

UNIFIED FACILITIES CRITERIA (UFC)

PAVER CONCRETE SURFACED AIRFIELDS PAVEMENT CONDITION INDEX (PCI)



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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/)

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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\

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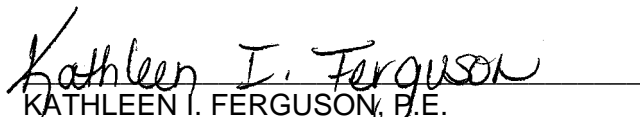
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Acknowledgment

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

CHAPTER 1

INTRODUCTION

1.1. Scope. This handbook contains distress definitions and measuring methods for concrete surfaced airfields. This information is used to determine the Pavement Condition Index (PCI). This handbook is based on the references in paragraph 1.7. with modifications for alkali-silica reaction and the addition of deduct values for each distress. AF Records Disposition. Ensure that all records created by this handbook are maintained and disposed of IAW AFMAN 37-139, "Records Disposition Schedule."

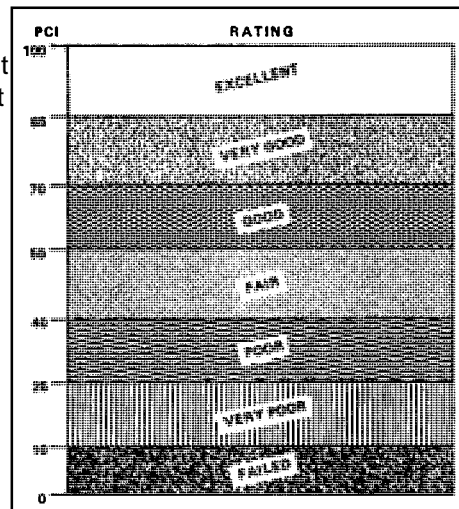
1.2. Pavement Condition Index. The PCI results from a condition survey and is a numerical rating of the pavement condition that ranges from 0 to 100, with 0 being the worst possible condition and 100 being the best possible condition (Figure 1.1).

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.

1.4. Deduct Values. Deduct value curves have been added to 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

Figure 1.1. Pavement Condition Index Rating Chart



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 each slab of the sample unit being surveyed and recording distress existing in the slab on the jointed rigid 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. A sketch is made of the sample unit, using the dots as joint intersections. The appropriate number code and severity for each distress should be placed in the square representing the slab. Sample units are chosen for inspection in accordance with guidance in TM 5-826-6/AFR 93-5.

1.7. References.

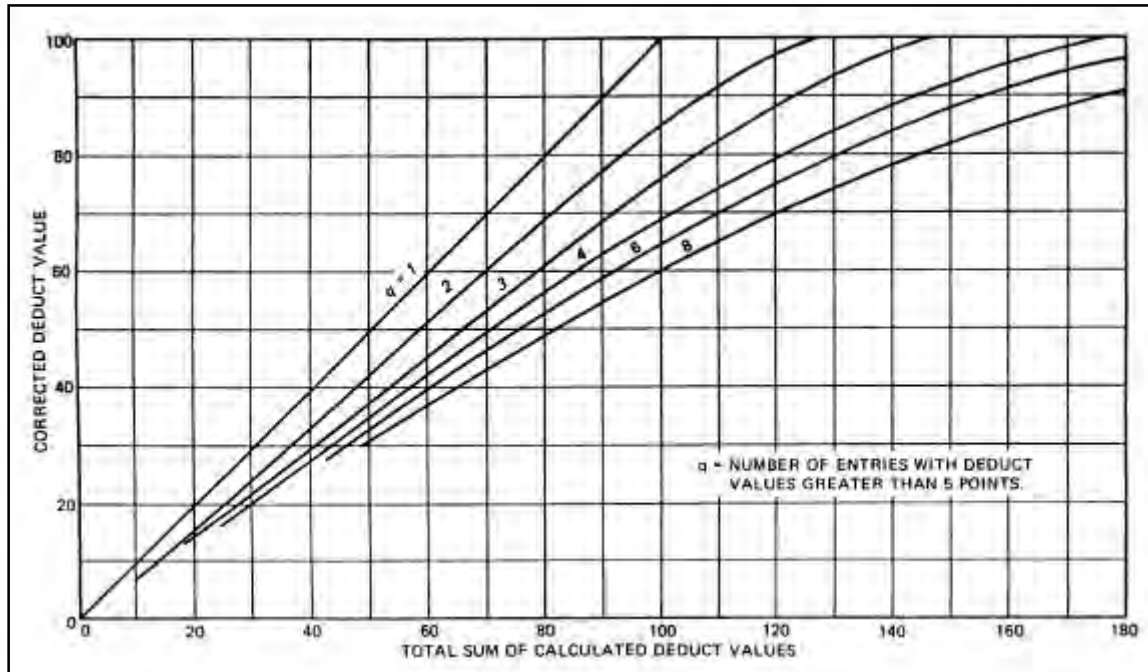
1.7.1. Shahin, M. Y., Darter, M. J., and Kohn, S. D. (1977). "Development of a Pavement Maintenance Management System," Volume V, CEEDO-TR-77-44, Air Force Civil Engineering Center, Tyndall Air Force Base, Florida.

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, Department of the Army. (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.

Figure 1.2. Corrected deduct values for jointed rigid pavements



**Table 1.1.
Frequently Occurring Problems
in Pavement Distress Identification**

**UFC 3-270-05
15 March 2001**

Situation	Action	Remarks
Distress in Jointed Rigid Pavements		
1. Low-severity scaling (i.e., crazing).	Count only if probable future scaling will occur within 2 to 3 years.	
2. Joint seal damage.	This is not counted on a slab-by-slab basis.	A severity level based on the overall condition of the joint seal in the sample unit is assigned.
3. Joint spall small enough to be filled during a joint seal repair.	Do not record.	
4. Medium- or high-severity intersecting crack (shattered slab).	No other distress should be counted.	
5. Corner or joint spalling caused by "D" cracking.	Only "D" cracking should be recorded.	If spalls are caused by factors other than "D" cracking, record each factor separately.
6. Crack repaired by a narrow patch (e.g., 4 to 10 in. wide).	Record only crack and not patch at appropriate severity level.	
7. Original distress of patch more severe than patch itself.	Original distress type should be recorded.	If, for example, patch material is present on scaled area of slab, only the scaling is counted.

CHAPTER 2

DEFINITIONS OF REPAIR OPTIONS

2.1. Grinding. Closely spaced diamond blades are used to remove material and provide a smooth surface.

2.2. Joint Reconstruction. The joint is replaced by resawing the joint after one or both sides of the joint have been patched and/or doweled to provide load transfer.

2.3. Patching.

2.3.1. Partial Depth. When the distress affects only the top few inches of the slab, the weakened concrete is removed down to sound concrete and the area patched.

2.3.2. Full Depth. When the distress extends through the slab, the affected area is saw cut and removed down to the base. The base should be recompact.

2.4. Seal Cracks. Cracks should be routed to remove any incompressibles before sealing.

2.5. Underseal. Undersealant, such as cement grout, is inserted by pressure beneath the slab to fill voids and resist future pumping action. It is recommended that load transfer be provided if needed to extend the life of the pavement.

CHAPTER 3

DISTRESS 61, BLOWUP

3.1. 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 infiltration of incompressible materials into the joint space. When expansion cannot relieve enough pressure, a localized upward movement of the slab edges (buckling) or shattering will occur in the vicinity of the joint. 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. Blowups are included for reference when closed sections are being evaluated for reopening. Deduct curves are shown in Figure 3.1. for blowup.

3.2. Severity Levels.

3.2.1. Low (L). Buckling or shattering has not rendered the pavement inoperative, and only a slight amount of roughness exists (Figure 3.2.).

3.2.2. Medium (M). Buckling or shattering has not rendered the pavement inoperative, but a significant amount of roughness exists (Figure 3.3.).

3.2.3. High (H). Buckling or shattering has rendered the pavement inoperative (Figure 3.4.).

(Note: For pavements to be considered operational, all foreign material from blowups must have been removed.)

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

3.4. Options for Repair.

- 3.4.1. L.* - Partial- or full-depth patch; slab replacement.
- 3.4.2. M.* - Partial- or full-depth patch; slab replacement.
- 3.4.3. H.* - Full-depth patch; slab replacement.

*Must provide expansion joints.

Figure 3.1. Deduct values for Distress 61, Blowup

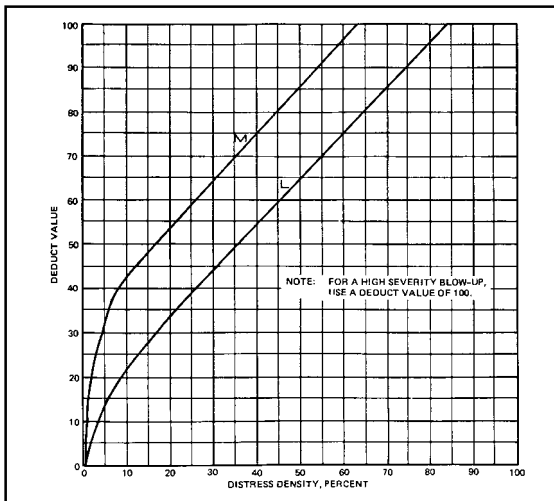


Figure 3.2. Low-severity blowup (note that this would only be considered low severity if the shattering in the foreground were the only part existing and the foreign material were removed)



Figure 3.3. Medium-severity blowup



Figure 3.4. High-severity blowup



CHAPTER 4

DISTRESS 62, CORNER BREAK

4.1. Description. A corner break is a crack that intersects the joints at a distance less than or equal to one-half the slab length on both sides, measured from the corner of the slab. For example, a slab with dimensions of 25 by 25 feet (7.5 by 7.5 meters) that has a crack intersecting the joint 5 feet (1.5 meters) from the corner on one side and 17 feet (5.1 meters) on the other side is not considered a corner break; it is a diagonal crack. However, a crack that intersects 7 feet (2.1 meters) on one side and 10 feet (3 meters) on the other is considered a corner break. A corner break differs from a corner spall in that the crack extends vertically through the entire slab thickness, while a corner spall intersects the joint at an angle. Load repetition combined with loss of support and curling stresses usually causes corner breaks. Deduct curves for corner breaks are shown in Figure 4.1.

4.2. Severity Levels.

4.2.1. L. Crack has either no spalling or minor spalling (no foreign object damage (FOD) potential). If nonfilled, it has a mean width less than approximately 1/8 inch (3.2 millimeters); a filled crack can be of any width, but the filler material must be in satisfactory condition. The area between the corner break and the joints is not cracked (Figures 4.2. and 4.3.).

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 1/8 inch (3.2 millimeters) and 1 inch (25.4 millimeters); (3) a filled crack is not spalled or only lightly spalled, but the filler is in unsatisfactory condition; (4) the area between the corner break and the joints is lightly cracked with loose or missing particles (Figures 4.4. and 4.5.).

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 inch (25.4 millimeters), creating a tire damage potential; or (3) the area between the corner break and the joints is severely cracked (Figure 4.6.).

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

4.4. Options for Repair.

4.4.1. L.* - Do nothing; seal cracks.

4.4.2. M.* - Seal cracks; full-depth patch; slab replacement.

4.4.3. H.* - Seal cracks; full-depth patch; slab replacement.

*Check for voids, consider undersealing project.

Figure 4.1. Deduct values for Distress 62,
Corner Break

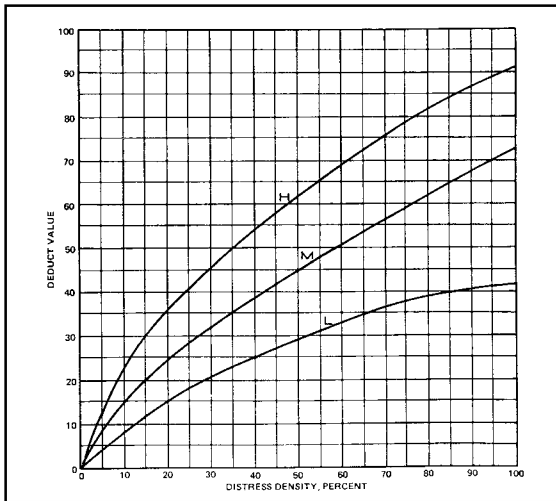


Figure 4.2. Low-severity corner break



Figure 4.3. Low-severity corner break



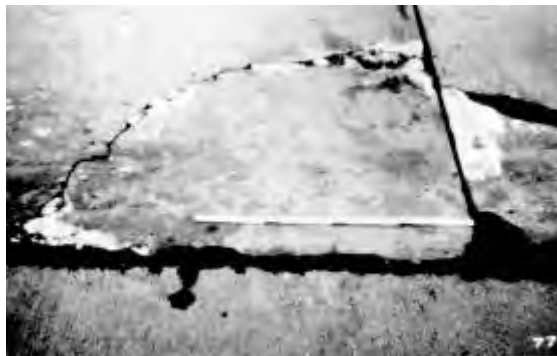
Figure 4.4. Medium-severity corner break (area between the corner break and the joints is lightly cracked)



Figure 4.5. Medium-severity corner break



Figure 4.6. High-severity corner break



CHAPTER 5

DISTRESS 63, CRACKS (LONGITUDINAL, TRANSVERSE, AND DIAGONAL)

5.1. Description. These cracks, which divide the slab into two or three pieces, are usually caused by a combination of load repetition, curling stresses, and shrinkage stresses. (For slabs divided into four or more pieces, see Shattered Slab/Intersecting Cracks.) Low-severity cracks are usually warping- or friction-related and are not considered major structural distresses. Medium- or high-severity cracks are usually working cracks and are considered major structural distresses. Deduct curves for cracking are shown in Figure 5.1.

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

5.2. Unreinforced PCC Severity Levels.

5.2.1. L. Crack has no spalling or minor spalling (no FOD potential). If nonfilled, it is less than 1/8 inch (3.2 millimeters) wide; a filled crack can be of any width, but its filler material must be in satisfactory condition (Figures 5.2., 5.3., and 5.4.).

5.2.2. M. One of the following conditions exists: (1) a filled or nonfilled crack is moderately spalled (some FOD potential); (2) a nonfilled crack has a mean width between 1/8 inch (3.2 millimeters) and 1 inch (25.4 millimeters); (3) a filled crack has no spalling or minor spalling, but the filler is in unsatisfactory condition; or (4) the slab is divided into three pieces by two or more cracks (Figures 5.5., 5.6., and 5.7.).

5.2.3. H. One of the following conditions exists: (1) a filled or nonfilled crack is severely spalled (definite FOD potential); (2) a nonfilled crack has a mean width approximately greater than 1 inch (25.4 millimeters), creating tire damage potential, or (3) the slab is divided into three pieces by two or more cracks, one of which is at least medium severity (Figures 5.8., 5.9., and 5.10.).

5.3. Reinforced Concrete Severity Levels.

5.3.1. L. (1) Nonfilled crack, 1/8 inch (3.2 millimeters) to 1/2 inch (12.7 millimeters) wide, with no faulting or spalling; (2) filled or nonfilled cracks of any width <1/2 inch (12.7 millimeters), with low-severity spalling; or (3) filled cracks of any width (filler satisfactory), with no faulting or spalling. (*Note:* Crack less than 1/8 inch (3.2 millimeters) wide with no spalling or faulting should be counted as shrinkage cracking.)

5.3.2. M. (1) Nonfilled cracks, 1/2 inch (12.7 millimeters) to 1 inch (25.4 millimeters) wide, no faulting or spalling; (2) filled cracks of any width, with faulting <3/8 inch (9.6 millimeters) or medium-severity spalling; or (3) nonfilled cracks of width < 1 inch with faulting < 3/8 inch or medium-severity spalling.

5.3.3. H. (1) Nonfilled cracks of width >1 inch (25.4 millimeters); (2) nonfilled cracks of any width, with faulting >3/8 inch (9.6 millimeters) or medium-severity spalling; or (3) filled cracks of any width, with faulting >3/8 inch (9.6 millimeters) or high-severity spalling.

5.4. How to Count. Once the severity has been identified, the distress is recorded as one slab. If a crack is repaired by a narrow patch (e.g., 4 to 10 inches (102 to 254 millimeters) wide), only the crack and not the patch should be recorded at the appropriate severity level.

5.5. Options for Repair.

5.5.1. L. Do nothing; seal cracks.

5.5.2. M. Seal cracks.

5.5.3. H. Seal cracks; full-depth patch; slab replacement.

Figure 5.1. Deduct value for Distress 63,
Longitudinal/Transverse/Diagonal Cracking

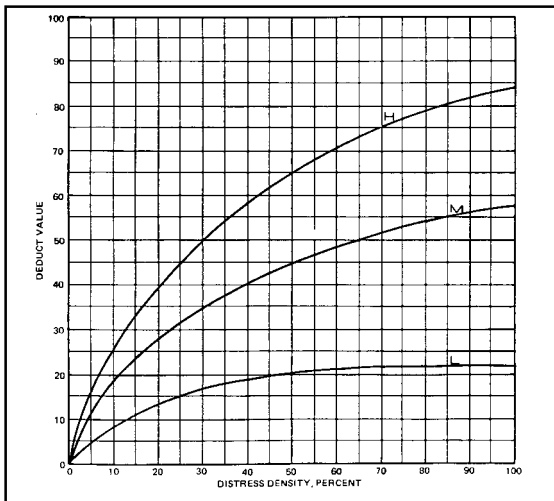


Figure 5.2. Low-severity longitudinal
crack



Figure 5.3. Low-severity longitudinal crack



Figure 5.4. Low-severity diagonal crack



Figure 5.5. Medium-severity longitudinal crack



Figure 5.6. Medium-severity transverse crack



Figure 5.7. Medium-severity transverse crack



Figure 5.8. High-severity crack



Figure 5.9. High-severity longitudinal cracks



Figure 5.10. High-severity crack



CHAPTER 6

DISTRESS 64, DURABILITY (“D”) CRACKING

6.1. Description. Durability cracking is caused by the inability of the concrete to withstand environmental factors such as freeze-thaw cycles. It usually appears as a pattern of cracks running parallel to a joint or linear crack. A dark coloring can usually be seen around the fine durability cracks. This type of cracking may eventually lead to disintegration of the concrete within 1 to 2 feet (0.3 to 0.6 meter) of the joint or crack. Deduct curves for durability cracking are shown in Figure 6.1.

6.2. Severity Levels.

6.2.1. 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 (Figures 6.2. and 6.3.).

6.2.2. M. (1) “D” cracking has developed over a considerable amount of slab area with little or no disintegration or FOD potential; or (2) “D” cracking has occurred in a limited area of the slab, such as in one or two corners or along one joint, but pieces are missing and disintegration has occurred. Some FOD potential (Figures 6.4. and 6.5.).

6.2.3. H. “D” cracking has developed over a considerable amount of slab area with disintegration of FOD potential (Figures 6.6. and 6.7.).

6.3. 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. If “D” cracking is counted, scaling on the same slab should not be recorded.

6.4. Options for Repair.

- 6.4.1. L. Do nothing; seal joints and cracks.
- 6.4.2. M. Full-depth patch; reconstruct joints.
- 6.4.3. H. Full-depth patch; reconstruct joints; slab replacement.

Figure 6.1. Deduct values for Distress 64,
Durability Cracking

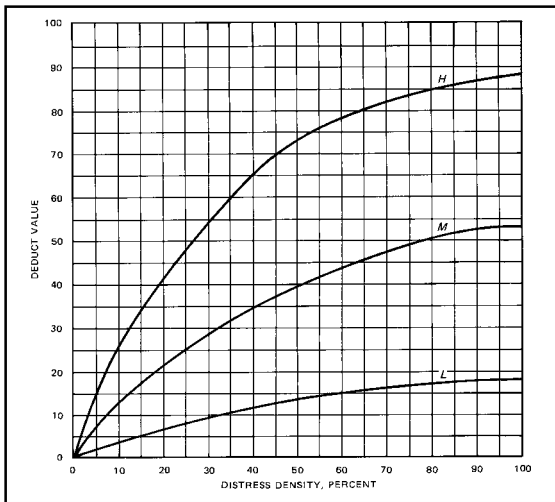


Figure 6.2. Low-severity "D" cracking



Figure 6.3. Low-severity "D" cracking approaching medium-severity (note slab is beginning to break up near corner)

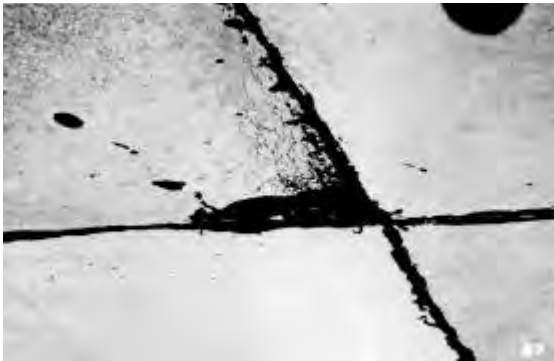


Figure 6.4. Medium-severity "D" cracking



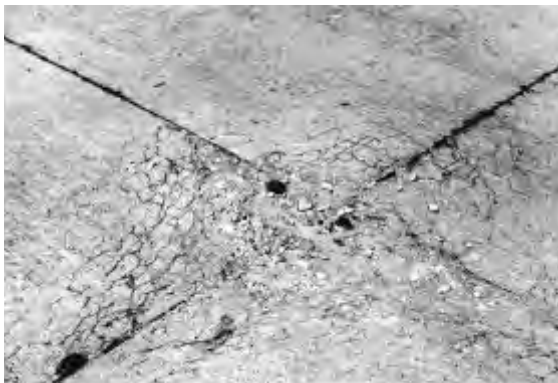
Figure 6.5. Medium-severity “D” cracking occurring in limited area of slab



Figure 6.6. High-severity “D” cracking (the “D” cracking occurs over more than one joint with some disintegration)



Figure 6.7. High-severity "D" cracking



CHAPTER 7

DISTRESS 65, JOINT SEAL DAMAGE

7.1. Description. Joint seal damage is any condition which enables soil or rocks to accumulate in the joints or allows significant infiltration of water. Accumulation of incompressible materials prevents the slabs from expanding and may result in buckling, shattering, or spalling. A pliable joint filler bonded to the edges of the slabs protects the joints from accumulation of materials and also prevents water from seeping down and softening the foundation supporting the slab. Deduct values for joint seal damage are shown in Figure 7.1.

Typical types of joint seal damage are (a) stripping of joint sealant, (b) extrusion of joint sealant, (c) weed growth, (d) hardening of the filler (oxidation), (e) loss of bond to the slab edges, and (f) lack or absence of sealant in the joint.

7.2. Severity Levels.

7.2.1. L. Joint sealer is in generally good condition throughout the section. Sealant is performing well, with only a minor amount of any of the above types of damage present (Figure 7.2.).

7.2.2. M. Joint sealer is in generally fair condition over the entire surveyed section, with one or more of the above types of damage occurring to a moderate degree. Sealant needs replacement within 2 years (Figure 7.3.).

7.2.3. H. Joint sealer is in generally poor condition over the entire surveyed section, with one or more of the above types of damage occurring to a severe degree. Sealant needs immediate replacement (Figures 7.4. and 7.5.).

7.3. How to Count. Joint seal damage is not counted on a slab-by-slab basis but is rated based on the overall condition of the sealant in the sample unit.

7.4. Options for Repair.

7.4.1. L. Do nothing.

7.4.2. M. Seal joints.

7.4.3. H. Seal joints.

Figure 7.1. Deduct values for Distress 65,
Joint Seal Damage

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

Figure 7.2. Low-severity joint seal damage



Figure 7.3. Medium-severity joint seal damage

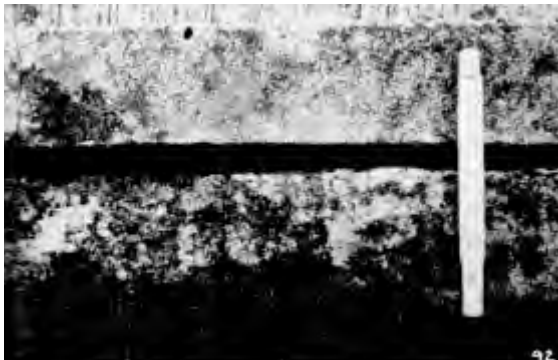


Figure 7.4. High-severity joint seal damage
(complete loss of sealant; joint is filled with
incompressible material)

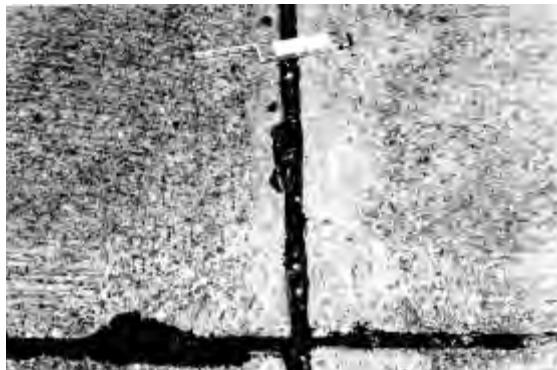


Figure 7.5. High-severity joint seal damage
(extensive amount of weed growth)



CHAPTER 8

DISTRESS 66, PATCHING, SMALL (LESS THAN 5 SQUARE FEET (1.5 SQUARE METERS))

8.1. Description. A patch is an area where the original pavement has been removed and replaced by a filler material. For condition evaluation, patching is divided into two types: small (less than 5 square feet (1.5 square meters)) and large (over 5 square feet (1.5 square meters)). Large patches are described in Chapter 9. Deduct curves for small patching are shown in Figure 8.1.

8.2. Severity Levels.

8.2.1. L. Patch is functioning well, with little or no deterioration (Figures 8.2. and 8.3.).

8.2.2. M. Patch has deteriorated, and/or moderate spalling can be seen around the edges. Patch material can be dislodged, with considerable effort (minor FOD potential) (Figures 8.4. and 8.5.).

8.2.3. H. Patch has deteriorated, either by spalling around the patch or cracking within the patch, to a state which warrants replacement (Figure 8.6.).

8.3. How to Measure. If one or more small patches having the same severity level are located in a slab, it is counted as one slab containing that distress. If more than one severity level occurs, it is counted as one slab with the higher severity level being recorded. If a crack is repaired by a narrow patch (e.g., 4 to 10 inches (102 to 254 millimeters) wide), only the crack and not the patch should be recorded at the appropriate severity level. If the original distress of a patch is more severe than the patch itself, the original distress type should be recorded.

8.4. Options for Repair.

8.4.1. L. Do nothing.

8.4.2. M. Replace patch, seal cracks.

8.4.3. H. Replace patch.

Figure 8.1. Deduct values for Distress 66,
Small Patch

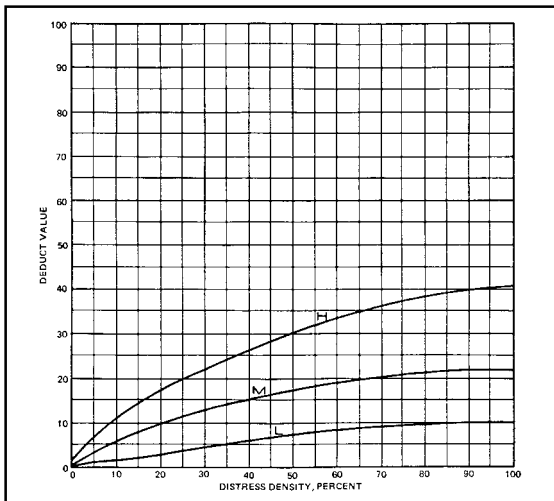


Figure 8.2. Low-severity small patch



Figure 8.3. Low-severity small patch



Figure 8.4. Medium-severity small patch



Figure 8.5. Medium-severity small patch



Figure 8.6. High-severity small patch



CHAPTER 9

DISTRESS 67, PATCHING, LARGE (OVER 5 SQUARE FEET (1.5 SQUARE METERS)) AND UTILITY CUT

9.1. Description. Patching is the same as defined in the previous section. A utility cut is a patch that has replaced the original pavement because of placement of underground utilities. The severity levels of a utility cut are the same as those for regular patching. Deduct curves for large patching are shown in Figure 9.1.

9.2. Severity Levels.

9.2.1. L. Patch is functioning well with very little or no deterioration (Figures 9.2., 9.3., and 9.4.).

9.2.2. M. Patch has deteriorated and/or moderate spalling can be seen around the edges. Patch material can be dislodged with considerable effort, causing some FOD potential (Figure 9.5.).

9.2.3. H. Patch has deteriorated to a state which causes considerable roughness and/or high FOD potential. The extent of the deterioration warrants replacement of the patch (Figure 9.6.).

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

9.4. Options for Repair.

9.4.1. L. Do nothing.

9.4.2. M. Seal cracks; repair distressed area; replace patch.

9.4.3. H. Replace patch; slab replacement.

Figure 9.1. Deduct values for Distress 67,
Patching/Utility Cut

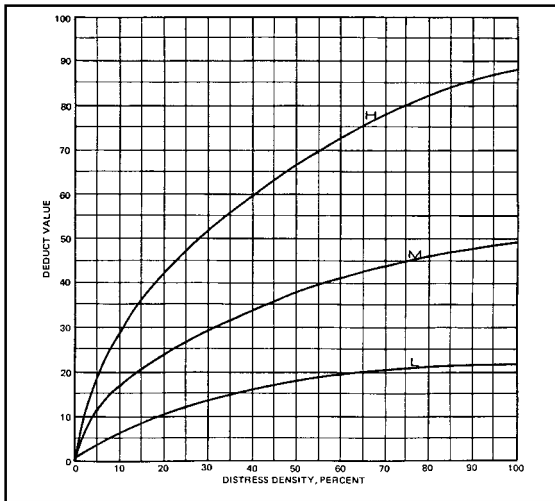


Figure 9.2. Low-severity patch



Figure 9.3. Low-severity patch



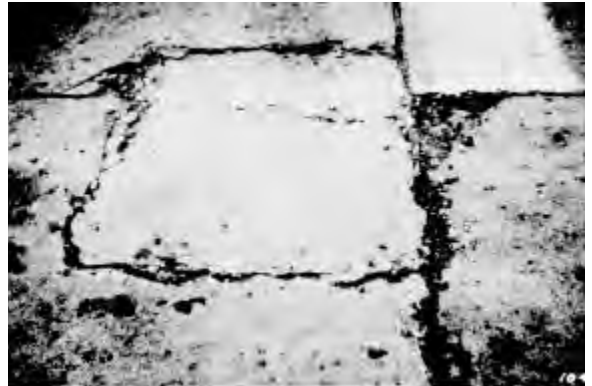
Figure 9.4. Low-severity utility cut



Figure 9.5. Medium-severity utility cut



Figure 9.6. High-severity patch



CHAPTER 10

DISTRESS 68, POPOUTS

10.1. 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 from approximately 1 inch (25.4 millimeters) to 4 inches (102 millimeters) in diameter and from 1/2 inch (12.7 millimeters) to 2 inches (50.8 millimeters) deep. Deduct curves for popouts are shown in Figure 10.1.

10.2. Severity Levels. No degrees of severity are defined for popouts. However, popouts must be extensive before they are counted as a distress; i.e., average popout density must exceed approximately three popouts per square yard over the entire slab area (Figure 10.2.).

10.3. 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 meter), at least three, random, 1-square-yard (1-square-meter) areas should be checked. When the average is greater than this density, the slab is counted.

10.4. Options for Repair. Do nothing.

Figure 10.1. Deduct values for Distress 68, Popouts

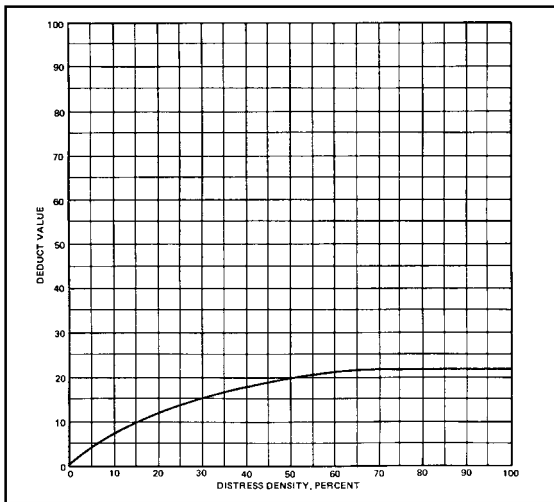


Figure 10.2. Popouts



CHAPTER 11

DISTRESS 69, PUMPING

11.1. Description. Pumping is the ejection of material by water through joints or cracks caused by deflection of the slab under passing loads. As the water is ejected, it carries particles of gravel, sand, clay, or silt and results 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. Deduct curves for pumping are shown in Figure 11.1.

11.2. Severity Levels. No degrees of severity are defined. It is sufficient to indicate that pumping exists (Figures 11.2., 11.3., 11.4., and 11.5.).

11.3. How to Count. Slabs are counted as follows (see diagram): one pumping joint between two slabs is counted as two slabs. However, if the remaining joints around the slab are also pumping, one slab is added per additional pumping joint (Figure 11.6.).

11.4. Options for Repair. Seal cracks and joints; underseal.

Figure 11.1. Deduct values for Distress 69, Pumping

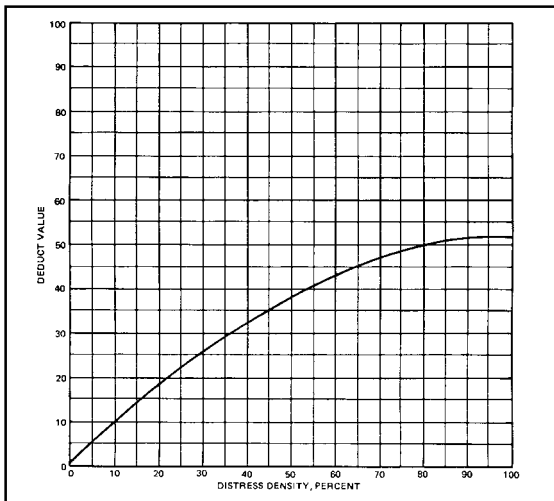


Figure 11.2. Pumping (note fine material on surface that has been pumped and has caused corner break)



Figure 11.3. Pumping (note stains on pavement)



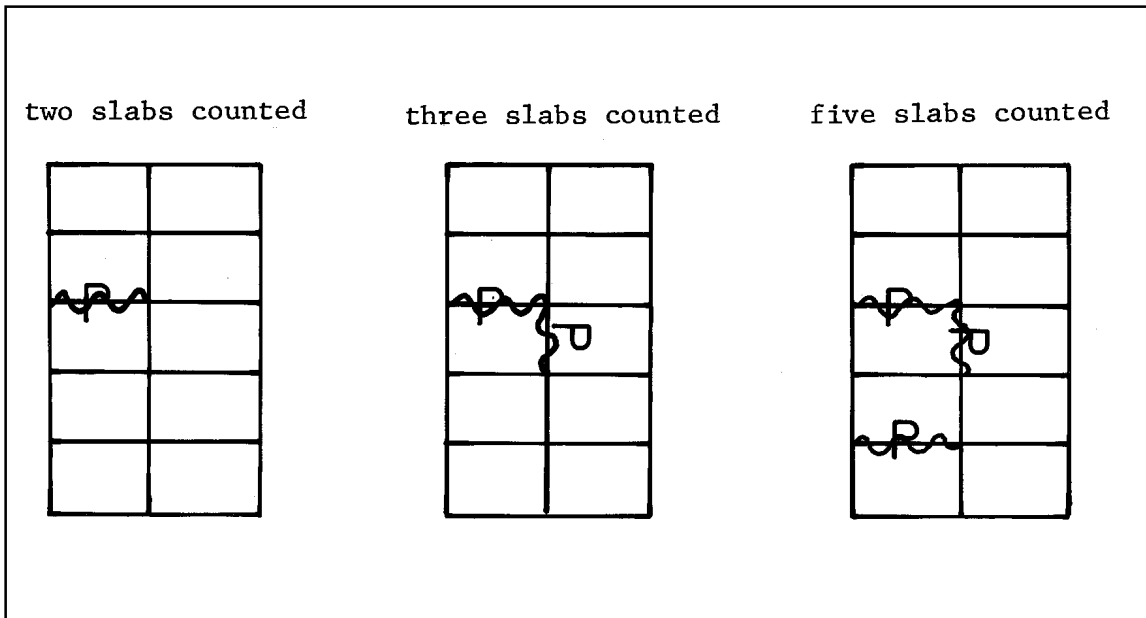
Figure 11.4. Pumping (close-up of fine materials collecting in the joint)



Figure 11.5. Pumping



Figure 11.6. Slab count for pumping



CHAPTER 12

DISTRESS 70, SCALING, MAP CRACKING, AND CRAZING

12.1. Description. Map cracking or crazing refers to a network of shallow, fine, or hairline cracks which extend only through the upper surface of the concrete. The cracks tend to intersect at angles of 120 degrees. Map cracking or crazing is usually caused by overfinishing the concrete and may lead to scaling of the surface. Scaling is the breakdown of the slab surface to a depth of approximately 1/4 inch (6.4 millimeters) to 1/2 inch (12.7 millimeters). Scaling may also be caused by deicing salts, improper construction, freeze-thaw cycles, and poor aggregate. Another recognized source of distress is the reaction between the alkalis (Na_2O and K_2O) in some cements and certain minerals in some aggregates. Products formed by the reaction between the alkalis and aggregate result in expansions that cause a breakdown in the concrete. This generally occurs throughout the slab and not just at joints where “D” cracking normally occurs. Deduct curves for scaling, map cracking, and crazing are shown in Figure 12.1.

12.2. Severity Levels Not Applicable to Alkali-Silica Reaction.

12.2.1. L. Crazing or map cracking exists over most of the slab area; the surface is in good condition with no scaling (Figure 12.2.). (*Note:* The low-severity level is an indicator that scaling may develop in the future. A slab should only be counted if, in the judgment of the pavement inspector, future scaling is likely to occur within 2 to 3 years.)

12.2.2. M. Slab is scaled over approximately 5 percent or less of the surface, causing some FOD potential (Figure 12.3.).

12.2.3. H. Slab is severely scaled, causing a high FOD potential. Usually more than 5 percent of the surface is affected (Figures 12.4. and 12.5.).

12.3. Severity Levels Applicable to Alkali-Silica Reaction (use deduct curves for Durability Cracking, Distress 64).

12.3.1. L. Alkali-silica reaction is noted on only a small portion of the slab and produces no FOD (Figure 12.6.).

12.3.2. M. Alkali-silica reaction is noted over the entire slab, but no loose aggregate exists (Figure 12.6.).

12.3.3. H. Alkali-silica reaction is causing scaling and producing FOD (Figure 12.7.).

12.4. 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.

12.5. Options for Repair.

12.5.1. L. Do nothing.

12.5.2. M. Partial-depth patch; slab replacement.

12.5.3. H. Slab replacement.

Figure 12.1. Deduct values for Distress 70, Scaling, Map Cracking, and Crazing

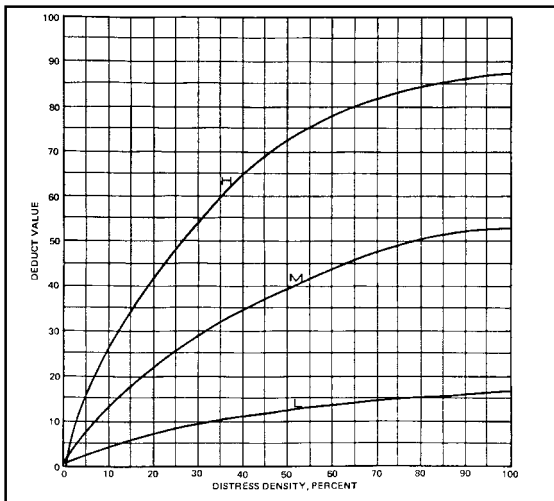


Figure 12.2. Low-severity crazing

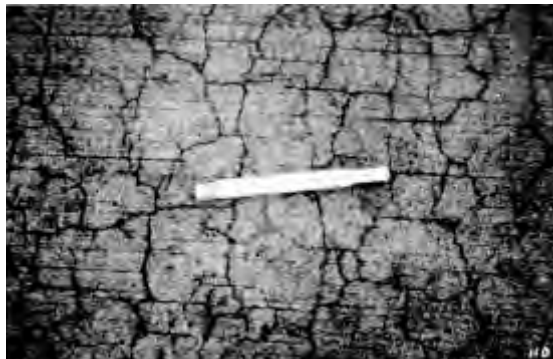


Figure 12.3. Medium-severity scaling

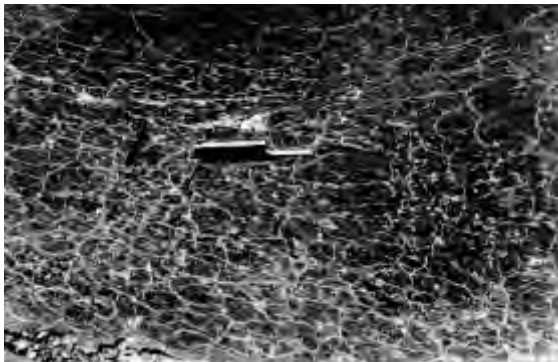


Figure 12.4. High-severity scaling



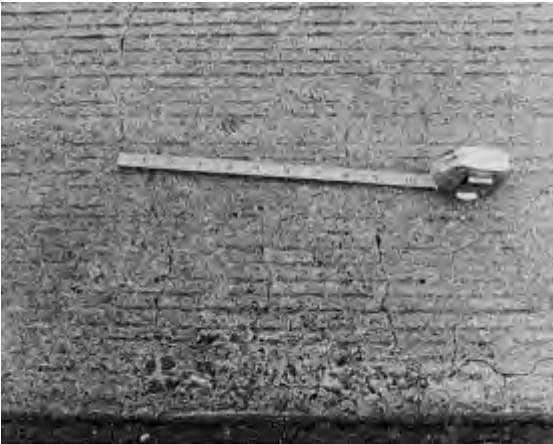
Figure 12.5. Close-up of high-severity scaling



Figure 12.6. High-severity scaling caused by alkali aggregate reaction. This could be low- or medium-severity alkali-silica reaction, depending on the extent of coverage over the slab



Figure 12.7. High-severity alkali-silica reaction on a grooved pavement. Note the missing pieces, creating FOD, on the lower part of the photograph



CHAPTER 13

DISTRESS 71, SETTLEMENT OR FAULTING

13.1. Description. Settlement or faulting is a difference of elevation at a joint or crack caused by upheaval or consolidation. Deduct curves for settlement or faulting are shown in Figure 13.1.

13.2. 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.

13.3. Difference in elevation.

	Runways/Taxiways	Aprons
L	<1/4 in. (6.4 mm)	1/8 ≤ 1/2 in. (3.2 - 12.7 mm) (Figures 13.2. and 13.3.)
M	1/4 - 1/2 in. (6.4 - 12.7 mm)	1/2 - 1 in. (12.7 - 25.4 mm) (Figure 13.4.)
H	>1/2 in. (12.7 mm)	>1 in. (25.4 mm) (Figures 13.5. and 13.6.)

13.4. How to Count. 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.

13.5. Options for Repair.

13.5.1. L.* Do nothing.

13.5.2. M.* Slab grinding or jacking.

13.5.3. H.* Slab grinding or jacking; slab replacement.

*Check for joint seal damage and voids. Consider undersealing and joint seal project.

Figure 13.1. Deduct values for Distress 71, Settlement or Faulting

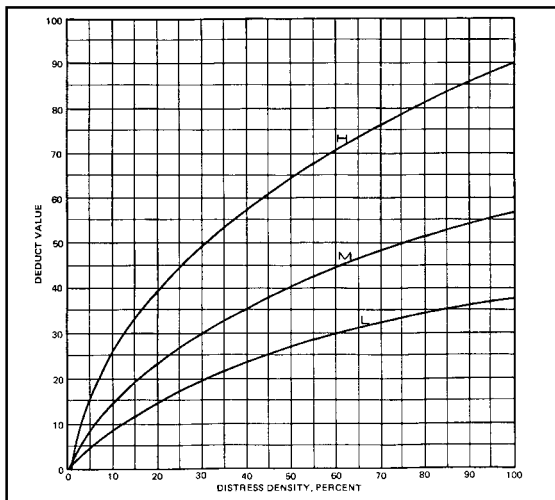


Figure 13.2. Low-severity settlement, 3/8 in. (9.6 mm), on apron

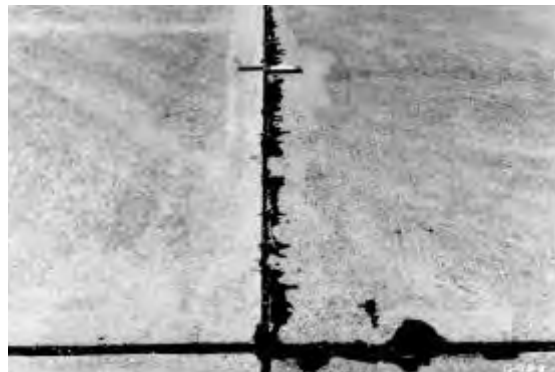


Figure 13.3. Low-severity settlement on apron



Figure 13.4. Medium-severity settlement on apron
>1/2 in. (>12.7 mm)



Figure 13.5. High-severity settlement on
taxiway/runway, 3/4 in. (19.1 mm)



Figure 13.6. High-severity settlement



CHAPTER 14

DISTRESS 72, SHATTERED SLAB/INTERSECTING CRACKS

14.1. Description. Intersecting cracks are cracks that break into four or more pieces because of overloading and/or inadequate support. The high-severity level of this distress type, as defined below, is referred to as a shattered slab. If all pieces or cracks are contained within a corner break, the distress is categorized as a severe corner break. Deduct curves for shattered slabs/intersecting cracks are shown in Figure 14.1.

14.2. Severity Levels.

14.2.1. L. Slab is broken into four or five pieces with the vast majority of the cracks (over 85 percent) of low severity (Figures 14.2. and 14.3.).

14.2.2. M. (1) Slab is broken into four or five pieces with over 15 percent of the cracks of medium severity (no high-severity cracks); or (2) slab is broken into six or more pieces with over 85 percent of the cracks of low severity (Figures 14.4. and 14.5.).

14.2.3. H. At this level of severity, the slab is called shattered: (1) slab is broken into four or five pieces with some or all of the cracks of high severity; (2) slab is broken into six or more pieces with over 15 percent of the cracks of medium or high severity (Figure 14.6.).

14.3. 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.

14.4. Options for Repair.

14.4.1. L. Seal cracks.

14.4.2. M. Seal cracks; full-depth patch; slab replacement.

14.4.3. H. Full-depth patch; slab replacement.

Figure 14.1. Deduct values for Distress 72,
Shattered Slab

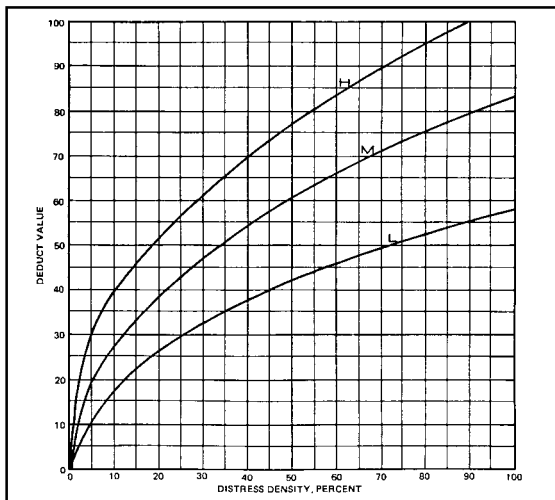


Figure 14.2. Low-severity intersecting cracks



Figure 14.3. Low-severity intersecting cracks



Figure 14.4. Medium-severity intersecting cracks



Figure 14.5. Medium-severity intersecting cracks



Figure 14.6. Shattered slab



CHAPTER 15

DISTRESS 73, SHRINKAGE CRACKS

15.1. Description. Shrinkage cracks are hairline cracks that are usually only a few feet long and do not extend across the entire slab. They are formed during the setting and curing of the concrete and usually do not extend through the depth of the slab. A deduct curve for shrinkage cracks is shown in Figure 15.1.

15.2. Severity Levels. No degrees of severity are defined. It is sufficient to indicate that shrinkage cracks exist (Figures 15.2. and 15.3.).

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

15.4. Options for Repair. Do nothing.

Figure 15.1. Deduct values for Distress 73,
Shrinkage Cracks

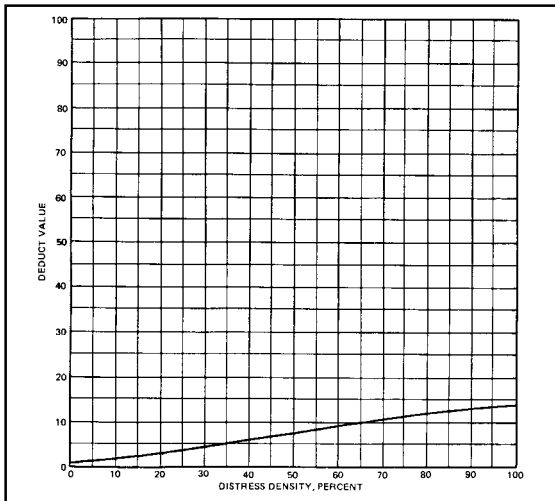


Figure 15.2. Shrinkage crack



Figure 15.3. Shrinkage cracks



CHAPTER 16

DISTRESS 74, SPALLING (TRANSVERSE AND LONGITUDINAL JOINTS)

16.1. Description. Joint spalling is the breakdown of the slab edges within 2 feet (0.6 meter) 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 loads. Weak concrete at the joint (caused by overworking) combined with traffic loads is another cause of spalling. Deduct curves for spalling joints are shown in Figure 16.1.

16.2. Severity Levels.

16.2.1. L. Spall over 2 feet (0.6 meter) long: (a) spall is broken into no more than three pieces defined by low- or medium-severity cracks; little or no FOD potential exists; or (b) joint is lightly frayed; little or no FOD potential exists (Figure 16.2.).

16.2.2. L. Spall less than 2 feet (0.6 meter) long: spall is broken into pieces or fragmented, little FOD or tire damage potential exists (Figure 16.3.).

16.2.3. M. Spall over 2 feet (0.6 meter) long: (a) spall is broken into more than three pieces defined by light or medium cracks; (b) spall is broken into no more than three pieces with one or more of the cracks being severe with some FOD potential existing; or (c) joint is moderately frayed, with some FOD potential (Figure 16.4.).

16.2.4. M. Spall less than 2 feet (0.6 meter) long: spall is broken into pieces or fragmented, with some of the pieces loose or absent, causing considerable FOD or tire damage potential (Figure 16.5.).

16.2.5. H. Spall over 2 feet (0.6 meter) long: (1) spall is broken into more than three pieces defined by one or more high-severity cracks with high FOD potential; or (2) joint is severely frayed, with high FOD potential (Figures 16.6. and 16.7.). (*Note:* If less than 2 ft (0.6 m) of the joint is lightly frayed, the spall should not be counted.)

16.3. 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 to be filled during a joint seal repair, it should not be recorded.

16.4. Options for Repair.

- 16.4.1. L. Do nothing.
- 16.4.2. M. Partial-depth patch.
- 16.4.3. H. Partial-depth patch.

Figure 16.1. Deduct values for Distress 74,
Spalling Along Joints

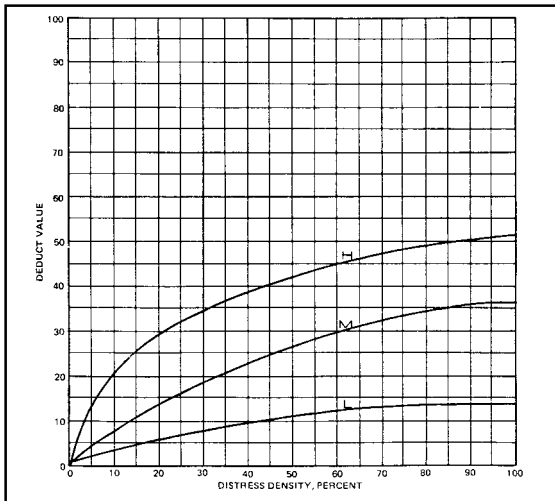


Figure 16.2. Low-severity joint spall



Figure 16.3. Low-severity joint spall



Figure 16.4. Medium-severity joint spall



Figure 16.5. Medium-severity joint spall



Figure 16.6. High-severity joint spall



Figure 16.7. High-severity joint spall



CHAPTER 17

DISTRESS 75, SPALLING (CORNER)

17.1. Description. Corner spalling is the raveling or breakdown of the slab within approximately 2 feet (0.6 meter) of the corner. A corner spall differs from the corner break in that the spall angles downward to intersect the joint, while a break extends vertically through the slab. Deduct curves for corner spalling are shown in Figure 17.1.

17.2. Severity Levels.

17.2.1. 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), (2) spall is defined by one medium-severity crack (little or no FOD potential) (Figures 17.2. and 17.3.).

17.2.2. 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 (Figures 17.4. and 17.5.).

17.2.3. 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 (Figures 17.6. and 17.7.).

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

17.4. Options for Repair.

17.4.1. L. Do nothing.

17.4.2. M. Partial-depth patch.

17.4.3. H. Partial-depth patch.

Figure 17.1. Deduct values for Distress 75,
Corner Spalling

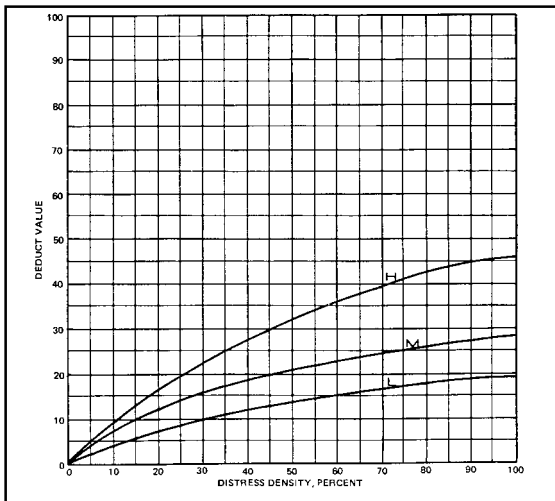


Figure 17.2. Low-severity corner spall



Figure 17.3. Low-severity corner spall



Figure 17.4. Medium-severity corner spall

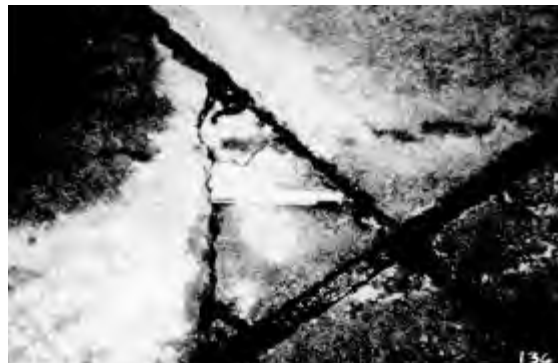


Figure 17.5. Medium-severity corner spall



Figure 17.6. High-severity corner spall



Figure 17.7. High-severity corner spall

