fig. X2.75).

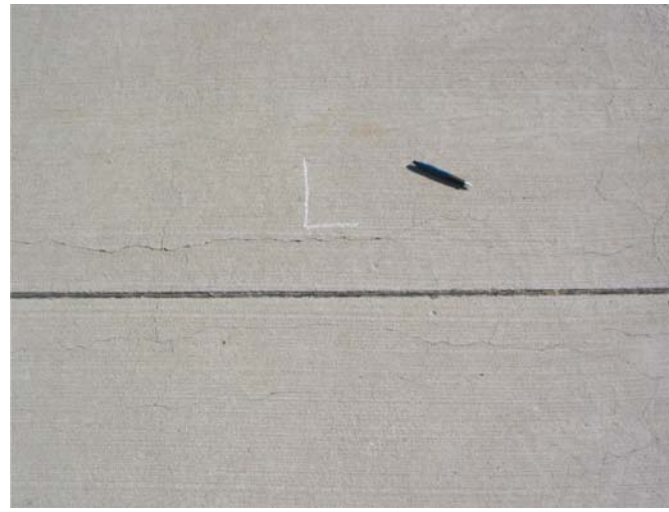


FIG. X2.74 Low-Severity ASR

X2.17.2.3 *H*—One or both of the following exist: (*1*) Loose or missing concrete fragments and poses high FOD potential, (*2*) Slab surface integrity and function significantly degraded and pavement requires immediate repairs; may also require repairs to adjacent structures or elements (see Fig. X2.76).

X2.17.3 *How to Count*—No other distresses should be recorded if high severity ASR is recorded.

FIG. X2.75 Medium-Severity ASR

FIG. X2.76 High-Severity ASR

X3. AC PAVEMENT DEDUCT CURVES

X3.1 See Figs. X3.1-X3.20.

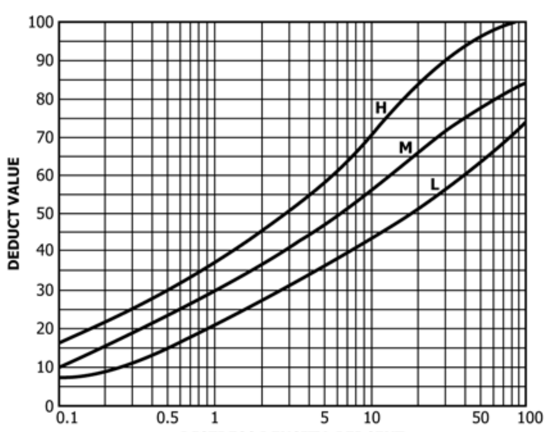


FIG. X3.1 Distress 1, Alligator Cracking

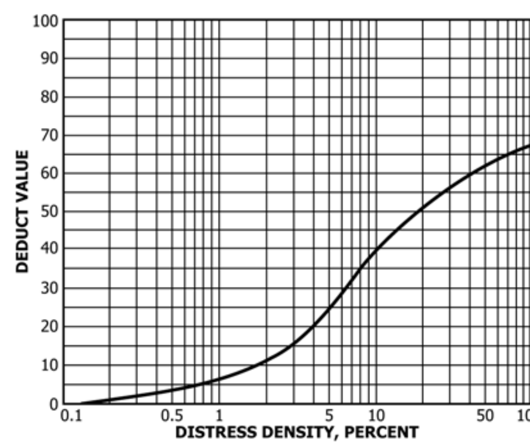


FIG. X3.2 Distress 2, Bleeding

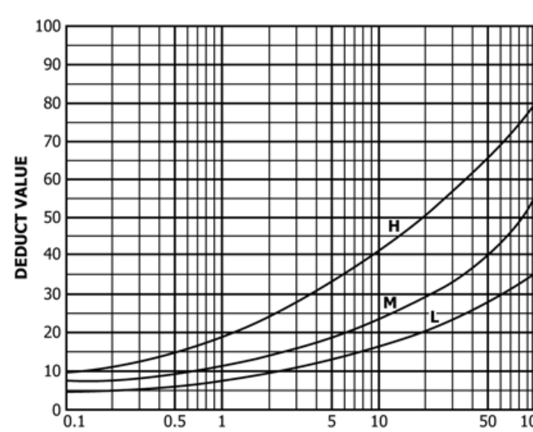


FIG. X3.3 Distress 3, Block Cracking

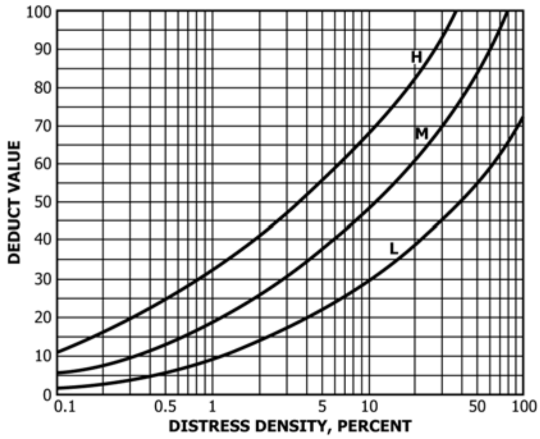


FIG. X3.4 Distress 4, Corrugation

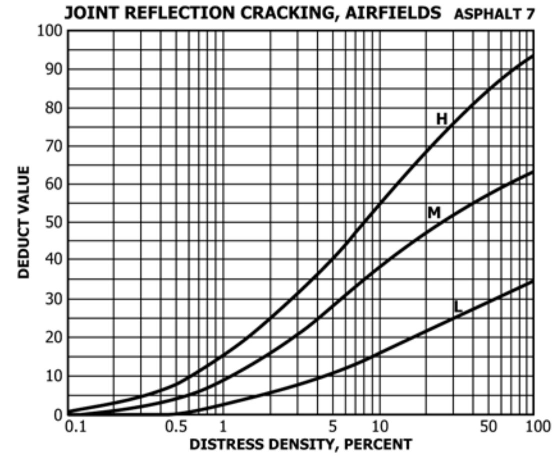


FIG. X3.7 Joint Reflection Cracking

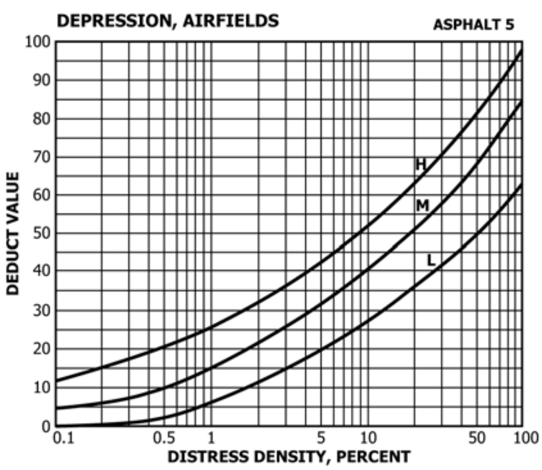


FIG. X3.5 Depression

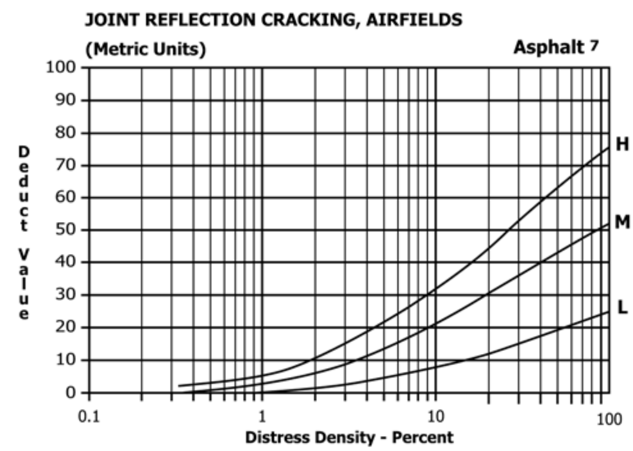


FIG. X3.8 Joint Reflection Cracking (Metric)

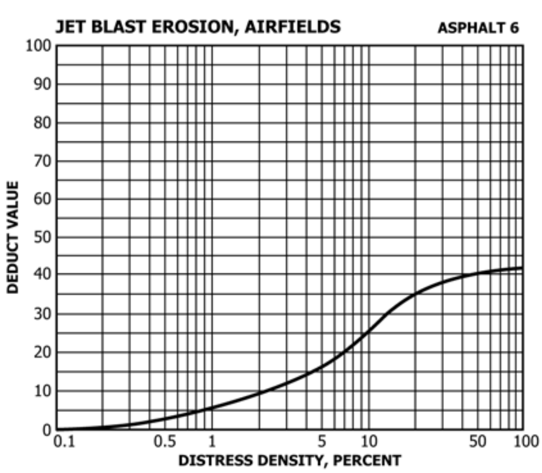


FIG. X3.6 Jet Blast

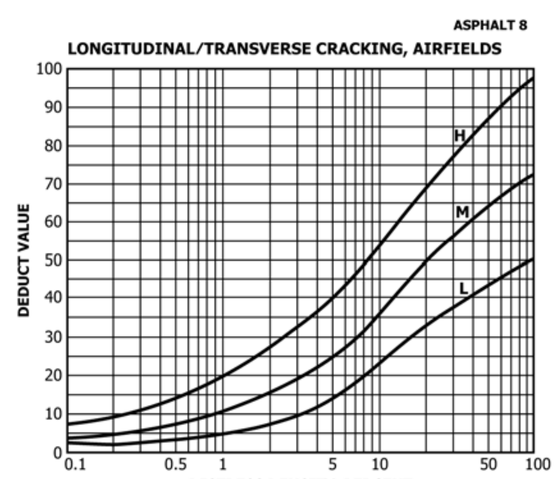


FIG. X3.9 Longitudinal/Transverse Cracking

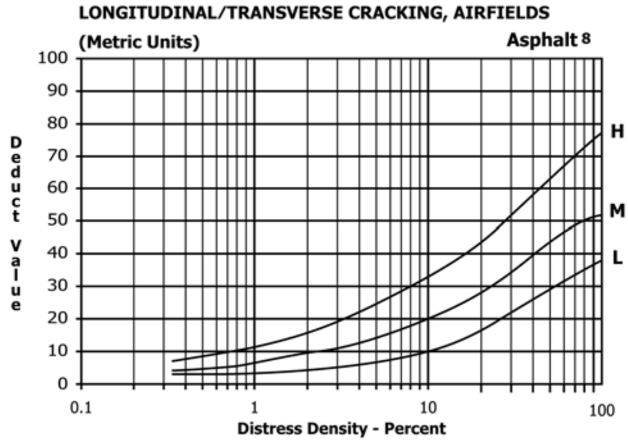


FIG. X3.10 Longitudinal/Transverse Cracking (Metric)

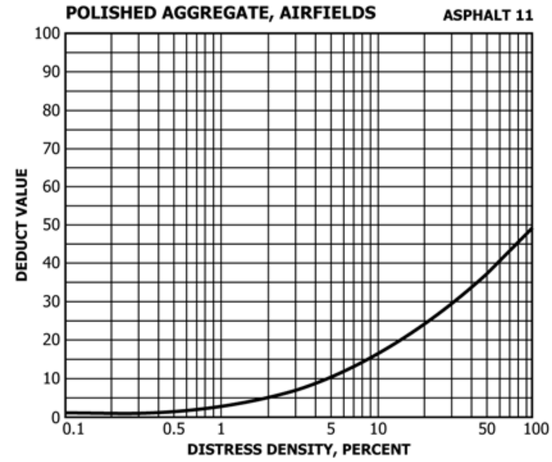


FIG. X3.13 Polished Aggregate

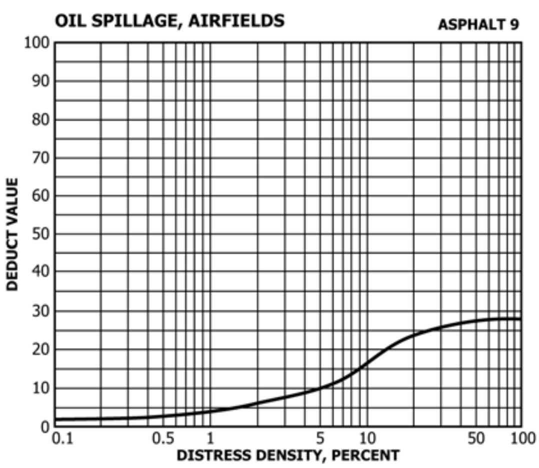


FIG. X3.11 Oil Spillage

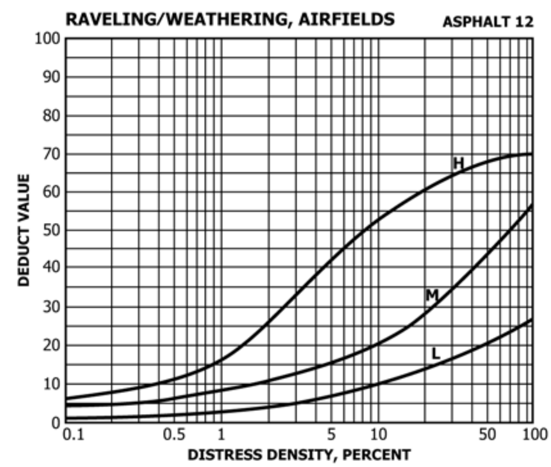


FIG. X3.14 Weathering/Raveling

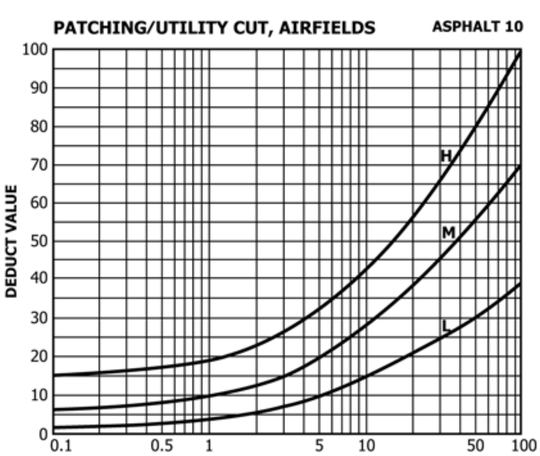


FIG. X3.12 Patching

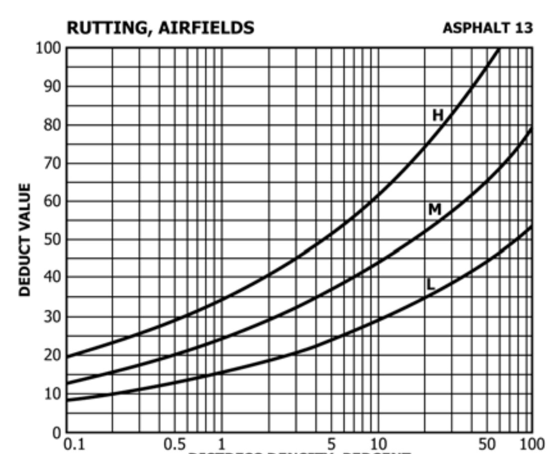


FIG. X3.15 Rutting

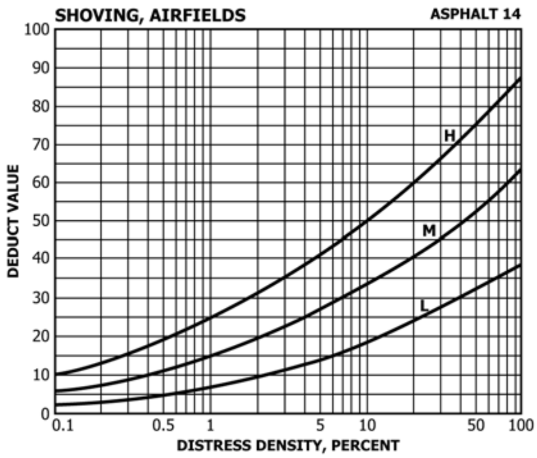


FIG. X3.16 Shoving

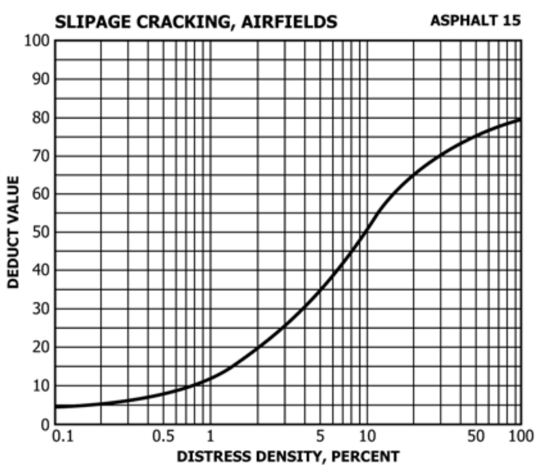


FIG. X3.17 Slippage Cracking

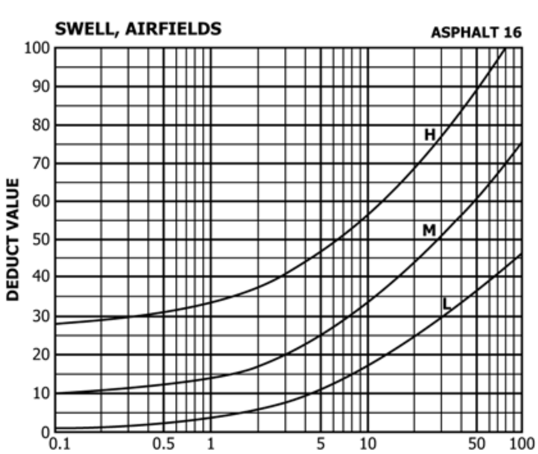


FIG. X3.18 Swelling

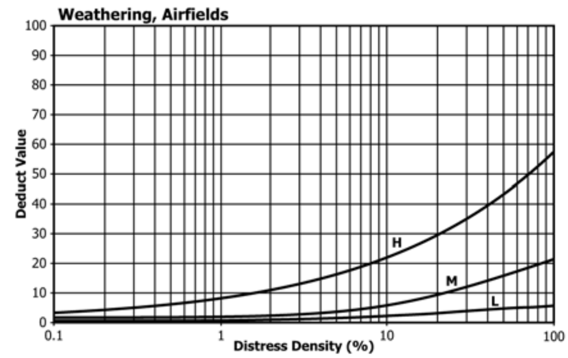


FIG. X3.19 Weathering

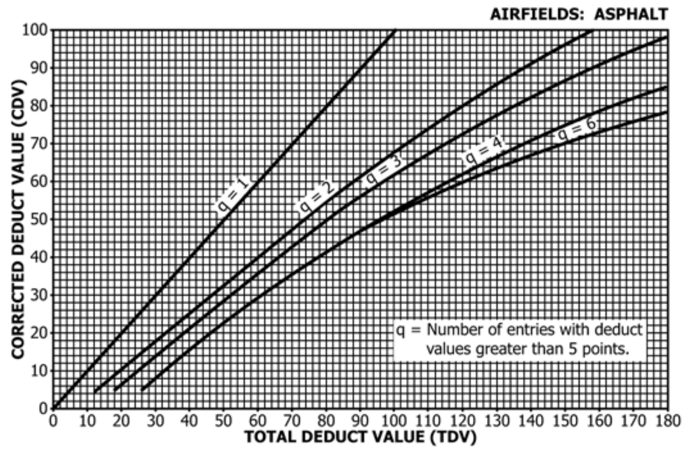


FIG. X3.20 Corrected DVs for Flexible Airfield Pavement

X4. PCC PAVEMENT DEDUCT CURVES

X4.1 See Figs. X4.1-X4.17.

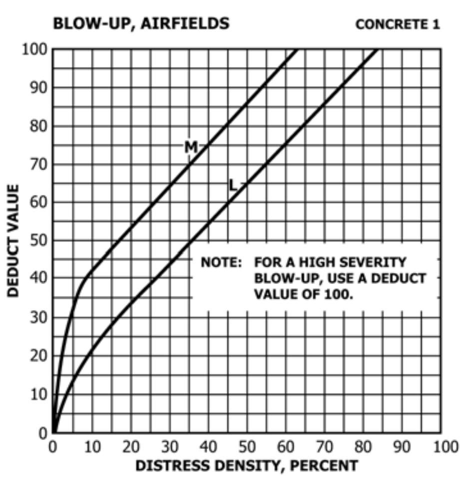


FIG. X4.1 Blowup

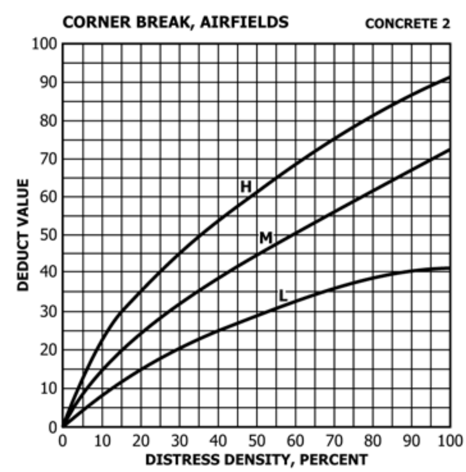


FIG. X4.2 Corner Break

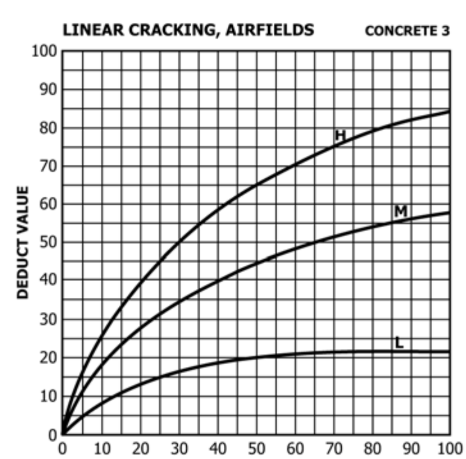


FIG. X4.3 Linear Cracking

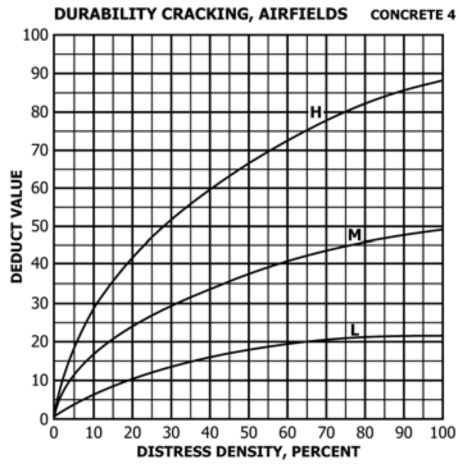


FIG. X4.4 Durability Cracking

JOINT SEAL DAMAGE **CONCRETE 5**

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

FIG. X4.5 Joint Seal Damage

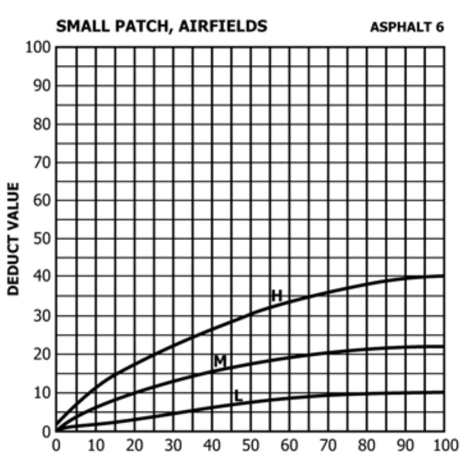


FIG. X4.6 Small Patch

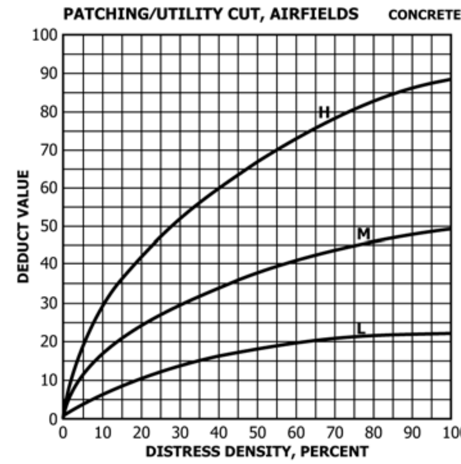


FIG. X4.7 Patching/Utility Cut

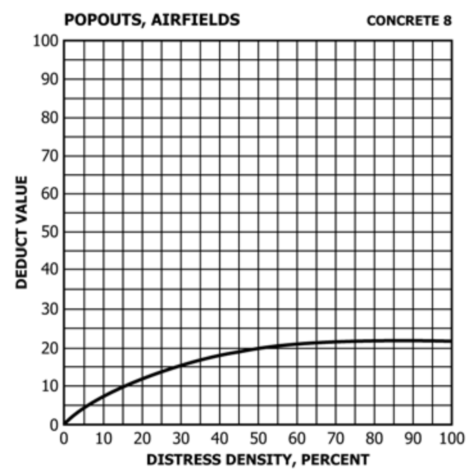


FIG. X4.8 Popouts

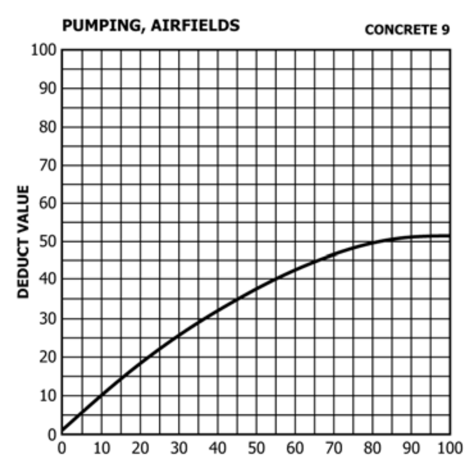


FIG. X4.9 Pumping

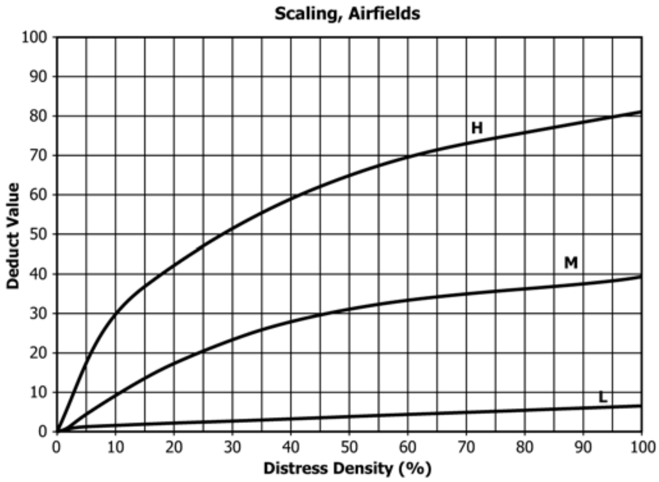


FIG. X4.10 Scaling/Crazing

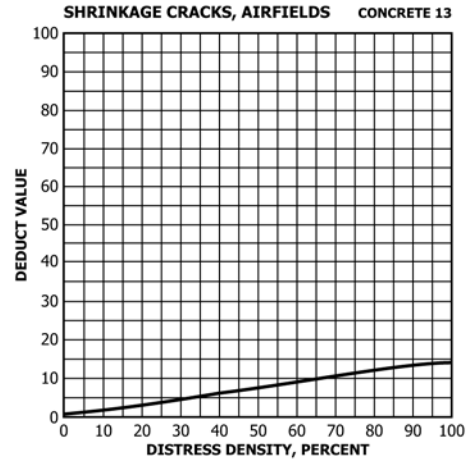


FIG. X4.13 Shrinkage Cracking

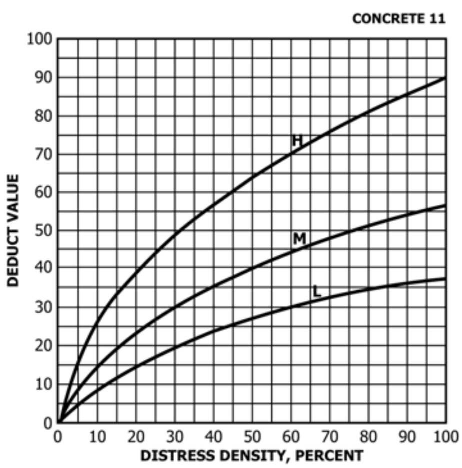


FIG. X4.11 Faulting

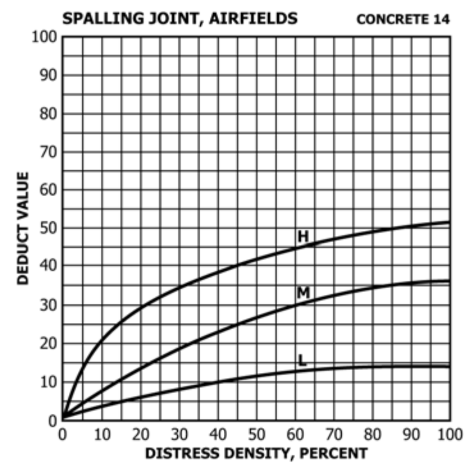


FIG. X4.14 Joint Spalling

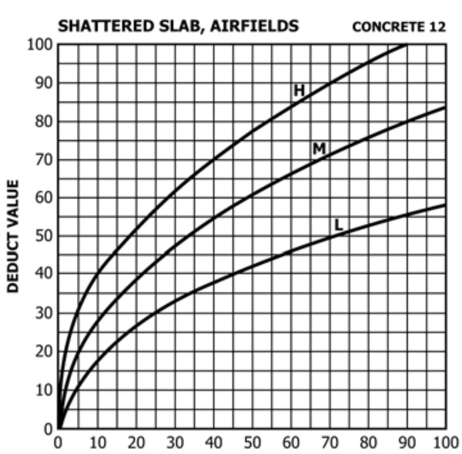


FIG. X4.12 Shattered Slab

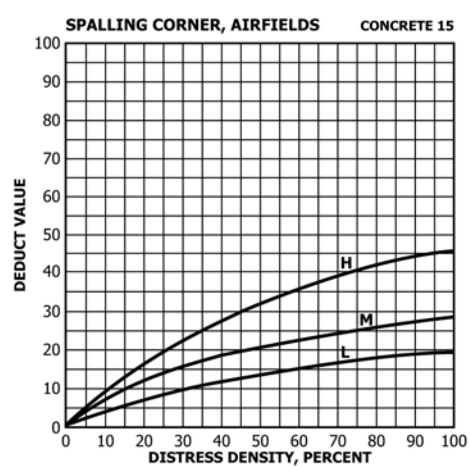


FIG. X4.15 Corner Spalling

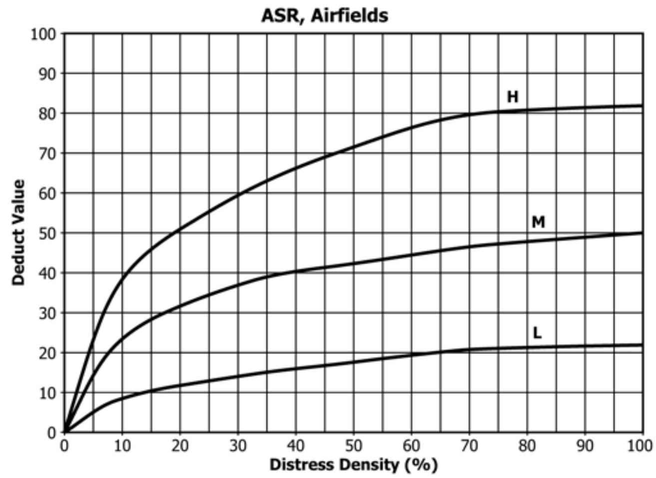


FIG. X4.16 Alkali Silica Reaction

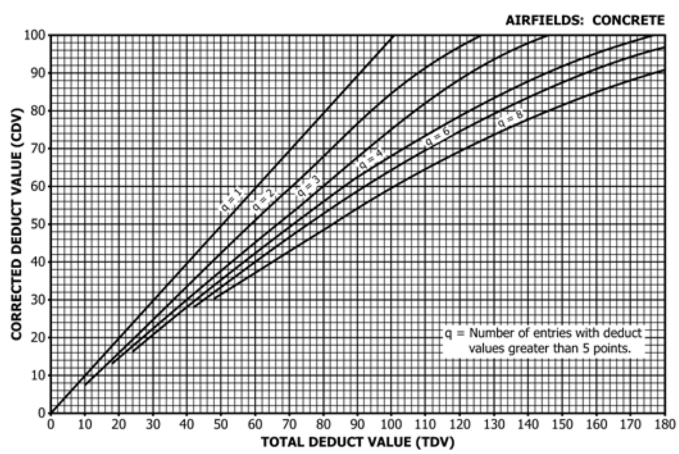


FIG. X4.17 Corrected DVs for Jointed Rigid Airfield Pavements

X5. BLANK FORMS

X5.1 See Figs. X5.1 and X5.2.

AIRFIELD ASPHALT PAVEMENT CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

SKETCH:

BRANCH ______________ **SECTION** _________ **SAMPLE UNIT** __________
SURVEYED BY ___________ **DATE** __________ **SAMPLE AREA** __________

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

DISTRESS SEVERITY	QUANTITY									TOTAL	DENSITY %	DEDUCT VALUE

FIG. X5.1 Flexible Pavement Condition Survey Data Sheet for Sample Unit

AIRFIELD CONCRETE PAVEMENTS
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

BRANCH ____________ SECTION ____________ SAMPLE UNIT ____________
SURVEYED BY __________ DATE ____________ SAMPLE AREA ____________

Distress Types

1. Blow up
2. Corner Break
3. Long/Trans/ Diagonal Crack
4. Durability Crack
5. Joint Seal Damage
6. Patching, 5 sf
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	DENSITY %	DEDUCT VALUE

SKETCH:

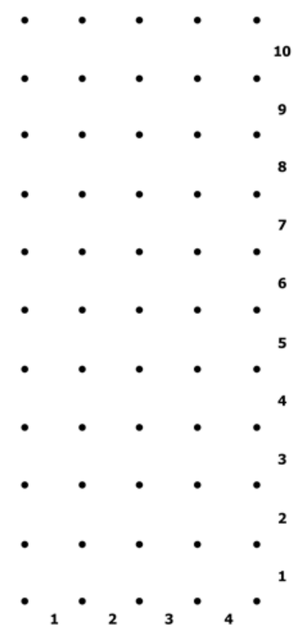


FIG. X5.2 Jointed Rigid Pavement Condition Survey Data Sheet for Sample Unit

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(1) Shahin, M. Y., Darter, M. I., and Kohn, S. D., "Development of a Pavement Maintenance Management System, Vol I, II, V," *Airfield Pavement Condition Rating*, US Air Force Civil Engineering Center, 1976.

(2) Kohn, S. D., and Shahin, M. Y., "Evolution of the Pavement Condition Index for Use on Porous Friction Surfaces," *Technical Report No. M-351*, US Army Construction Engineering Research Laboratory, Champaign, IL, 1984.

(3) Air Force Regulation 93-5, *Airfield Pavement Evaluation Program*, Department of the Air Force, Headquarters US Air Force, Washington, D.C.

(4) Advisory Circular No: 150/5380-6, *Guidelines and Procedures for Maintenance of Airport Pavements*, Federal Aviation Administration, US Department of Transportation.

(5) U.S. Naval Facilities Engineering Command Military Handbook 1021/2, "General Concepts for Airfield Pavement Design," 1988.

(6) *Pavement Condition Index (PCI) Field Manuals for Asphalt Surfaced Airfields*, American Public Works Association.

(7) *Pavement Condition Index (PCI) Field Manuals for Concrete Surfaced Airfields*, American Public Works Association.

(8) Green, W. H., and Eckrose, R. A., *Airport Pavement Inspection by PCI*, 2nd edition, Eckrose/Green Associates, Madison, WI, 1988.