

UNIFIED FACILITIES CRITERIA (UFC)

PAVER ASPHALT SURFACED AIRFIELDS PAVEMENT CONDITION INDEX (PCI)



APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

UNIFIED FACILITIES CRITERIA (UFC)

PAVER ASPHALT SURFACED AIRFIELDS PAVEMENT CONDITION INDEX (PCI)

Any copyrighted material included in this UFC is identified at its point of use. Use of the copyrighted material apart from this UFC must have the permission of the copyright holder.

U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by \1\ ... /1/)

Change No.	Date	Location
1	16 May 2006	Revised Foreword

The format of this document does not conform to UFC 1-300-1; however, it will be reformatted at the next major revision.

FOREWORD

\1\

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with [USD\(AT&L\) Memorandum](#) dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: [Criteria Change Request \(CCR\)](#). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site <http://dod.wbdg.org/>.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current. /1/

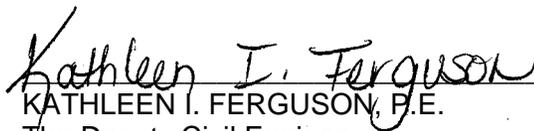
AUTHORIZED BY:



DONALD L. BASHAM, P.E.
Chief, Engineering and Construction
U.S. Army Corps of Engineers



DR. JAMES W. WRIGHT, P.E.
Chief Engineer
Naval Facilities Engineering Command



KATHLEEN I. FERGUSON, P.E.
The Deputy Civil Engineer
DCS/Installations & Logistics
Department of the Air Force



Dr. GET W. MOY, P.E.
Director, Installations Requirements and
Management
Office of the Deputy Under Secretary of Defense
(Installations and Environment)

CANCELLED

Contents

Chapter 1 Introduction

1.1. Scope	1
1.2. Pavement Condition Index	1
1.3. Pavement Condition Rating.	1
1.4. Deduct Values	1
1.5. Frequently Occurring Problems	2
1.6. Inspection Procedure.	2
1.7. References	2

Table 1.1. Frequently occurring problems
in flexible pavement distress
identification 4

Chapter 2 Definitions of Repair Options

2.1. Overlay	7
2.2. Patching.	7
2.3. Reconstruction.	7
2.4. Recycle	7
2.5. Rejuvenator	7
2.6. Seal Cracks	7
2.7. Surface Seal	7

Chapter 3 Distress 41, Alligator or Fatigue Cracking

- 3.1. Description. 9
- 3.2. Severity Levels 9
- 3.3. How to Measure 10
- 3.4. Options for Repair 10

Chapter 4 Distress 42, Bleeding

- 4.1. Description. 15
- 4.2. Severity Levels 15
- 4.3. How to Measure 15
- 4.4. Options for Repair 15

Chapter 5 Distress 43, Block Cracking

- 5.1. Description. 19
- 5.2. Severity Levels 19
- 5.3. How to Measure 20
- 5.4. Options for Repair 20

Chapter 6 Distress 44, Corrugation

- 6.1. Description. 27
- 6.2. Severity Levels 27
- 6.3. How to Measure 27 Table 6.1. Measurement Criteria 28
- 6.4. Options for Repair 28

Chapter 7 Distress 45, Depression

7.1. Description.	31
7.2. Severity Levels	31
7.3. How to Measure	31
7.4. Options for Repair	32

Table 7.1. Maximum Depth of Depression . . 32

Chapter 8 Distress 46, Jet Blast Erosion

8.1. Description.	37
8.2. Severity Levels	37
8.3. How to Measure	37
8.4. Options for Repair	37

Chapter 9 Distress 47, Joint-Reflection Cracking from PCC (Longitudinal and Transverse)

9.1. Description.	41
9.2. Severity Levels	41
9.3. How to Measure	42
9.4. Options for Repair	42

Chapter 10 Distress 48, Longitudinal and Transverse Cracking (Non-PCC Joint Reflective)

10.1. Description	47
10.2. Severity Levels	47
10.3. Porous Friction Course Severity Levels	48
10.4. How to Measure	48
10.5. Options for Repair	48

Acknowledgment

Chapter 11 Distress 49, Oil Spillage

11.1. Description	55
11.2. Severity Levels	55
11.3. How to Measure	55
11.4. Options for Repair	55

Chapter 12 Distress 50, Patching and Utility Cut Patch

12.1. Description	59
12.2. Severity Levels	59
12.3. Porous Friction Courses	59
12.4. How to Measure	59
12.5. Options for Repair	60

Chapter 13 Distress 51, Polished Aggregate

13.1. Description	65
13.2. Severity Levels	65
13.3. How to Measure	65
13.4. Options for Repair	65

Chapter 14 Distress 52, Raveling and Weathering

14.1. Description	69
14.2. Severity Levels	69
14.3. Porous Friction Course Severity Levels	69
14.4. How to Measure	70
14.4. Options for Repair	70

Chapter 15 Distress 53, Rutting

15.1. Description	77
15.2. Severity Levels	77
15.3. How to Measure	77
15.4. Options for Repair	78

Table 15.1. Mean Rut Depth Criteria 77

Chapter 16 Distress 54, Shoving of Asphalt Pavement by PCC Slabs

16.1. Description	87
16.2. Severity Levels	87
16.3. How to Measure	87
16.4. Options for Repair	88

Chapter 17 Distress 55, Slippage Cracking

17.1. Description	91
17.2. Severity Levels	91
17.3. How to Measure	91
17.4. Options for Repair	91

Chapter 18 Distress 56, Swell

18.1. Description	95	
18.2. Severity Levels	95	
18.3. How to Measure	95	Table 18.1. Swell Criteria 96
18.4. Options for Repair	96	

CANCELLED

This manual was prepared by Messrs. D. M. Ladd and Richard H. Grau, U.S. Army Engineer Research and Development Center, Vicksburg, MS, and is an update of the 1989 version prepared by Dr. M. Y. Shahin, U.S. Army Construction Engineering Research Laboratory, Champaign, IL. Funding for this project was provided by the U.S. Air Force Civil Engineering Support Agency (AFCESA/CESC), Tyndall Air Force Base, Florida, and the Naval Facilities Engineering Command (NAVFAC), Norfolk, Virginia. Monitor at AFCESA/CESC was Mr. Richard Smith, and monitors at NAVFAC were Messrs. Charlie Schiavino and Vince Donnally.

CANCELLED

CANCELLED

CHAPTER 1

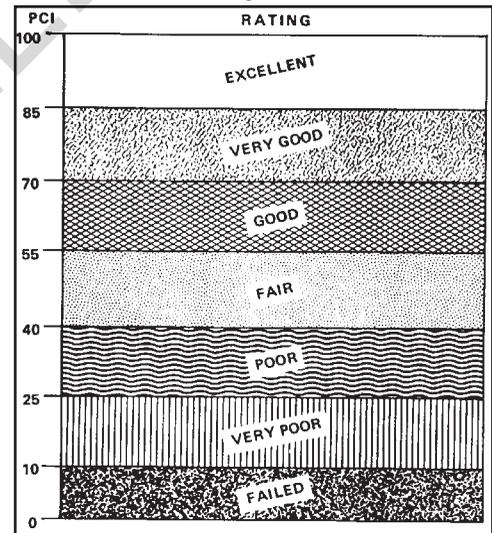
INTRODUCTION

1.1. Scope. This handbook contains distress definitions and measurement methods for determining the Pavement Condition Index (PCI) of asphalt surfaced airfields. This handbook is based on the references in paragraph 1.7. with the addition of deduct curves for each type of distress. New severity level definitions have been included for the porous friction course, weathering, and raveling distress. **AF Records Disposition.** Ensure that all records created by this handbook are maintained and disposed of IAW AFMAN 37-139, "Records Disposition Schedule."

1.2. Pavement Condition Index. The pavement condition index (PCI) results from a condition survey and is 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 as shown on Figure 1.1.

1.3. Pavement Condition Rating. The pavement condition rating is a description of pavement condition as a function of the PCI value that varies from failed to excellent as shown in Figure 1.1.

Figure 1.1. Pavement Condition Index Rating Chart



1.4. Deduct Values. Deduct value curves have been included in this handbook for each distress. The curves for corrected deduct values are also included as Figure 1.2.

1.5. Frequently Occurring Problems. Frequently occurring problems that are commonly encountered are outlined in Table 1.1. for emphasis, and the rater should be aware of these problems before starting the condition survey.

1.6. Inspection Procedure. Each sample unit chosen should be individually inspected. The actual inspection is performed by walking over the sample unit to measure the distress type and severity and recording the data on the flexible pavement survey data sheet (Figure 1.3.). This figure should be enlarged and copied for actual use. One data sheet is used for each sample unit. Each column on the data sheet is used to represent a distress type, and the amount and severity of each distress located are listed in the column. Sample units are selected in accordance with guidance contained in TM 5-826-6/AFR 93-5.

1.7. References.

1.7.1. Shahin, M. Y., Darter, M. J., and Kohn, S. D. (1977). "Development of a Pavement Maintenance Management System," Volume V, CEEDO-TR-77-44, Air Force Civil Engineering Center, Tyndall Air Force Base, Florida.

1.7.2. American Society for Testing and Materials (ASTM). *Annual Book of ASTM Standards*. "Standard Test Method for Airfield Pavement Condition Index Surveys," Designation: ASTM D 5340-93, Philadelphia, PA.

1.7.3. U.S. Air Force. (1989). "Pavement Condition Index (PCI) Field Manual for Concrete Surfaced Airfields," Washington, D.C.

1.7.4. Headquarters, U.S. Army Corps of Engineers. (1989). "Procedures for U.S. Army and U.S. Air Force Airfield Pavement Condition Surveys," TM 5-826-6/AFR 93-5, Washington, D.C.

CANCELLED

Figure 1.2. Corrected deduct values for flexible pavements

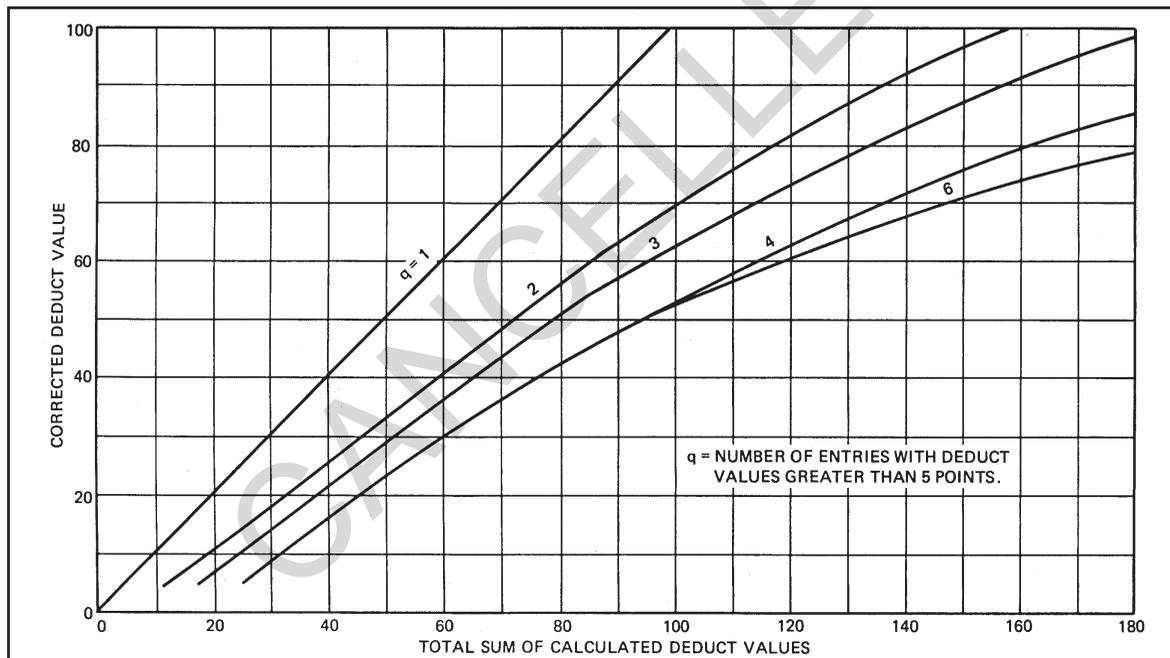


Table 1.1. Frequently Occurring Problems in Flexible Pavement Distress Identification

Situation	Action	Remarks
1. Alligator cracking and rutting in same area.	Record each separately at respective severity level.	
2. Bleeding counted in area.	Polished aggregate is not counted in same area.	
3. Polished aggregate in very small amount.	Do not count.	Polished aggregate is only counted when there is a significant amount.
4. Any distress (including cracking) in a patched area.	Do not record.	Effect of distress is considered in patch severity level.
5. Block cracking is recorded.	No longitudinal and transverse cracking should be recorded.	Does not apply to asphaltic concrete (AC) over portland cement concrete (PCC).
6. Asphalt overlay over concrete.	Block cracking, jointed reflection cracking, and longitudinal and transverse cracking reflected from old concrete is recorded separately.	AC over PCC could have, for example, 100-percent block cracking, 10-percent joint reflection cracking, and 1-percent longitudinal and transverse cracking.

CHAPTER 2

DEFINITIONS OF REPAIR OPTIONS

2.1. Overlay. Application of asphalt concrete over the existing surface to correct surface deficiencies and/or increase the load-carrying capacity of the pavement.

2.2. Patching.

2.2.1. Shallow. A stable, compact leveling course is placed in depressions to level the surface.

2.2.2. Partial-depth. Deteriorated area of the pavement is removed and replaced.

2.2.3. Full-depth. Deteriorated area of the pavement, base course, and subgrade is removed and replaced. The subgrade should be recompacted.

2.3. Reconstruction. Complete replacement of the pavement, base course, and subgrade.

2.4. Recycle. Reworking a pavement structure or its component material to improve the performance and correct noted deficiencies.

2.5. Rejuvenator. Application of material which chemically reacts with the asphalt surface to restore the properties lost due to weathering.

2.6. Seal Cracks. Routing, or use of heat lance, to remove debris from cracks before sealing.

2.7. Surface Seal. Application of bituminous spray, such as a fog seal.

(Note: Due to possible foreign object damage (FOD) problems, the MAJCOM engineer must be consulted prior to using a surface seal or rejuvenators as repair options.)

CANCELLED

CHAPTER 3

DISTRESS 41, ALLIGATOR OR FATIGUE CRACKING

3.1. Description. Alligator or fatigue cracking is a series of interconnecting cracks caused by fatigue failure of the asphalt surface under repeated traffic loading. The cracking initiates at the bottom of the asphalt surface (or stabilized base) where tensile stress and strain is highest under a wheel load. The cracks propagate to the surface initially as a series of parallel cracks. After repeated traffic loading, the cracks connect and form many-sided, sharp-angled pieces that develop a pattern resembling chicken wire or the skin of an alligator. The pieces are less than 2 feet (0.6 meters) on the longest side. Deduct curves for alligator cracking are shown in Figure 3.1.

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

Alligator cracking is considered a major structural distress.

3.2. Severity Levels.

3.2.1. Low (L). Fine, longitudinal hairline cracks running parallel to each other with no or only a few interconnecting cracks. The cracks are not spalled (Figures 3.2., 3.3., and 3.4.).

3.2.2. Medium (M). Further development of light alligator cracking into a pattern or network of cracks that may be lightly spalled (Figures 3.5. and 3.6.).

3.2.3. High (H). Network or pattern cracking progressed so that pieces are well-defined and spalled at the edges: some of the pieces rock under traffic (Figure 3.7.).

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

3.4. Options for Repair.

3.4.1. L. Do nothing; surface seal;* overlay.

3.4.2. M. Partial- or full-depth patch; overlay; reconstruct.

3.4.3. H. Partial- or full-depth patch; overlay; reconstruct.

* Improperly applied rejuvenators or surface seals may cause skid problems on high-speed surfaces.

Figure 3.1. Deduct values for Distress 41, Alligator Cracking

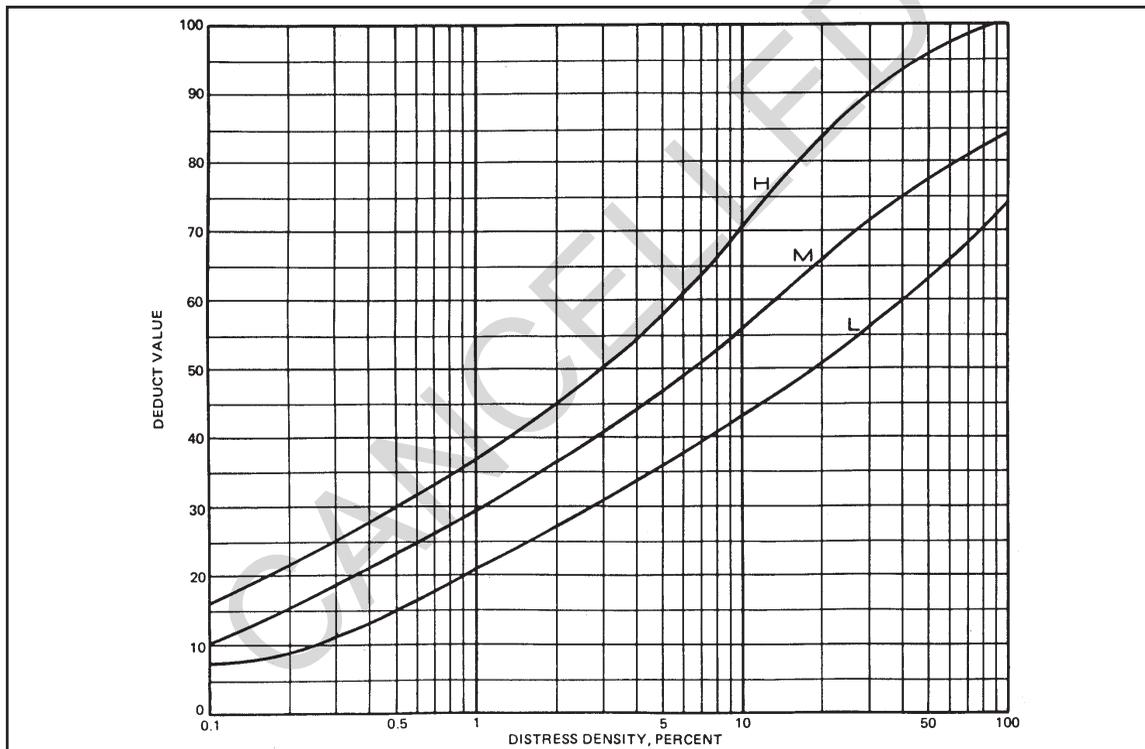


Figure 3.2. Low-severity alligator cracking



Figure 3.3. Low-severity alligator cracking



Figure 3.4. Low-severity alligator cracking, approaching medium severity



Figure 3.5. Medium-severity alligator cracking



Figure 3.6. Medium-severity alligator cracking



Figure 3.7. High-severity alligator cracking



CHAPTER 4

DISTRESS 42, BLEEDING

4.1. Description. Bleeding is a film of bituminous material on the pavement surface which creates a shiny, glass-like, reflecting surface that usually becomes quite sticky. Bleeding is caused by excessive amounts of asphalt cement or tars in the mix and/or low air-void content. It occurs when asphalt fills the voids of the mix during hot weather and then expands onto the surface of the pavement. Since the bleeding process is not reversible during cold weather, asphalt or tar will accumulate on the surface. A deduct curve for bleeding is shown in Figure 4.1.

4.2. Severity Levels.

No degrees of severity are defined. Bleeding should be noted when it is extensive enough to cause a reduction in skid resistance (Figure 4.2.).

4.3. How to Measure. Bleeding is measured in square feet (square meters) of surface area. If bleeding is counted, polished aggregate is not counted in the same area.

4.4. Options for Repair.

Do nothing; apply heat, roll sand, and sweep loose material.

Figure 4.1. Deduct values for Distress 42, Bleeding

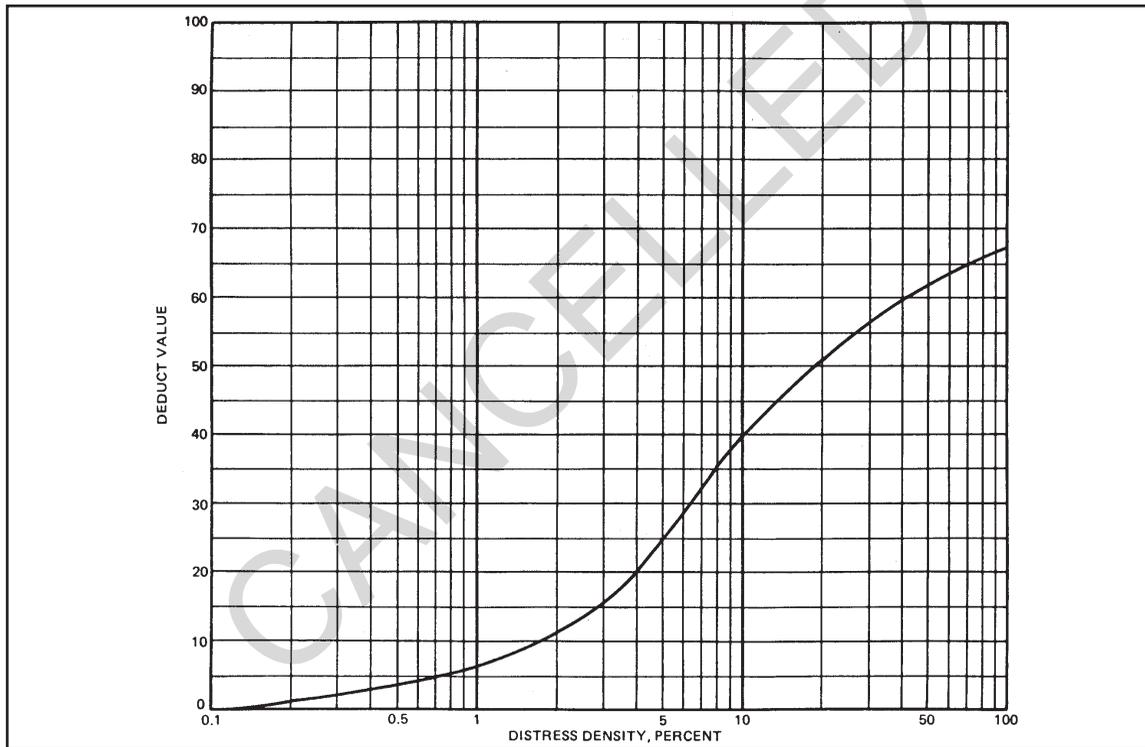


Figure 4.2. Bleeding



CANCELLED

CHAPTER 5

DISTRESS 43, BLOCK CRACKING

5.1. 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 feet to 10 by 10 feet (0.3 by 0.3 meter to 3 by 3 meters). Block cracking is caused mainly by shrinkage of the asphalt concrete (AC) and daily temperature cycling (which results in daily stress/strain cycling). It is not load-associated. The occurrence of block cracking usually indicates that the asphalt has hardened significantly. Block cracking normally occurs over a large proportion of pavement area but sometimes will occur in nontraffic areas. This type of distress differs from alligator cracking in that alligator cracks form smaller, many-sided pieces with sharp angles. Also, unlike block cracks, alligator cracks are caused by repeated traffic loadings and, therefore, are located only in traffic areas (i.e., wheel paths). Deduct curves for block cracking are shown in Figure 5.1.

5.2. Severity Levels.

5.2.1. L. Blocks are defined by cracks that are nonspalled (sides of the crack are vertical) or only lightly spalled, causing no FOD potential. Nonfilled cracks have 1/4 inch (6.4 millimeters) or less mean width, and filled cracks have filler in satisfactory condition (Figures 5.2., 5.3., and 5.4.).

5.2.2. M. Blocks are defined by either: (1) filled or nonfilled cracks that are moderately spalled (some FOD potential); (2) nonfilled cracks that are not spalled or have only minor spalling (some FOD potential), but have a mean width greater than approximately 1/4 inch (6.4 millimeters); or (3) filled cracks that are not spalled or have only minor spalling (some FOD potential), but have filler in unsatisfactory condition (Figures 5.5. and 5.6.).

5.2.3. H. Blocks are well-defined by cracks that are severely spalled, causing a definite FOD potential (Figures 5.7. and 5.8.).

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

5.4. Options for Repair.

5.4.1. L. Do nothing; apply rejuvenator.*

5.4.2. M. Seal cracks; apply rejuvenator;* recycle surface.

5.4.3. H. Seal cracks; recycle surface.

* Improperly applied rejuvenators or surface seals may cause skid problems on high-speed surfaces.

Figure 5.1. Deduct values for Distress 43, Block Cracking

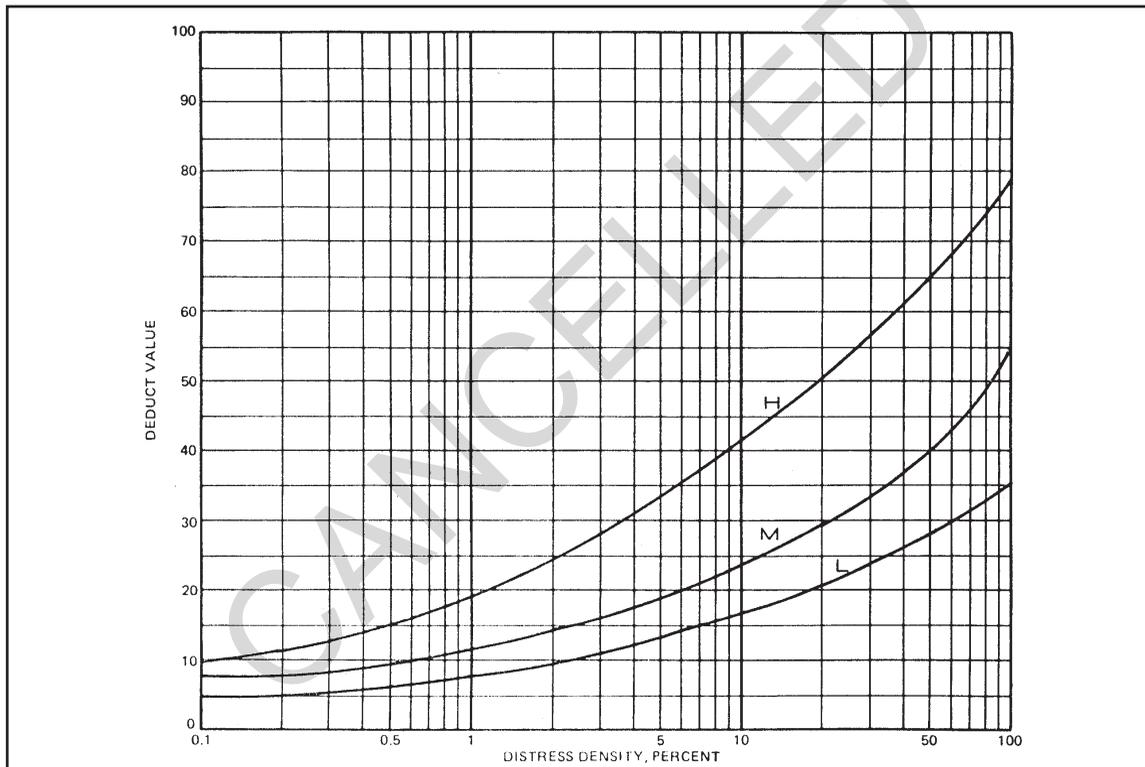


Figure 5.2. Low-severity block cracking



Figure 5.3. Low-severity block cracking



Figure 5.4. Low-severity block cracking



Figure 5.5. Medium-severity block cracking



Figure 5.6. Medium-severity block cracking



Figure 5.7. High-severity block cracking



Figure 5.8. High-severity block cracking



CANCELLED

CHAPTER 6

DISTRESS 44, CORRUGATION

6.1. Description. Corrugation is a series of closely spaced ridges and valleys (ripples) occurring at fairly regular intervals (usually less than 5 feet) (1.5 meters) 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. An illustration of corrugation is shown in Figure 6.1. and an example is shown in Figure 6.2. Deduct curves for corrugation are shown in Figure 6.3.

6.2. Severity Levels.

6.2.1. L. Corrugations are minor and do not significantly affect ride quality (see measurement criteria below).

6.2.2. M. Corrugations are noticeable and significantly affect ride quality (see measurement criteria below).

6.2.3. H. Corrugations are easily noticed and severely affect ride quality (see measurement criteria below).

6.3. How to Measure. Corrugation is measured in square feet (square meters) of surface area. The mean elevation difference between the ridges and valleys of the corrugations indicates the level of severity. To determine the mean elevation difference, a 10-foot (3-meter) straightedge should be placed perpendicular to the corrugations so that the depth of the valleys can be measured in inches (millimeters). The mean depth is calculated from five such measurements.

Table 6.1. Measurement Criteria

Severity	Runways and High-Speed Taxiways	Taxiways and Aprons
L	<1/4 inch (<6.4 millimeters)	<1/2 inch (<12.7 millimeters)
M	1/4 to 1/2 inch (6.4 to 12.7 millimeters)	1/2 to 1 inch (12.7 to 25.4 millimeters)
H	≥ 1/2 inch (≥ 12.7 millimeters)	≥ 1 inch (≥ 25.4 millimeters)
Corrugation is not commonly found on airfield pavements.		

6.4. Options for Repair.

6.4.1. L. Do nothing.

6.4.2. M. Reconstruct and mill.

6.4.3. H. Reconstruct, mill, and overlay.

Figure 6.1. Illustration of corrugation

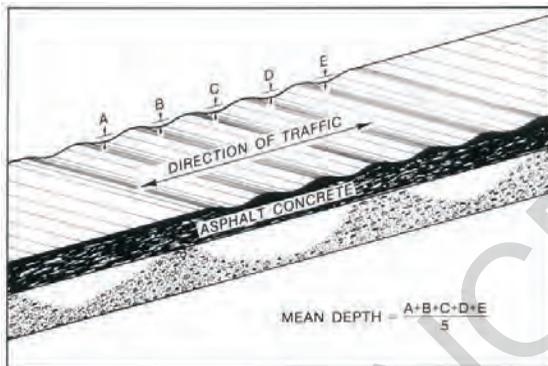
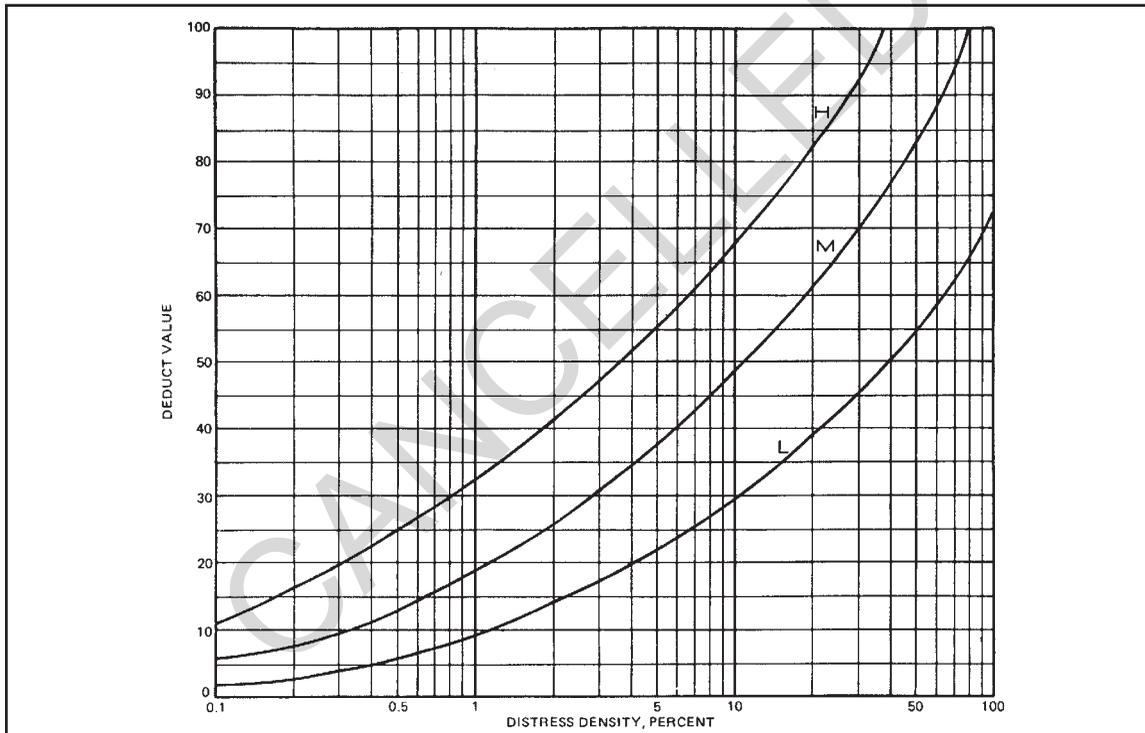


Figure 6.2. Corrugation



Figure 6.3. Deduct values for Distress 44, Corrugation



CHAPTER 7

DISTRESS 45, DEPRESSION

7.1. 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 water. Depressions can be caused by settlement of the foundation soil or can be “built up” during construction. Depressions cause roughness and, when filled with water of sufficient depth, can cause hydroplaning of aircraft. Deduct curves for depression are shown in Figure 7.1.

7.2. Severity Levels.

7.2.1. 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) (Figure 7.2.).

7.2.2. M. The depression can be observed, moderately affects pavement riding quality, and causes hydroplaning potential on runways (see measurement criteria below) (Figures 7.3. and 7.4.).

7.2.3. H. The depression can be readily observed, severely affects pavement riding quality, and causes definite hydroplaning potential (see measurement criteria below) (Figure 7.5.).

7.3. How to Measure. Depressions are measured in square feet (square meters) of surface area. The maximum depth of the depression determines the level of severity. This depth can be measured by placing a 10-foot (3-meters) straightedge across the depressed area and measuring

the maximum depth in inches (millimeters). Depressions larger than 10 feet (3 meters) across must be measured by either visual estimation or direct measurement when filled with water.

Table 7.1. Maximum Depth of Depresson

Severity	Runways and High-Speed Taxiways	Taxiways and Aprons
L	1/8 to 1/2 inch (3.2 to 12.7 millimeters)	1/2 to 1 inch (12.7 to 25.4 millimeters)
M	1/2 to 1 inch (12.7 to 25.4 millimeters)	1 to 2 inch (25.4 to 50.8 millimeters)
H	>1 inch (>25.4 millimeters)	>2 inch (>50.8 millimeters)

7.4. Options for Repair.

7.4.1. L. Do nothing.

7.4.2. M. Shallow,* partial-, or full-depth patch.

7.4.3. H. Shallow,* partial-, or full-depth patch.

* Shallow patching will be used on runways where FOD is a concern.

Figure 7.1. Deduct values for Distress 45, Depression

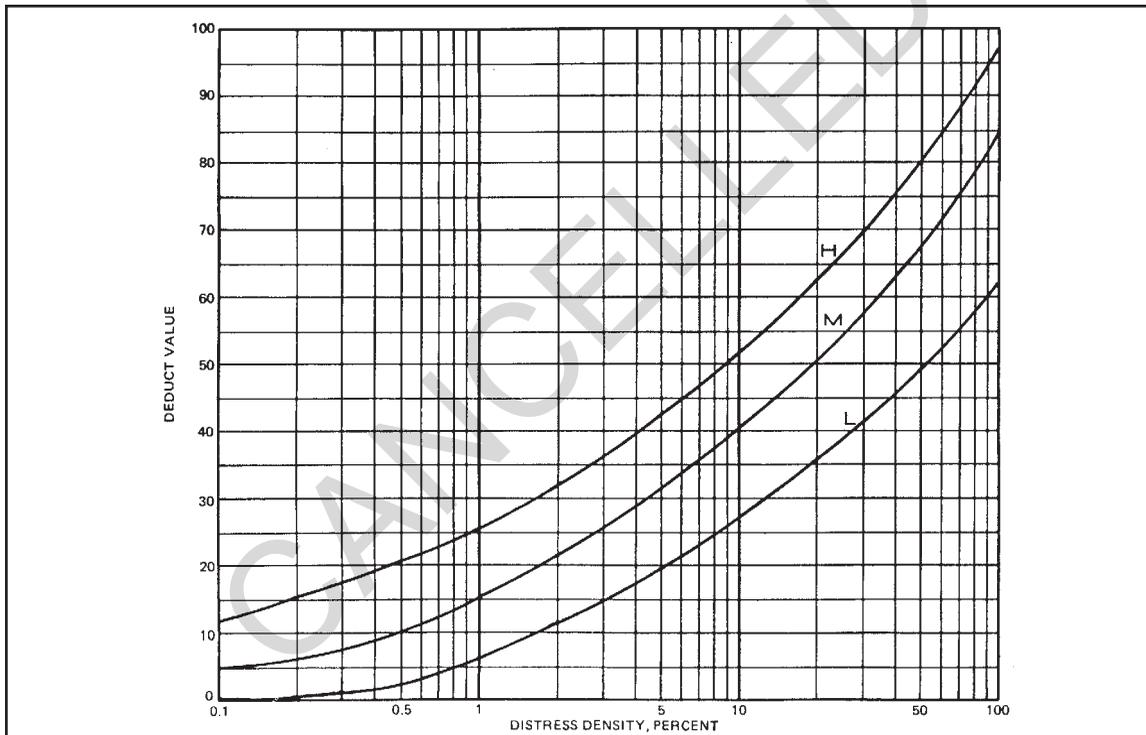


Figure 7.2. Low-severity depression



Figure 7.3. Medium-severity depression



Figure 7.4. Medium-severity depression

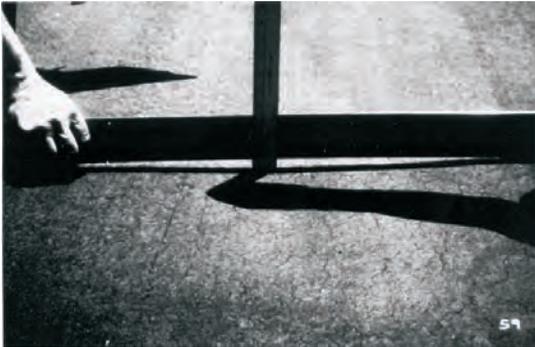


Figure 7.5. High-severity depression



CANCELLED

CHAPTER 8

DISTRESS 46, JET BLAST EROSION

8.1. Description. Jet blast erosion causes darkened areas on the pavement surface when bituminous binder has been burned or carbonized; localized burned areas may vary in depth up to approximately 1/2 inch (12.7 millimeters). A deduct curve for jet blast erosion is shown in Figure 8.1.

8.2. Severity Levels.

No degrees of severity are defined. It is sufficient to indicate that jet blast erosion exists (Figures 8.2. and 8.3.).

8.3. How to Measure. Jet blast erosion is measured in square feet (square meters) of surface area.

8.4. Options for Repair.

Do nothing; partial-depth patch; apply rejuvenator.*

* Improperly applied rejuvenators or surface seals may cause skid problems on high-speed surfaces.

Figure 8.1. Deduct values for Distress 46, Jet Blast Erosion

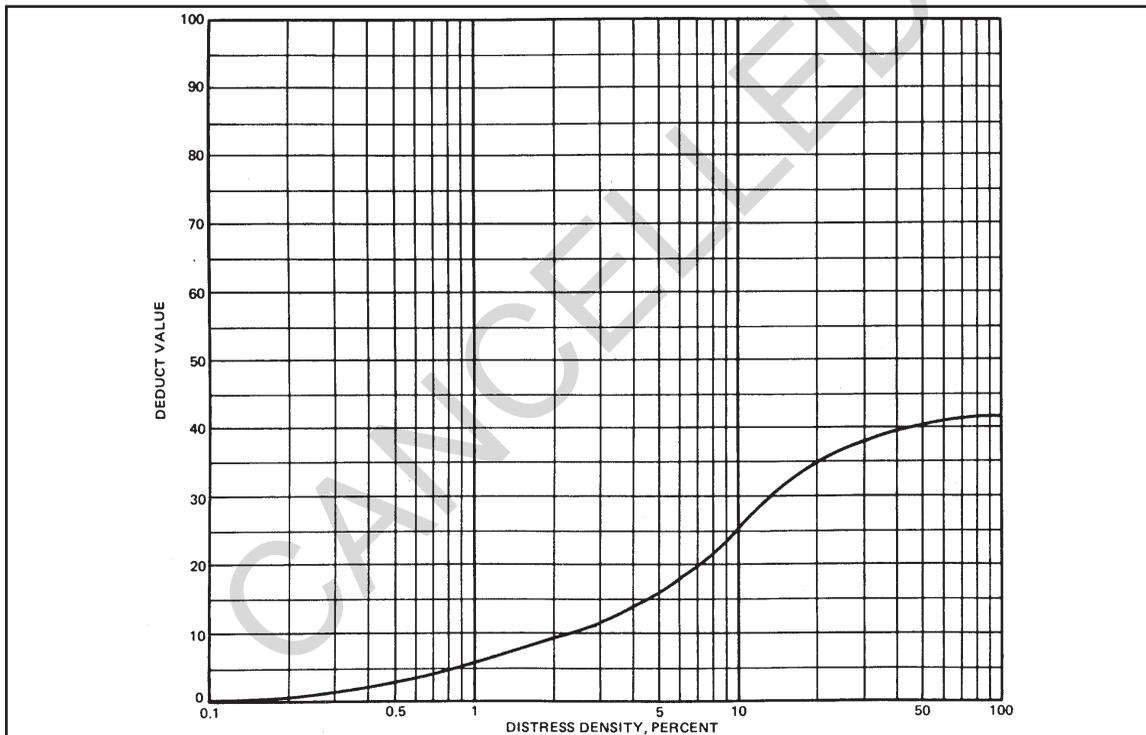


Figure 8.2. Jet blast erosion



Figure 8.3. Jet blast erosion



CANCELLED

CHAPTER 9

DISTRESS 47, JOINT-REFLECTION CRACKING FROM PCC (LONGITUDINAL AND TRANSVERSE)

9.1. 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 (i.e., cement stabilized, lime stabilized); such cracks are listed as longitudinal and transverse cracks. Joint-reflection cracking is caused mainly by movement of the PCC slab beneath the 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. Deduct curves for joint-reflection cracking from PCC are shown in Figure 9.1.

9.2. Severity Levels.

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 1/4 inch (6.4 millimeters) or less. Filled cracks are of any width, but their filler material is in satisfactory condition (Figure 9.2.).

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 only lightly spalled, but the filler is in unsatisfactory condition; (3) nonfilled cracks are not spalled or are only lightly spalled, but the mean crack width is greater than 1/4 inch (6.5 millimeters); or (4) light random cracking exists near the crack or at the corner of intersecting cracks (Figures 9.3. and 9.4.).

9.2.3. H. Cracks are severely spalled (definite FOD potential) and can be either filled or nonfilled of any width (Figure 9.5.).

9.3. How to Measure. Joint-reflection cracking is measured in linear feet (linear meters). The length and severity level of each crack should be identified and recorded. If the crack does not have the same severity level along its entire length, each portion should be recorded separately. For example, a crack that is 50 feet (15 meters) long may have 10 feet (3 meters) of high severity, 20 feet (6 meters) of medium severity, and 20 feet (6 meters) of light severity; these would all be recorded separately.

9.4. Options for Repair.

- 9.4.1. L. Do nothing; seal cracks over 1/8 inch (3.2 millimeters).
- 9.4.2. M. Seal cracks; partial-depth patch.
- 9.4.3. H. Seal cracks; partial-depth patch; reconstruct joint.

Figure 9.1. Deduct values for Distress 47, Joint-Reflection Cracking

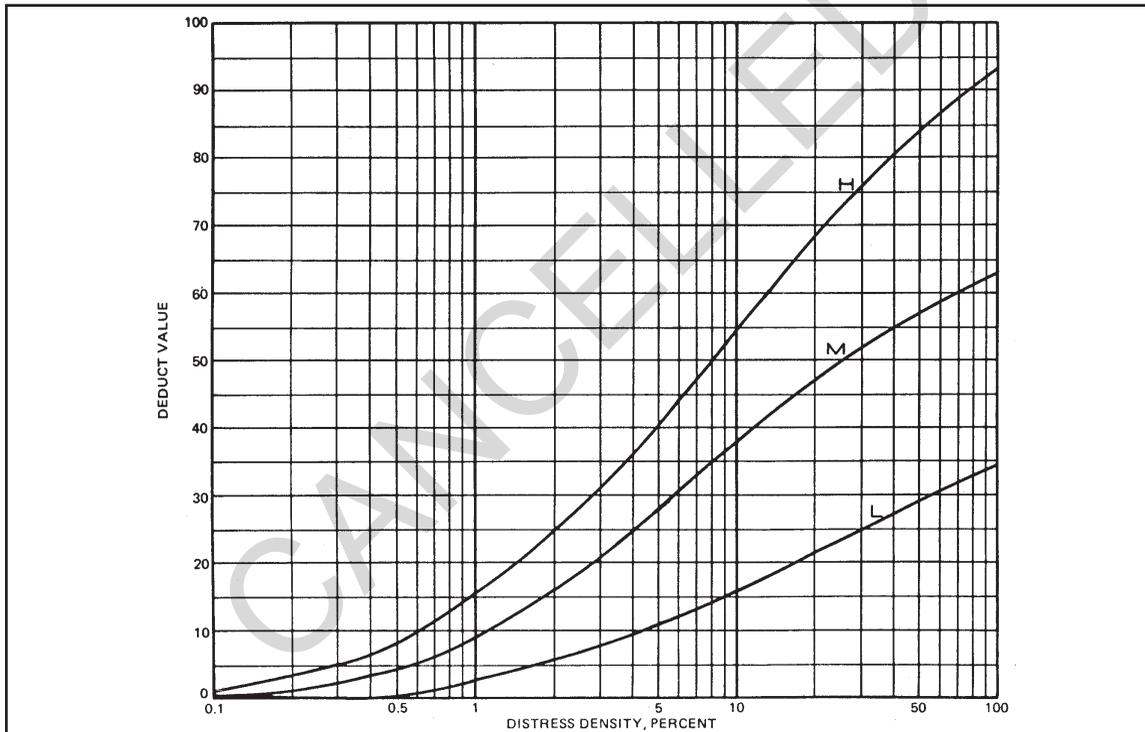


Figure 9.2. Low-severity, joint-reflection cracking



Figure 9.3. Medium-severity, joint-reflection cracking



Figure 9.4. Medium-severity, joint-reflection cracking



Figure 9.5. High-severity, joint-reflection cracking



CANCELLED

CHAPTER 10

DISTRESS 48, LONGITUDINAL AND TRANSVERSE CRACKING (NON-PCC JOINT REFLECTIVE)

10.1. 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 center line or direction of laydown. They may be caused by items 2 or 3 above. These types of cracks are not usually load-associated. If the pavement is fragmented along a crack, the crack is said to be spalled. Deduct curves for longitudinal and transverse cracking are shown in Figure 10.1.

10.2. Severity Levels.

10.2.1. L. Cracks have either minor spalling (little or no FOD potential) or no spalling. The cracks can be filled or nonfilled. Nonfilled cracks have a mean width of 1/4 inch (6.4 millimeters) or less; filled cracks are of any width, but their filler material is in satisfactory condition (Figures 10.2. and 10.3.).

10.2.2. 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 only lightly spalled, but the filler is in unsatisfactory condition; (3) nonfilled cracks are not spalled or are only lightly spalled, but mean crack width is greater than 1/4 inch (6.4 millimeters); or (4) lightly random cracking exists near the crack or at the corners of intersecting cracks (Figures 10.4. and 10.5.).

10.2.3. H. Cracks are severely spalled, causing definite FOD potential. They can be either filled or nonfilled of any width (Figure 10.6.).

10.3. Porous Friction Course Severity Levels.

Note: these severity levels are in addition to the existing definitions.

10.3.1. L. Average raveled area around the crack is less than 1/4 inch (6.4 millimeters) wide (Figure 10.7.).

10.3.2. M. Average raveled area around the crack is 1/4 inch (6.4 millimeters) to 1 inch (25.4 millimeters) wide (Figure 10.8.).

10.3.3. H. Average raveled area around the crack is greater than 1 inch (25.4 millimeters) wide (Figure 10.9.).

10.4. How to Measure. Longitudinal and transverse cracks are measured in linear feet (linear meters). 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.

10.5. Options for Repair.

10.5.1. L. Do nothing; seal cracks over 1/8 inch (3.2 millimeters); apply rejuvenator;* surface seal*.

10.5.2. M. Seal cracks.

10.5.3. H. Seal cracks; partial-depth patch.

* Improperly applied rejuvenators or surface seals may cause skid problems on high-speed surfaces.

Note: Sealing cracks in porous friction courses stops water flow, traps water, and causes pavement failure due to freeze/thaw action.

CANCELLED

Figure 10.1. Deduct Values for Distress 48, Longitudinal and Transverse Cracking

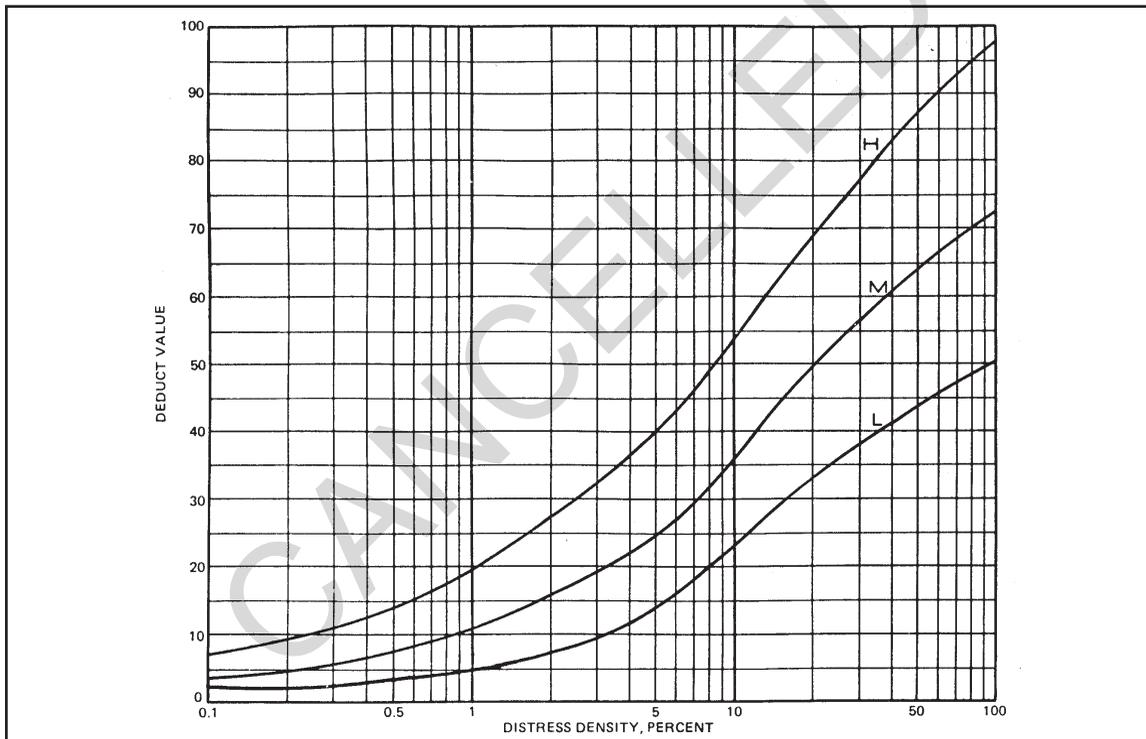


Figure 10.2. Low-severity, longitudinal crack



Figure 10.3. Low-severity, longitudinal cracks, approaching medium



Figure 10.4. Medium-severity, longitudinal construction joint crack



Figure 10.5. Medium-severity, longitudinal crack



Figure 10.6. High-severity, longitudinal crack



Figure 10.7. Low-severity crack, porous friction course (PFC) pavement



Figure 10.8. Medium-severity crack, PFC pavement



Figure 10.9. High-severity crack, PFC pavement



CHAPTER 11

DISTRESS 49, OIL SPILLAGE

11.1. Description. Oil spillage is the deterioration or softening of the pavement surface caused by the spilling of oil, fuel, or other solvents. A deduct curve for oil spillage is shown in Figure 11.1.

11.2. Severity Levels.

No degrees of severity are defined. It is sufficient to indicate that oil spillage exists (Figures 11.2. and 11.3.).

11.3. How to Measure. Oil spillage is measured in square feet (square meters) of surface area.

11.4. Options for Repair.

Do nothing; partial- or full-depth patch.

CANCELLED

Figure 11.1. Deduct values for Distress 49, Oil Spillage

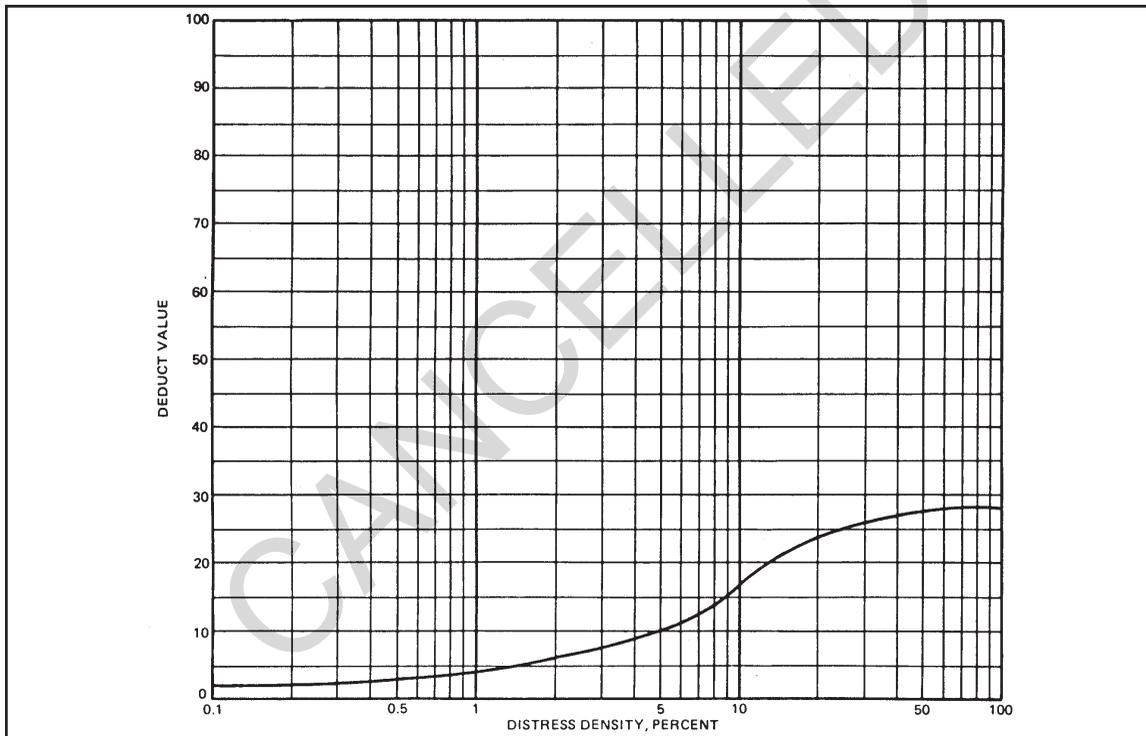


Figure 11.2. Oil spillage



Figure 11.3. Oil spillage



CANCELLED

CHAPTER 12

DISTRESS 50, PATCHING AND UTILITY CUT PATCH

12.1. Description. A patch is considered a defect, regardless of how well it is performing. Deduct curves for patching and utility cut patches are shown in Figure 12.1.

12.2. Severity Levels.

12.2.1. L. Patch is in good condition and is performing satisfactorily (Figures 12.2. and 12.3.).

12.2.2. M. Patch is somewhat deteriorated and affects riding quality to some extent (Figure 12.4.).

12.2.3. H. Patch is badly deteriorated and affects riding quality significantly or has high FOD potential. Patch needs replacement (Figure 12.5.).

12.3. Porous Friction Courses. The use of dense-graded AC patches in PFC surfaces causes a water damming effect at the patch that contributes to differential skid resistance of the surface. Low-severity, dense-graded patches should be rated as medium severity because of the differential friction problem. Medium- and high-severity patches are rated the same as above.

12.4. How to Measure. Patching is measured in square feet (square meters) of surface area. However, if a single patch has areas of differing severity levels, these areas should be measured and recorded separately. For example, a 25-square-foot (2.3-square-meter) patch may have 10 square feet (1.0 square meter) of medium severity and 15-square-feet (1.4-square-meters) of light severity. These areas would be recorded separately. Any distress found in a patched area will not be recorded; however, its effects on the patch will be considered when determining the patch's severity level.

12.5. Options for Repair.

12.5.1. L. Do nothing.

12.5.2. M. Seal cracks; repair distress in patch; replace patch.

12.5.3. H. Replace patch.

Note: Sealing cracks in porous friction courses stops water flow, traps water, and causes pavement failure due to freeze/thaw action.

CANCELLED

Figure 12.1. Deduct values for Distress 50, Patching and Utility Cut

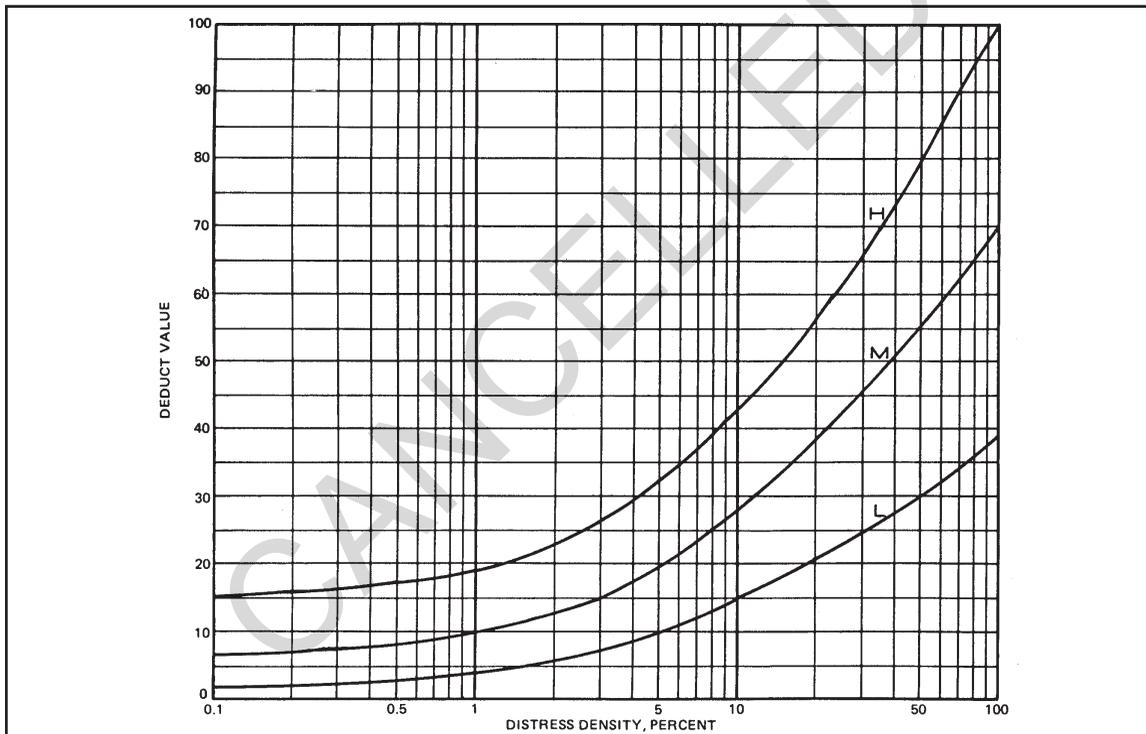


Figure 12.2. Low-severity patch



Figure 12.3. Low-severity patch



Figure 12.4. Medium-severity patch



Figure 12.5. High-severity patch



CANCELLED

CHAPTER 13

DISTRESS 51, POLISHED AGGREGATE

13.1. 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. Existence of this type of distress is also indicated when the number on a skid resistance rating test is low or has dropped significantly from previous ratings. A deduct curve for polished aggregate is shown in Figure 13.1.

13.2. Severity Levels.

No degrees of severity are defined. However, the degree of polishing should be significant before it is included in the condition survey and rated as a defect (Figure 13.2.).

13.3. How to Measure. Polished aggregate is measured in square feet (square meters) of surface area. If bleeding is counted, polished aggregate is not counted in the same area.

13.4. Options for Repair.

Do nothing; overlay; surface friction course.

Figure 13.1. Deduct values for Distress 51, Polished Aggregate

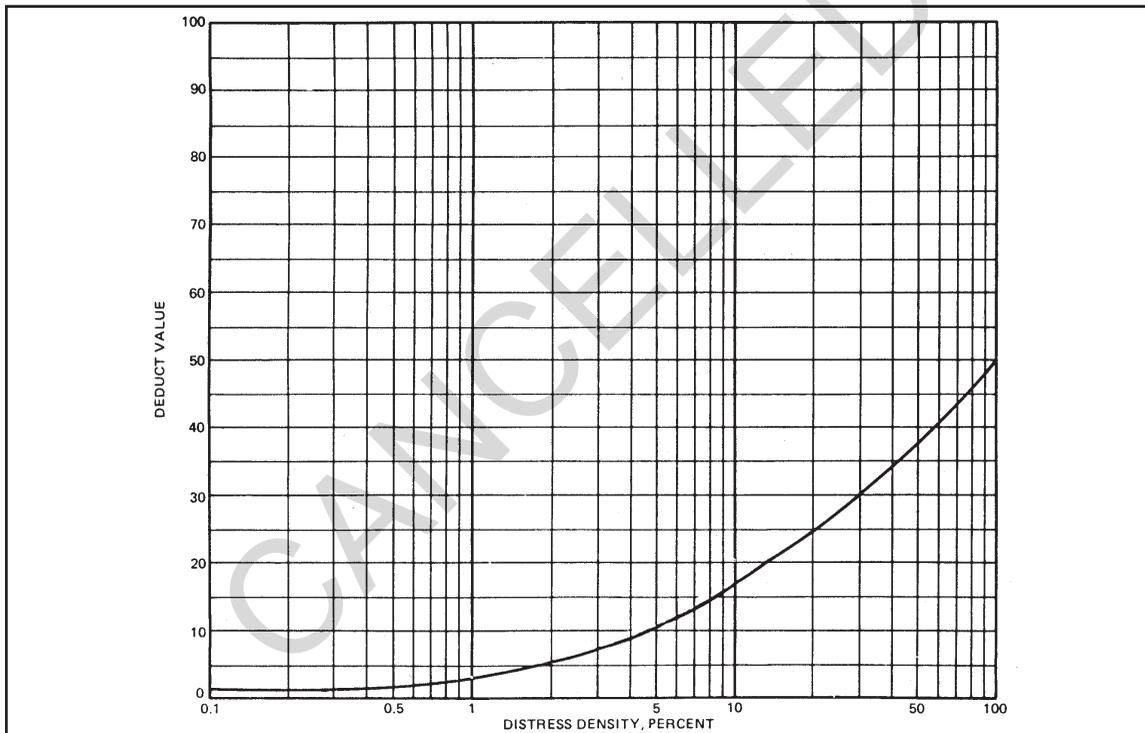
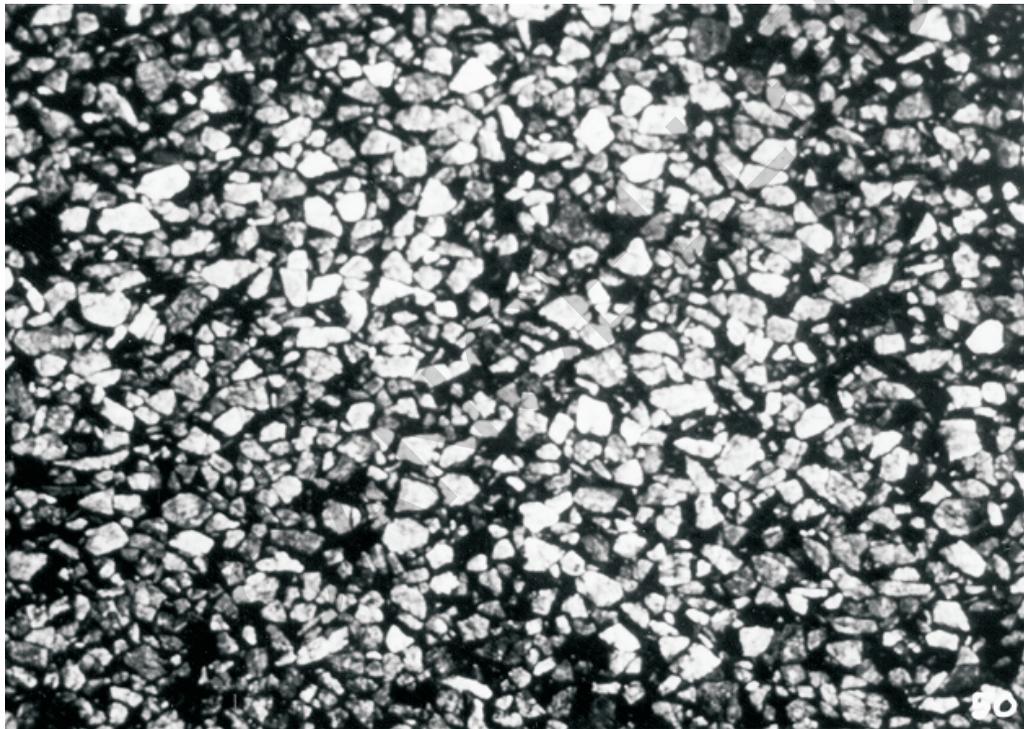


Figure 13.2. Polished aggregate



CANCELLED

CHAPTER 14

DISTRESS 52, RAVELING AND WEATHERING

14.1. Description. Raveling and weathering are the wearing away of the pavement surface caused by the dislodging of aggregate particles and loss of asphalt or tar binder. They may indicate that the asphalt binder has hardened significantly. Deduct curves for raveling and weathering are shown in Figure 14.1.

14.2. Severity Levels.

14.2.1. L. Aggregate or binder has started to wear away, causing little or no FOD potential (Figures 14.2. and 14.3.).

14.2.2. M. Aggregate and/or binder has worn away, causing some FOD potential. The surface texture is moderately rough and pitted (Figure 14.4.).

14.2.3. H. Aggregate and/or binder has worn away, causing a high FOD potential. The surface texture is severely rough and pitted (Figure 14.5.).

14.3. Porous Friction Course Severity Levels. (Figure 14.6. shows a porous friction course with no distress).

14.3.1. L. In a square-foot (square-meter) representative sample, the number of aggregate pieces missing is between 5 and 20 and/or the number of missing aggregate clusters (when more than one adjoining aggregate piece is missing) does not exceed 1 (Figure 14.7.).

14.3.2. M. In a square-foot (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 percent of the square-foot (square-meter) area (Figures 14.8. and 14.9.).

14.3.3. H. In a square-foot (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 percent of the square-foot (square-meter) area (Figure 14.10.).

14.4. How to Measure. Raveling and weathering are measured in square feet (square meters) or surface area. Mechanical damage caused by hook drags, tire rims, or snow plows is counted as areas of high-severity raveling and weathering.

14.5. Options for Repair.

14.5.1. L. Do nothing; apply rejuvenator;* surface seal.*

14.5.2. M. Apply rejuvenator; surface seal.

14.5.3. H. Overlay; recycle; reconstruct.

* Improperly applied rejuvenators or surface seals may cause problems on high-speed surfaces.

Figure 14.1. Deduct values for Distress 52, Raveling/Weathering

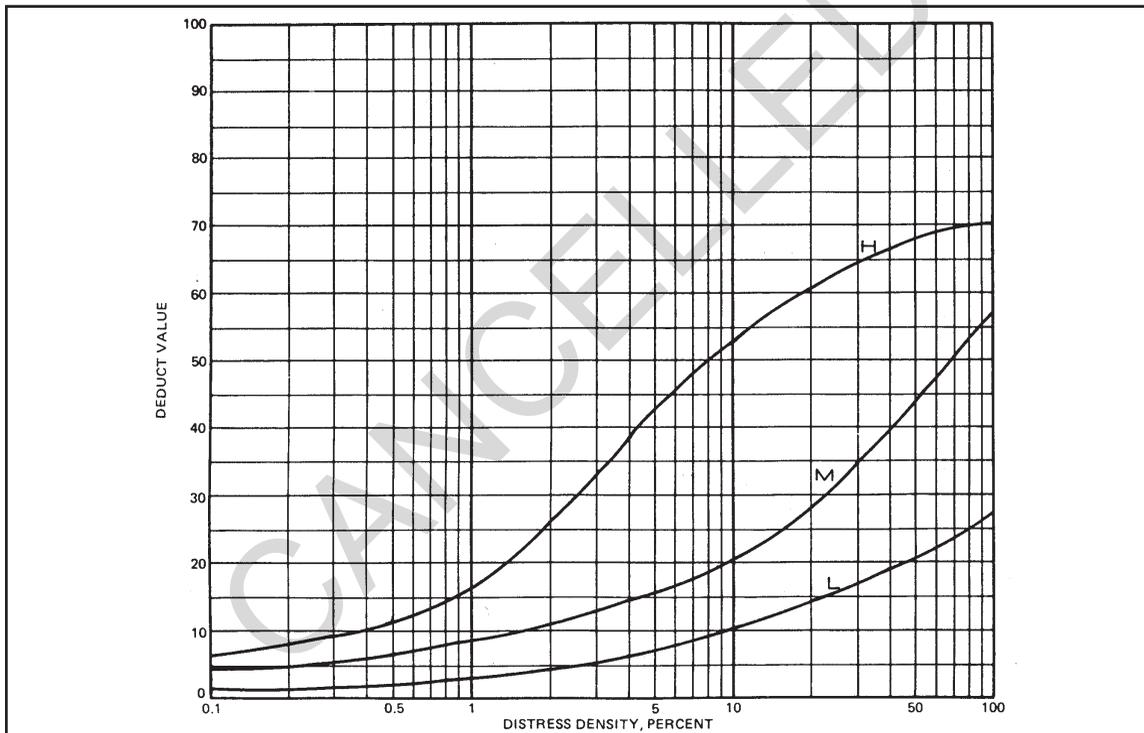


Figure 14.2. Low-severity raveling/weathering



Figure 14.3. Low-severity raveling/weathering



Figure 14.4. Medium-severity raveling/weathering



Figure 14.5. High-severity raveling/weathering



Figure 14.6. Typical PFC surface with no raveling and weathering

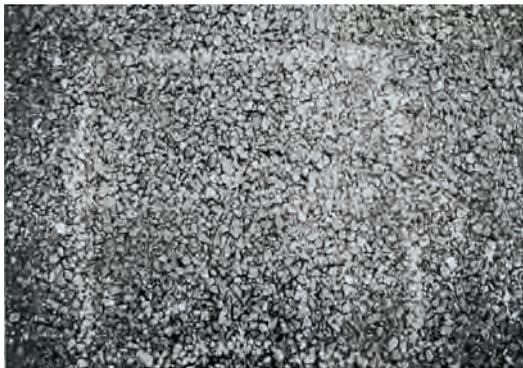


Figure 14.7. Low-severity raveling/weathering in PFC surface. Note only two aggregate pieces and one aggregate cluster missing

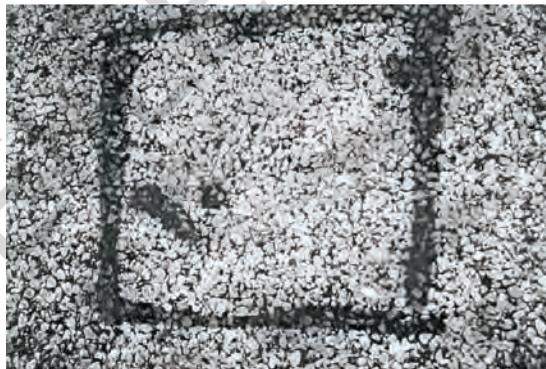


Figure 14.8. Medium-severity raveling/weathering in PFC surface. Note no single aggregate pieces are missing, but six aggregate clusters that do not exceed 25% of the square-foot (square-meter) area are missing

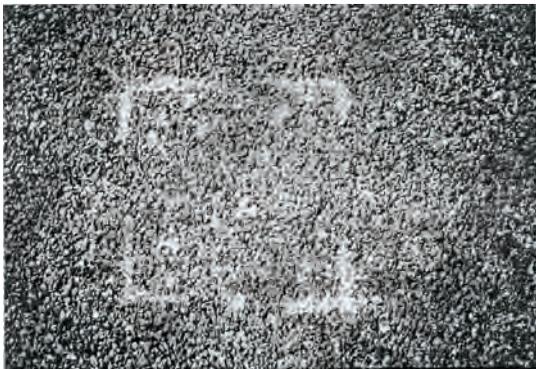


Figure 14.9. Medium-severity raveling/weathering in PFC surface. Note seven single aggregate pieces are missing, and five aggregate clusters that do not exceed 25% of the square-foot (square-meter) area are missing

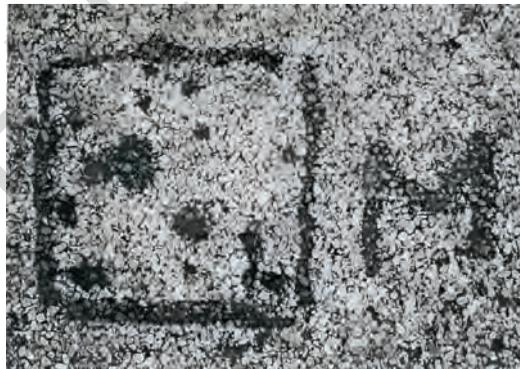


Figure 14.10. High-severity raveling/weathering in PFC surface. Note single aggregate pieces and aggregate clusters that exceed 25% of the square-foot (square-meter) area are missing



CHAPTER 15

DISTRESS 53, RUTTING

15.1. 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. It is 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. Deduct curves for rutting are shown in Figure 15.1.

15.2. Severity Levels.

Mean Rut Depth Criteria

Table 15.1. Mean Rut Depth Criteria

Severity	All Pavement Sections
L	≤ 1/4 to 1/2 inch (≤ 6.4 to 12.7 millimeters) (Figure 15.2. and Figure 15.3.)
M	>1/2 inch ≤ 1 inch (>12.7 to ≤ 25.4 millimeters) (Figures 15.4 and 15.5.)
H	>1 inch (>25.4 millimeters) (Figures 15.6. and 15.7.)

15.3. How to Measure. Rutting is measured in square feet (square meters) of surface area, and its severity is determined by the depth of the rut. To determine the rut depth, a straightedge should be laid across the rut and the maximum depth measured.

15.4. Options for Repair.

15.4.1. L. Do nothing.

15.4.2. M. Shallow,* partial- or full-depth patch; partial- or full-depth patch and overlay.

15.4.3. H. Shallow,* partial- or full-depth patch; partial- or full-depth patch and overlay.

* Shallow patching will not be used on runways where FOD is of concern.

CANCELLED

Figure 15.1. Deduct values for Distress 53, Rutting

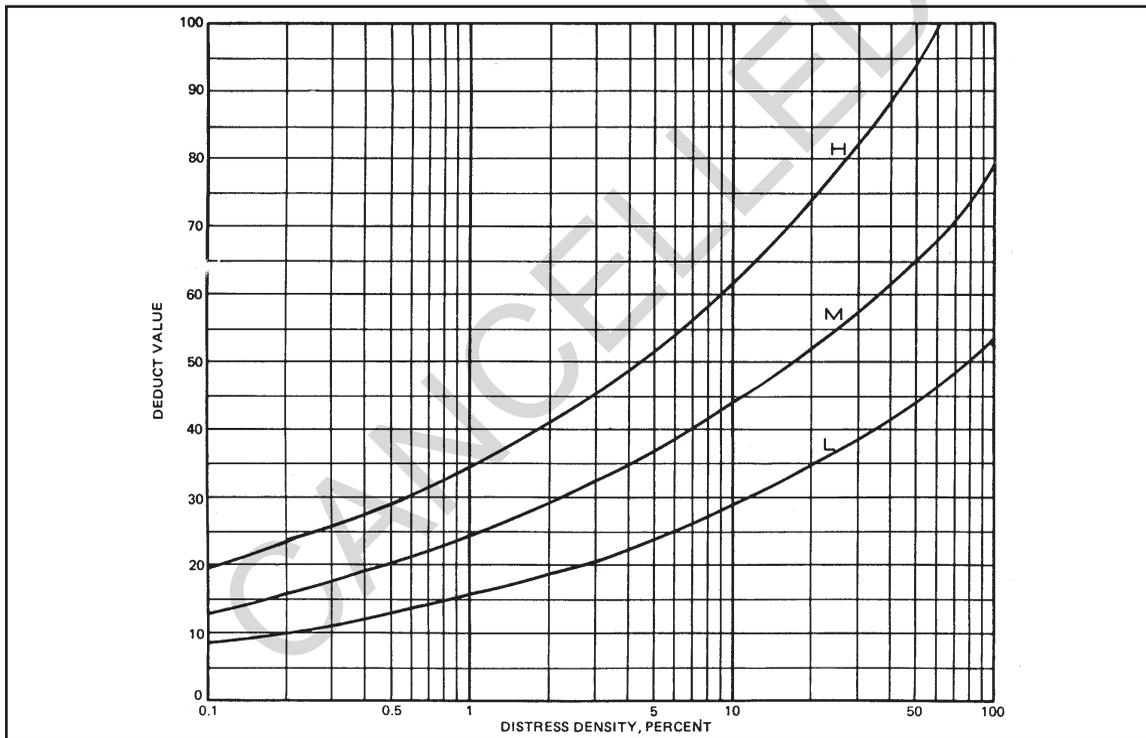


Figure 15.2. Low-severity rutting

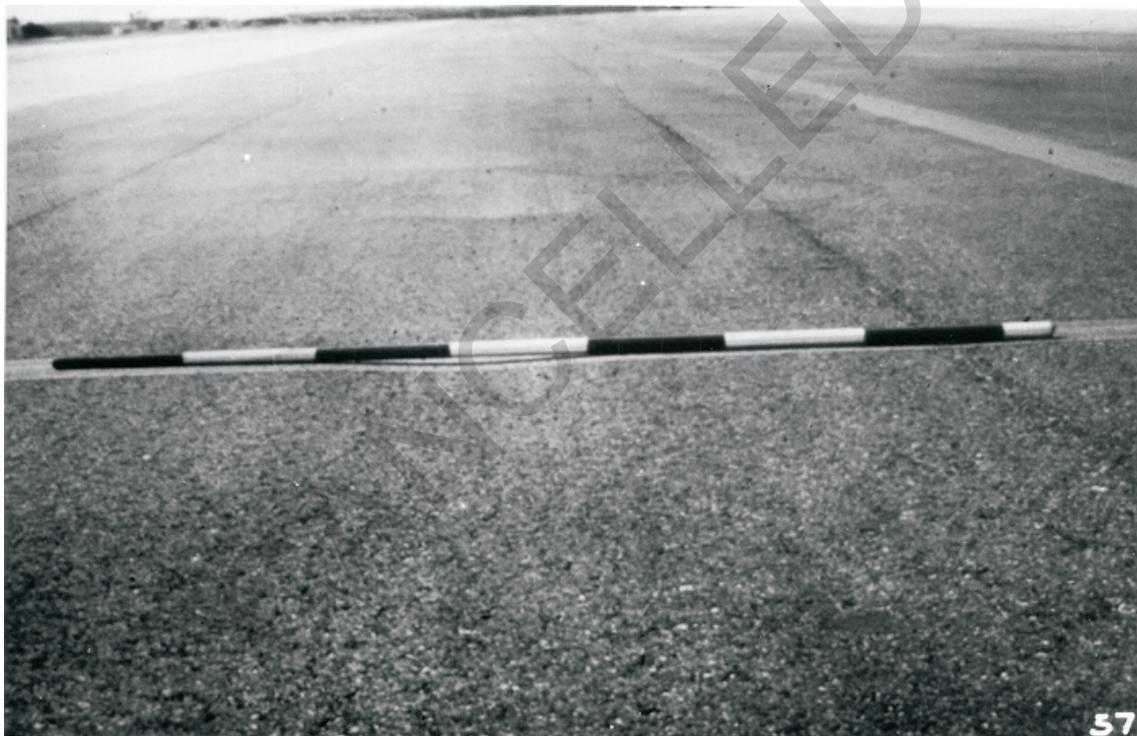


Figure 15.3. Low-severity rutting

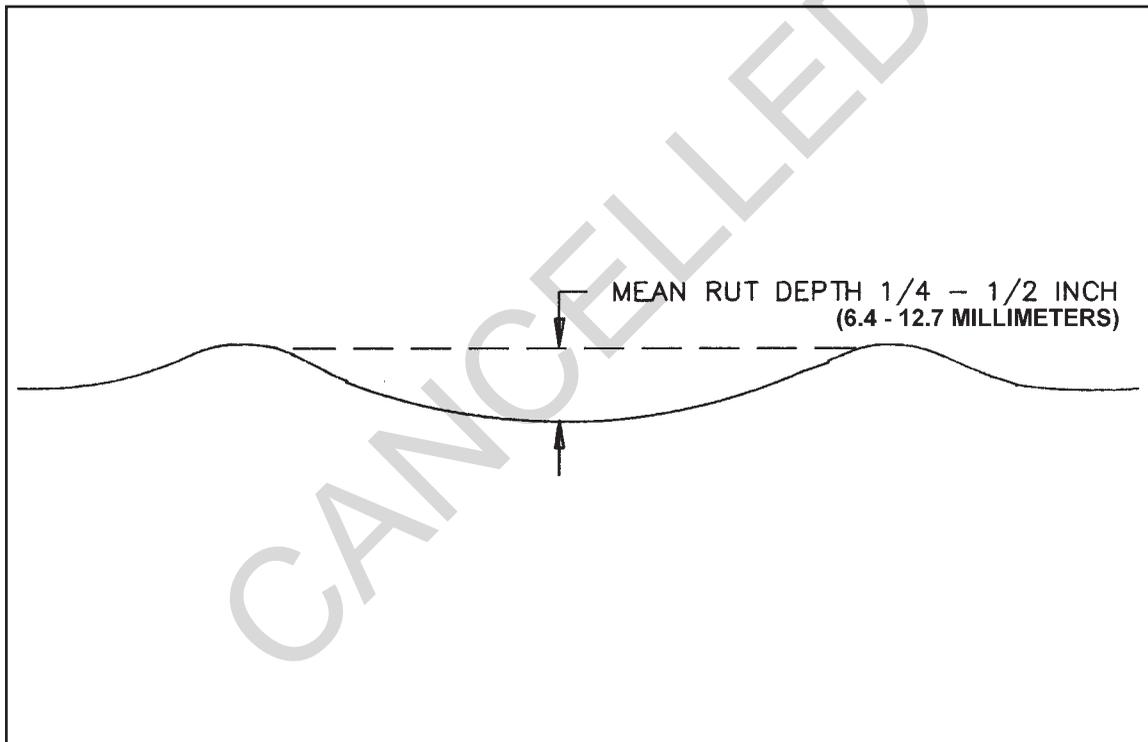


Figure 15.4. Medium-severity rutting

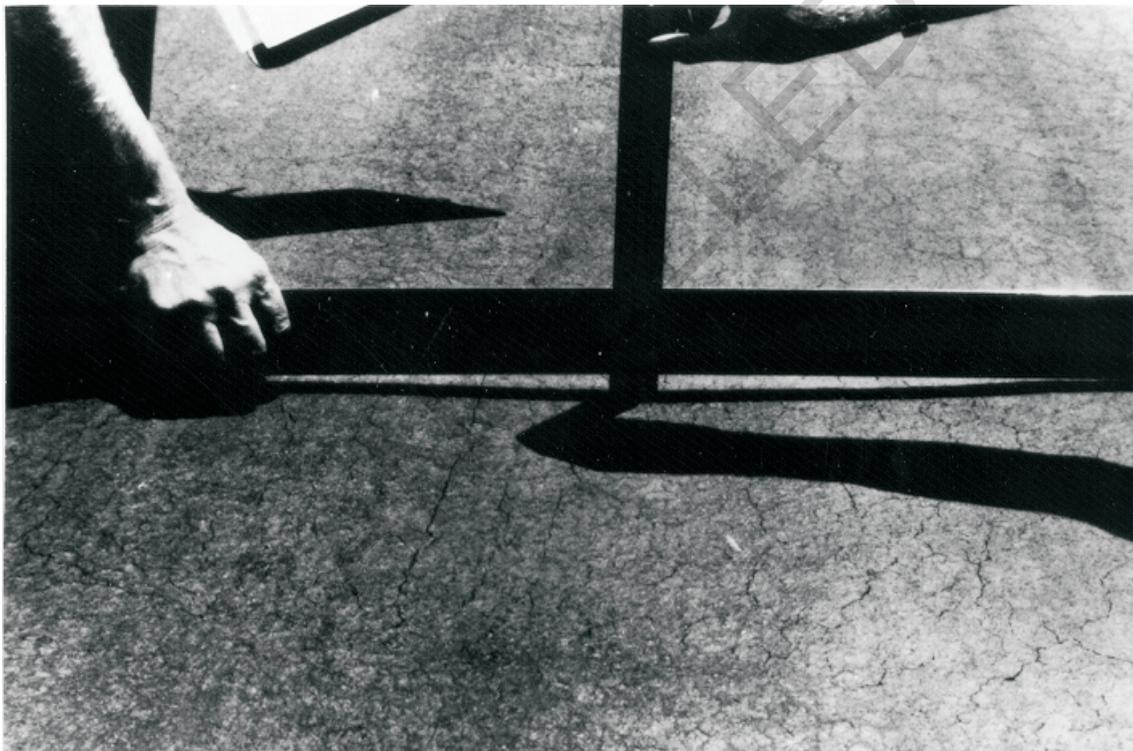


Figure 15.5. Medium-severity rutting

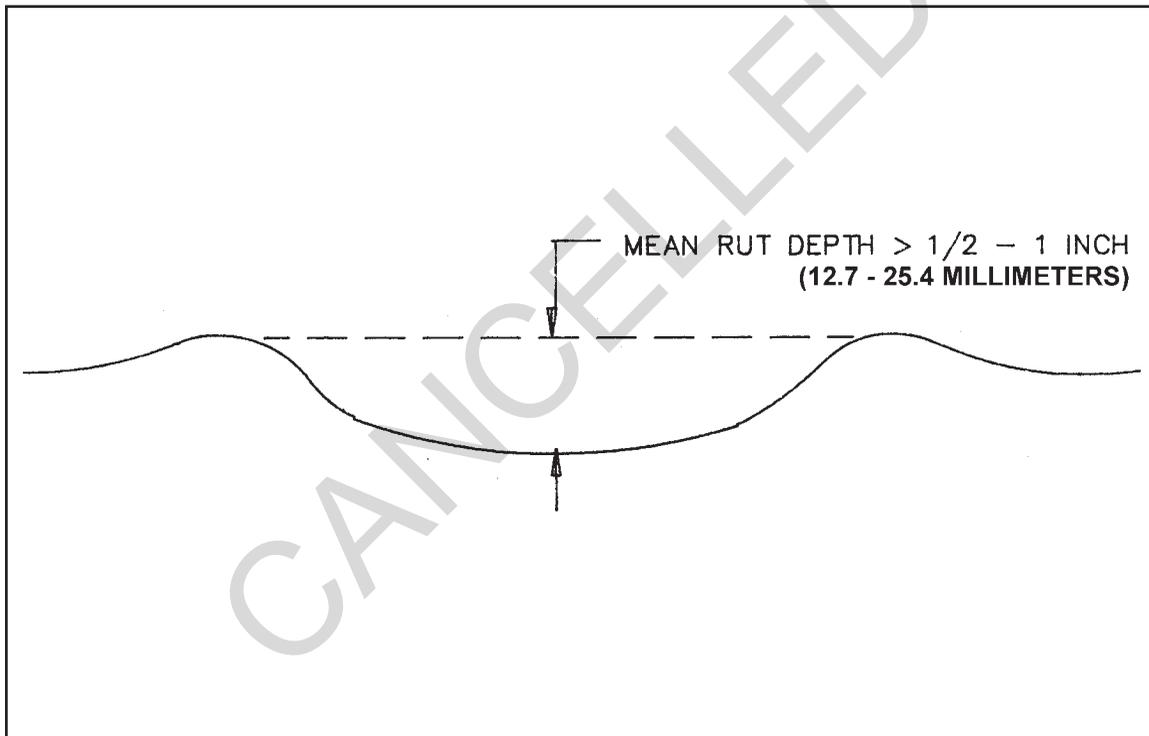
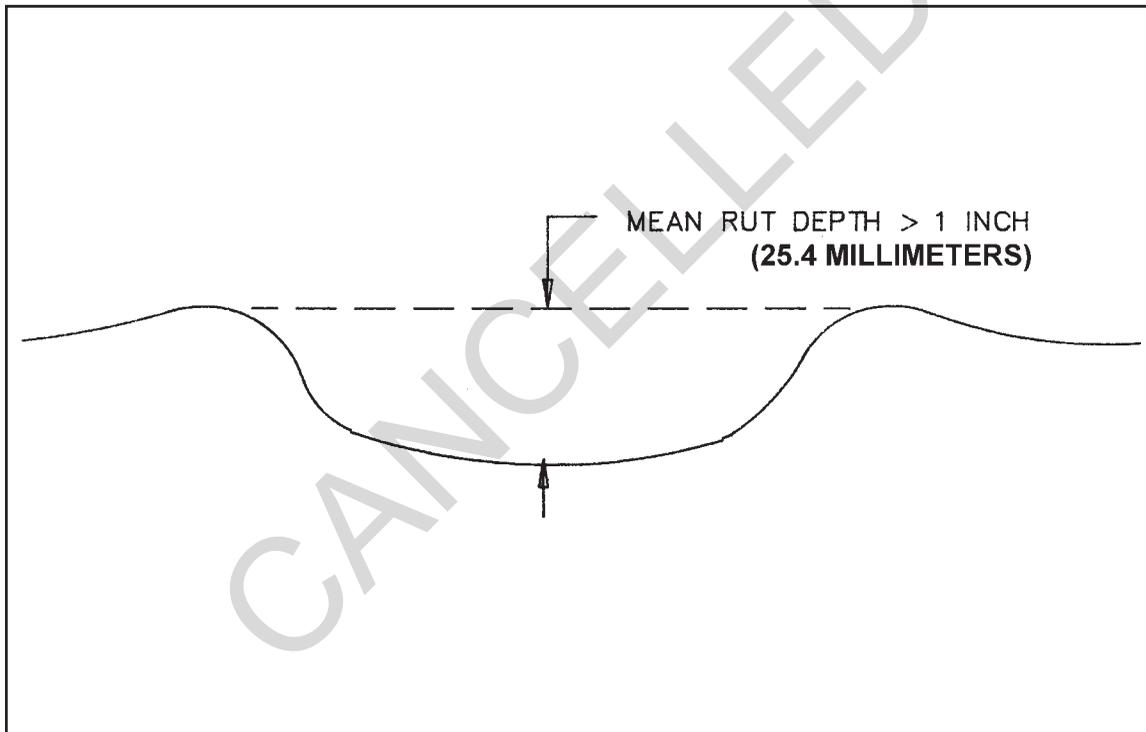


Figure 15.6. High-severity rutting



Figure 15.7. High-severity rutting



CANCELLED

CHAPTER 16

DISTRESS 54, SHOVING OF ASPHALT PAVEMENT BY PCC SLABS

16.1. 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 of the joints as they are filled with incompressible materials that prevent them from reclosing. Deduct curves for shoving of asphalt pavement by PCC slabs are shown in Figure 16.1.

16.2. Severity Levels.

16.2.1. L. A slight amount of shoving has occurred, with little effect on ride quality and no break-up of the asphalt pavement (Figure 16.2.).

16.2.2. M. A significant amount of shoving has occurred, causing moderate roughness or break-up of the asphalt pavement (Figure 16.2.).

16.2.3. H. A large amount of shoving has occurred, causing severe roughness or break-up of the asphalt pavement (Figure 16.3.).

16.3. How to Measure. Shoving is measured by determining the area in square feet (square meters) of the swell caused by shoving.

16.4. Options for Repair.

16.4.1. L. Do nothing.

16.4.2. M. Partial-depth patch; full-depth patch.

16.4.3. H. Partial-depth patch; full-depth patch.

CANCELLED

Figure 16.1. Deduct values for Distress 54, Shoving of Flexible Pavement by PCC Slabs

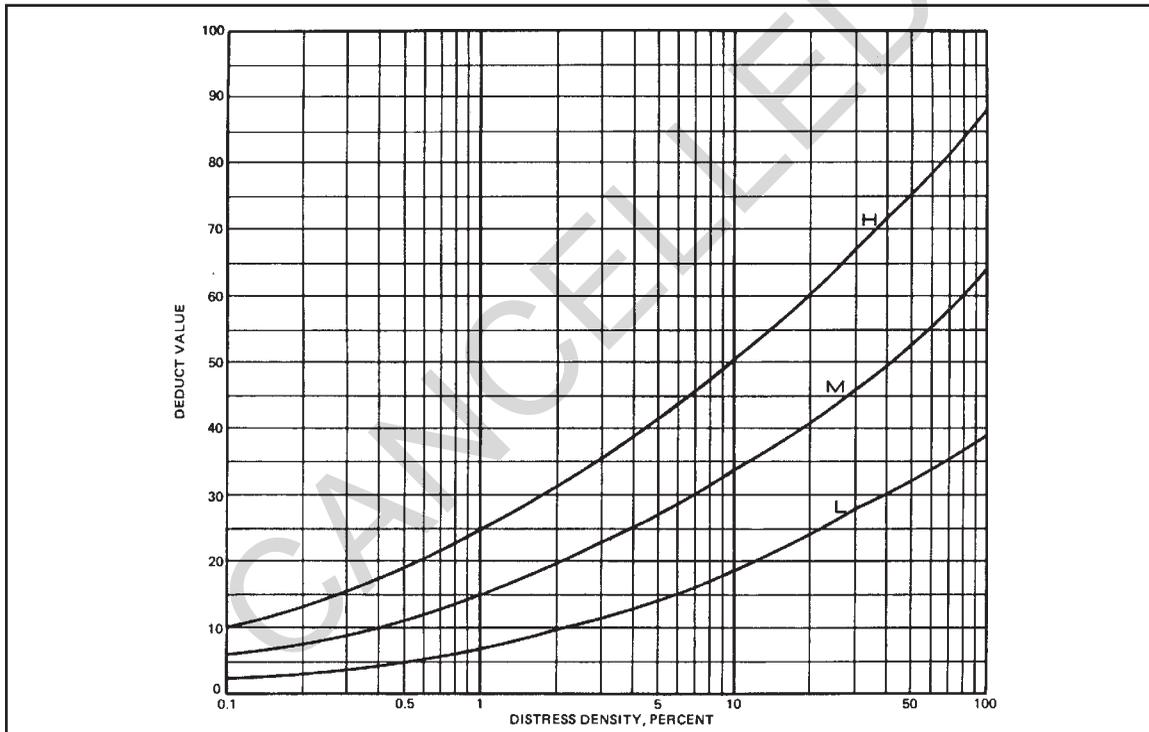


Figure 16.2. Low-severity shove on the outside and medium-severity shove in the middle



Figure 16.3. High-severity shoving



CHAPTER 17

DISTRESS 55, SLIPPAGE CRACKING

17.1. 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. Deduct curve for slippage cracks is shown in Figure 17.1.

17.2. Severity Levels.

No degrees of severity are defined. It is sufficient to indicate that a slippage crack exists (Figures 17.2. and 17.3.).

17.3. How to Measure. Slippage cracking is measured in square feet (square meters) of surface area.

17.4. Options for Repair.

Do nothing, partial-, or full-depth patch.

Figure 17.1. Deduct curve for Distress 55, Slippage Cracking

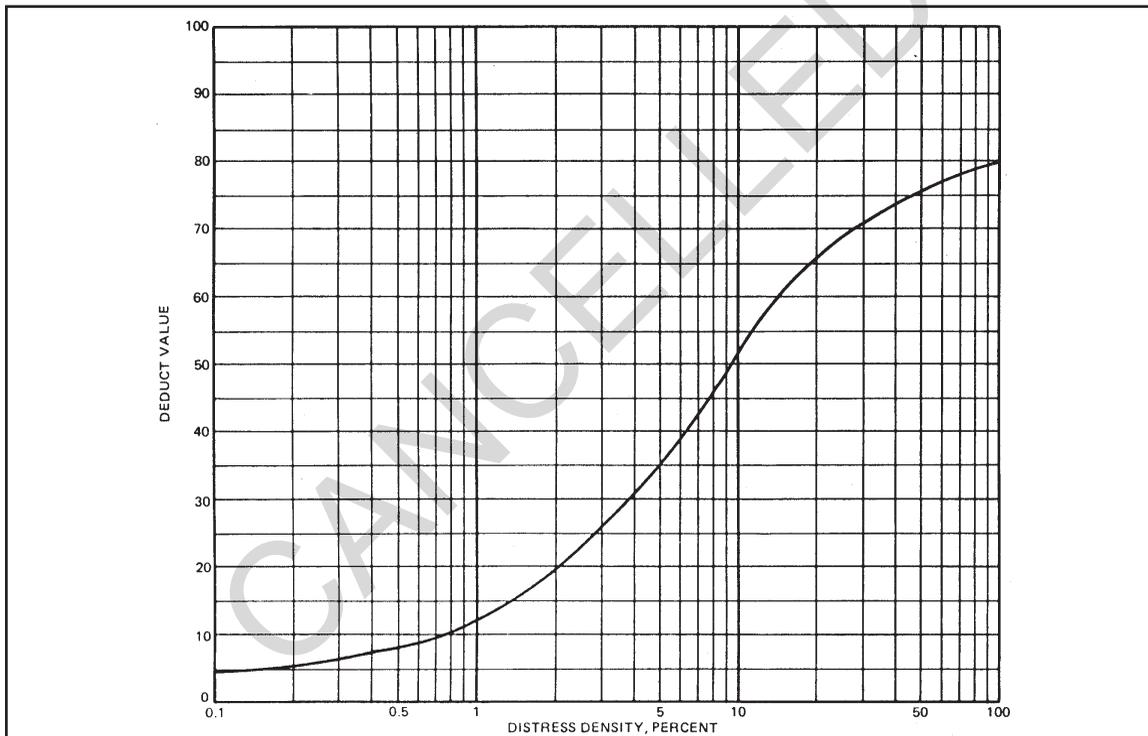


Figure 17.2. Slippage cracking



Figure 17.3. Slippage cracking



CANCELLED

CHAPTER 18

DISTRESS 56, SWELL

18.1. 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 blow-up in the PCC slab. Deduct curves for swell are shown in Figure 18.1.

18.2. Severity Levels.

18.2.1. L. Swell is barely visible and has a minor effect on the pavement's ride quality as determined at the normal aircraft speed for the pavement section under consideration. (Low-severity swells may not always be observable, but their existence can be confirmed by driving a vehicle over the section at the normal aircraft speed. An upward acceleration will occur if the swell is present) (Figure 18.2.).

18.2.2. M. Swell can be observed without difficulty and has a significant effect on the pavement's ride quality as determined at the normal aircraft speed for the pavement section under consideration (Figure 18.3.).

18.2.3. H. Swell can be readily observed and severely affects the pavement's ride quality at the normal aircraft speed for the pavement section under consideration (Figure 18.4. and Figure 18.5.).

18.3. How to Measure. The surface area of the swell is measured in square feet (square meters). The severity rating should consider the type of pavement section (i.e., runway, taxiway, or apron). For example, a swell of sufficient magnitude to cause considerable roughness on a

runway at high speeds would be rated as more severe than the same swell located on the apron or taxiway where the normal aircraft operating speeds are much lower. The following guidance is provided for runways:

Table 18.1. Swell Criteria

Severity	Height Differential
L	<3/4 inch (<19 millimeters)
M	3/4 to 1-1/2 inch (19 to 38 millimeters)
H	>1-1/2 inch (>38 millimeters)

18.4. Options for Repair.

- 18.4.1. L. Do nothing.
- 18.4.2. M. Reconstruct.
- 18.4.3. H. Reconstruct.

Figure 18.1. Deduct curve for Distress 56, Swell

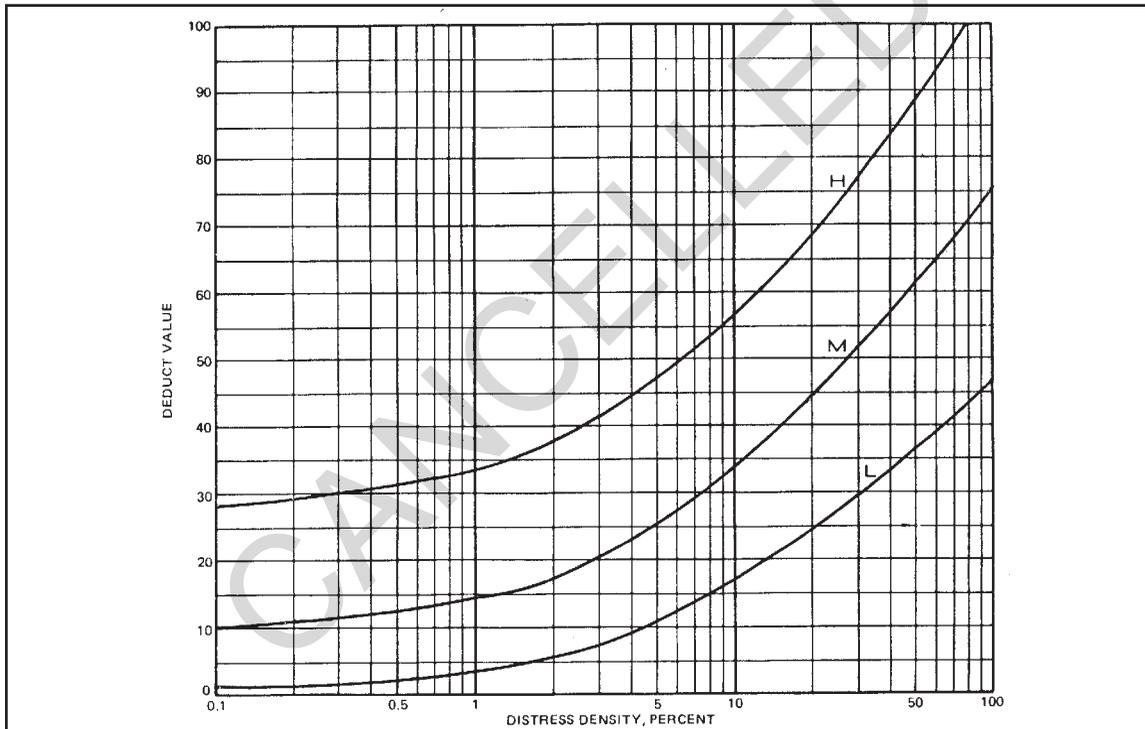


Figure 18.2. Low-severity swell

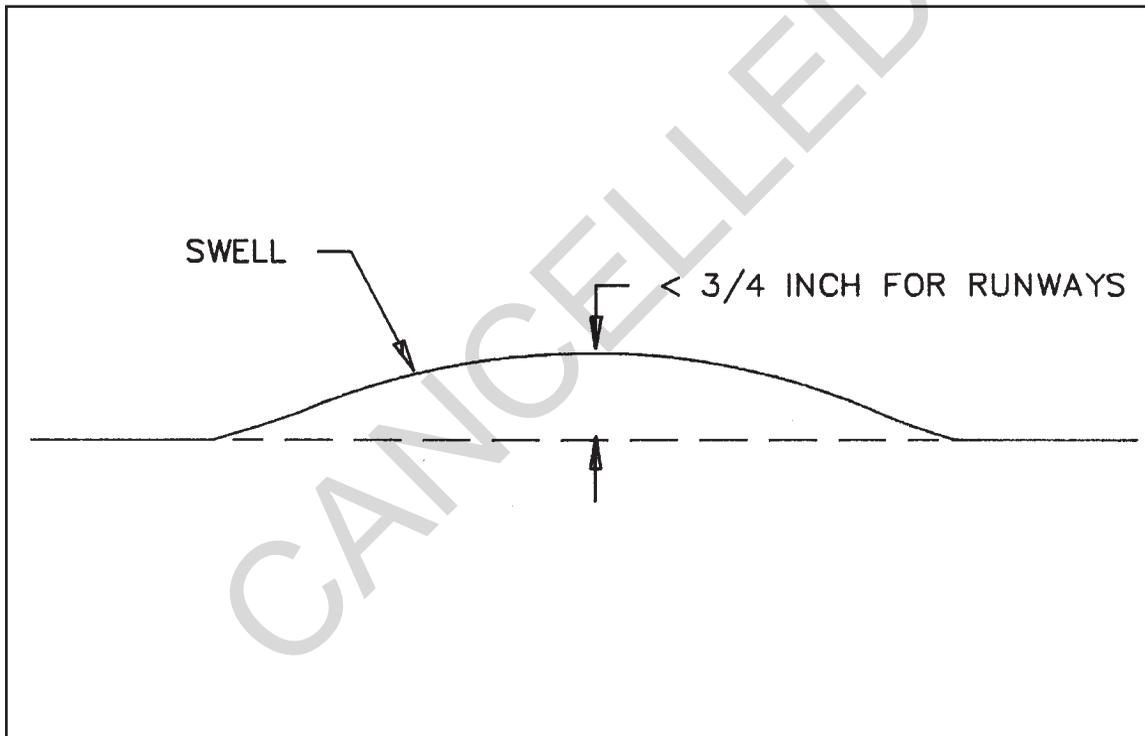


Figure 18.3. Medium-severity swell

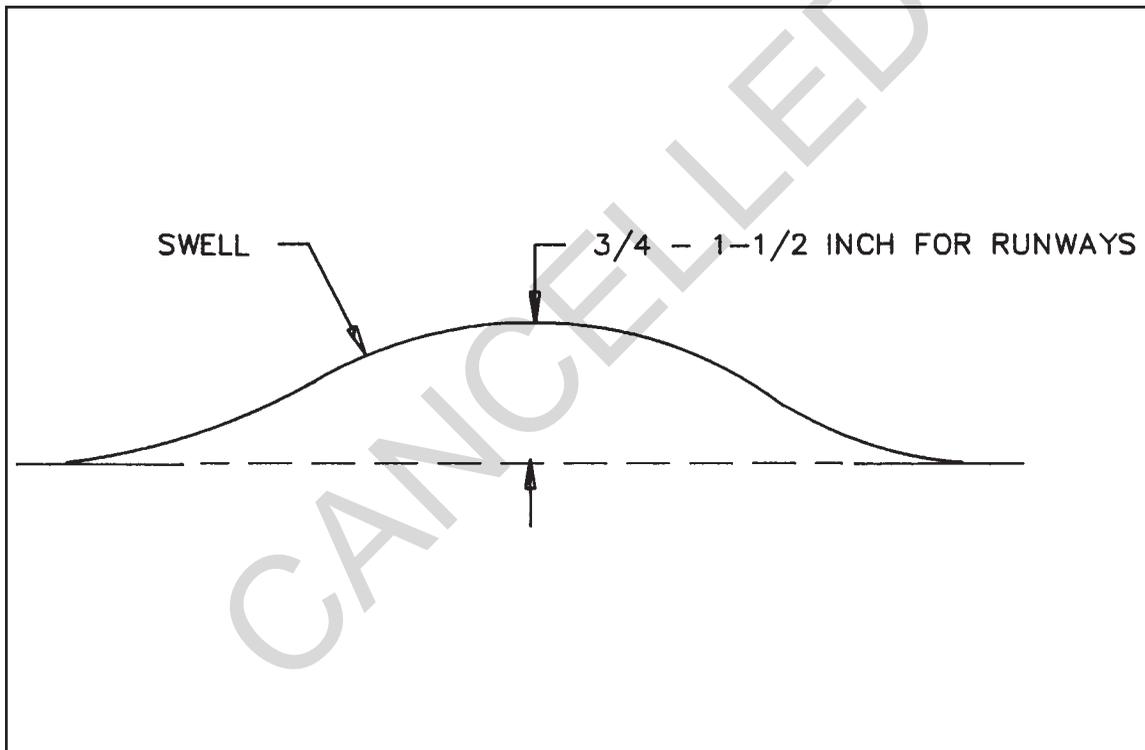


Figure 18.4. High-severity swell

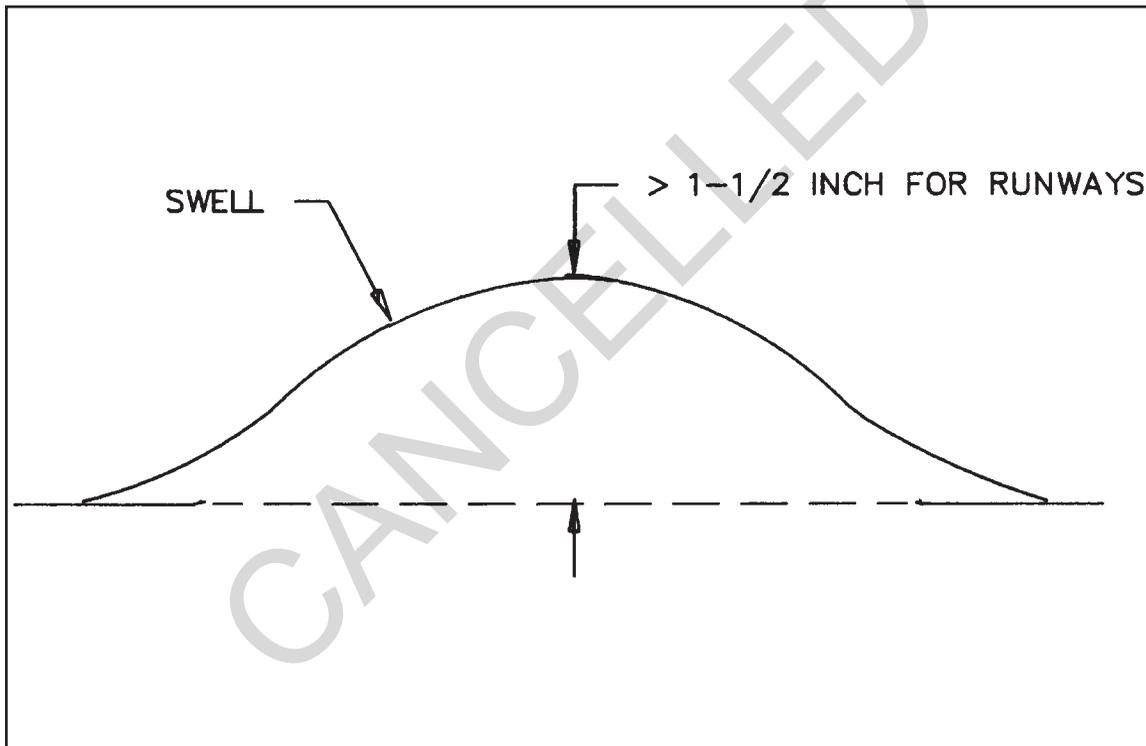


Figure 18.5. High-severity swell



CANCELLED