PAVER CONCRETE DISTRESS MANUAL

Pavement Distress Identification Guide for Jointed Concrete Roads and Parking Lots

U.S. Army Center for Public Works
CPW

US Army Corps of Engineers
Construction Engineering Research Laboratories

TR 97/105
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Foreword

This document is a revision and technical update of the original *PAVER Concrete Distress Manual* by M.Y. Shahin and S.D. Kohn (USACERL, June 1989). This update was prepared for the Directorate of Engineering, U.S. Army Center for Public Works (USACPW) under Military Interdepartmental Purchase Request (MIPR) E87950430, "Technical Support for Army Transportation Infrastructure (PAVER)," dated September 1995. The Technical Monitor was Ali A. Achmar, CECPW-ER.

The work was conducted by the Maintenance Management and Preservation Division (FL-P) of the Facilities Technology Laboratory (FL), U.S. Army Construction Engineering Research Laboratories (USACERL). The Principal Investigator was M.Y. Shahin, CECER-FL-P. Jeffrey A. Burkhalter is acknowledged for his assistance in collecting new data, revising technical content, and preparing the revised distress manual. Gordon L. Cohen, Technical Information Team (CECER-TR-I), was publication designer and technical editor. Dr. Simon S. Kim is Chief, CECER-FL-P, and Donald F. Fournier is Acting Operations Chief, CECER-FL.

Dr. Michael J. O'Connor is the Director of USACERL.

This updated manual supersedes "PAVER Field Manual, Jointed Concrete/ Asphalt Surfaced Roads and Parking Lots," REV 6/89 (USACERL, June 1989).

Table of Contents

Introduction

Objective and Scope of This Manual

This pavement distress manual is intended for use in conjunction with the PAVER Engineered Management System (EMS). The manual defines distresses and measurement methods for inspecting the condition of jointed concrete roads and parking lots. The definitions and methods are keyed for use in determining a Pavement Condition Index (PCI), which is a central component of the PAVER EMS.

This manual is specially designed for use in the field during pavement inspections, but is also appropriate for use in pavement inspection training courses. A reference list is provided on page 48 for readers who want more detailed information about PAVER, determining the PCI for roads and parking lots, and how to use it in pavement management.

Frequently Asked Questions About Identifying and Counting Concrete Pavement Distresses

This manual lists alphabetically 19 distress types for jointed concrete pavements. Distress definitions apply to both plain and reinforced jointed concrete pavements, with the exception of linear cracking distress, which is defined separately for plain and reinforced jointed concrete.

New PAVER users often ask about identification and counting methods for various distresses. Detailed answers to these questions are included for each distress under the heading "How to Count." For the reader's convenience, however, the most frequently asked questions are addressed below:

1. **How should faulting be counted?** Faulting is counted only at joints. Faulting associated with cracking is not counted separately since it is incorporated into the severity-level definitions of cracks. Crack definitions are also used in defining corner breaks and divided slabs.

2. **How should joint seal damage be counted?** Joint seal damage is not counted on a slab-by-slab basis. Instead, a severity level is assigned based on the overall condition of the joint seal in the area.

3. **How are shrinkage cracks distinguished from linear cracks?** Cracks in reinforced concrete slabs that are less than 1/8 in. wide are counted as shrinkage cracks. Shrinkage cracks

should not be counted to determine if a slab is broken into four or more pieces.

4. **When should low-severity scaling be counted?**
   Low-severity scaling (i.e., crazing) should be counted only if there is evidence that future scaling is likely to occur.

The reader should note that the items above are general issues, and do not stand alone as inspection criteria. To measure each distress type properly, the inspector must be familiar with the individual distress criteria, which are described and illustrated on the pages that follow.

Ride Quality Assessment

Two types of distresses—Blowup/Buckling and Railroad Crossings—require an assessment of ride quality in order to establish a distress-severity level. To assess ride quality for these distresses, the inspector should use the following severity-level definitions:

L Low. Vehicle vibrations (e.g., from corrugation) are noticeable, but no reduction in speed is necessary for comfort or safety; and/or individual bumps or settlements cause the vehicle to bounce slightly, but create little discomfort.

M Medium. Vehicle vibrations are significant and some reduction in speed is necessary for safety and comfort; and/or individual bumps or settlements cause the vehicle to bounce significantly, creating some discomfort.

H High. Vehicle vibrations are so excessive that speed must be reduced considerably for safety and comfort; and/or individual bumps or settlements make the vehicle to bounce excessively, creating substantial discomfort, a safety hazard, or a strong posibility of causing vehicle damage.

The inspector should drive at the posted speed in a sedan that is representative of cars typically seen in local traffic. Pavement sections near stop signs should be rated at a deceleration speed appropriate for the intersection.

The Concrete Pavement Distresses

The following pages describe and illustrate the 20 distresses defined in the PAVER Engineered Management System (EMS) for jointed concrete roads and parking lots.

Each two-page spread is dedicated to a single type of concrete distress. The distresses are presented alphabetically and numbered. The pages of the manual are tab-indexed for the user's convenience during inspections in the field.

It should be noted that the figure numbers in this manual intentionally begin at Figure 21 rather than Figure 1. This is because the photo illustrations (and page tabs) are indexed to match the concrete pavement distress numbers used in the PAVER EMS. Distress (and figure) numbers 1–20 are reserved in PAVER for evaluating the condition of asphalt roads and parking lots.

Blowup/Buckling

Description

Blowups or buckles occur in hot weather, usually at a transverse crack or joint that is not wide enough to permit slab expansion. 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.

Severity Levels

L Buckling or shattering causes low-severity ride quality (Figure 21a).

M Buckling or shattering causes medium-severity ride quality (Figure 21b).

H Buckling or shattering causes high-severity ride quality (Figure 21c).

How to Count

At a crack, a blowup is counted as being in one slab. However, if the blowup occurs at a joint and affects two slabs, the distress should be recorded as occurring in two slabs. When a blowup renders the pavement impassable, it should be repaired immediately.

Figure 21a. Low-Severity Blowup/Buckling.

Figure 21b. Medium-Severity Blowup/Buckling.

Figure 21c. High-Severity Blowup/Buckling.

Corner Break

Description

A corner break is a crack that intersects the joints at a distance less than or equal to half the slab length on both sides, measured from the corner of the slab. For example, a slab measuring 3.5 by 6.0 m (11.5 by 20.0 ft) that has a crack 1.5 m (5 ft) on one side and 3.5 m (11.5 ft) on the other side is not considered a corner break; it is a diagonal crack. However, a crack that intersects 0.5 m (4 ft) on one side and 2.5 m (8 ft) 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, whereas a corner spall intersects the joint at an angle. Load repetition combined with loss of support and curling stresses usually cause corner breaks.

Severity Levels

L Break is defined by a low-severity* crack. A low severity crack is < 13 mm (1/2 in.), cracks of any width with satisfactory filler; no faulting. The area between the break and the joints is not cracked or may be lightly cracked (Figure 22a).

M Break is defined by a medium-severity* crack and/or the area between the break and the joints has a medium crack. A medium severity crack is a non-filled crack > 13 mm and < 50 mm (>1/2 in. and < 2 in.), a non-filled crack < 50 mm (2 in.) with faulting < 10 mm (3/8 in.), or a any filled crack with faulting < 10 mm (3/8 in.) (Figure 22b).

H Break is defined by a high-severity* crack and/or the area between the break and the joints is highly cracked. A high severity crack is a non-filled crack >50 mm (2 in.) wide, or any filled or non-filled crack with faulting >10 mm (3/8 in.) (Figure 22c).

How to Count

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.
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 low- and medium-severity corner breaks should be counted as one slab with a medium corner break.

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* The above crack severity definitions are for non-reinforced slabs. For reinforced slabs, see Linear Cracking.

Figure 22a. Low-Severity Corner Break.

Figure 22b. Medium- Severity Corner Break.

Figure 22c. High-Severity Corner Break.

Divided Slab

Description

Slab is divided by cracks into four or more pieces due to overloading and/ or inadequate support. If all pieces or cracks are contained within a corner break, the distress is categorized as a severe corner break.

Severity Levels

Table 1 lists severity levels for divided slabs. Examples are shown in Figures 23a through 23c.

Table 1. Levels of Severity for Divided Slabs.

Severity of Majority of Cracks	Number of Pieces in Cracked Slab		
	4 to 5	6 to 8	More than 8
L	L	L	M
M	L	M	H
H	M	H	H

How to Count

If the divided slab is medium- or high-severity, no other distress is counted for that slab.

Figure 23a. Low-Severity Divided Slab.

Figure 23b. Medium-Severity Divided Slab.

Figure 23c. High-Severity Divided Slab.

Durability ("D") Cracking

Description

"D" Cracking is caused by freeze-thaw expansion of the large aggregate which, over time, gradually breaks down the concrete. This distress usually appears as a pattern of cracks running parallel and close to a joint or linear crack. Since the concrete becomes saturated near joints and cracks, a dark-colored deposit can usually be found around fine "D" cracks. This type of distress may eventually lead to disintegration of the entire slab.

Severity Levels

L "D" cracks cover less than 15 percent of slab area. Most of the cracks are tight, but a few pieces may be loose and or missing (Figure 24a).

M One of the following conditions exists (Figure 24b): (1) "D" cracks cover less than 15 percent of the area and most of the pieces are loose and or missing, or (2) "D" cracks cover more than 15 percent of the area. Most of the cracks are tight, but a few pieces may be loose or missing.

H "D" cracks cover more than 15 percent of the area and most of the pieces have come out or could be removed easily (Figure 24c).

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 exists, the slab is counted as having the higher severity distress. For example, if low and medium "D" cracking are on the same slab, the slab is counted as medium-severity cracking only.

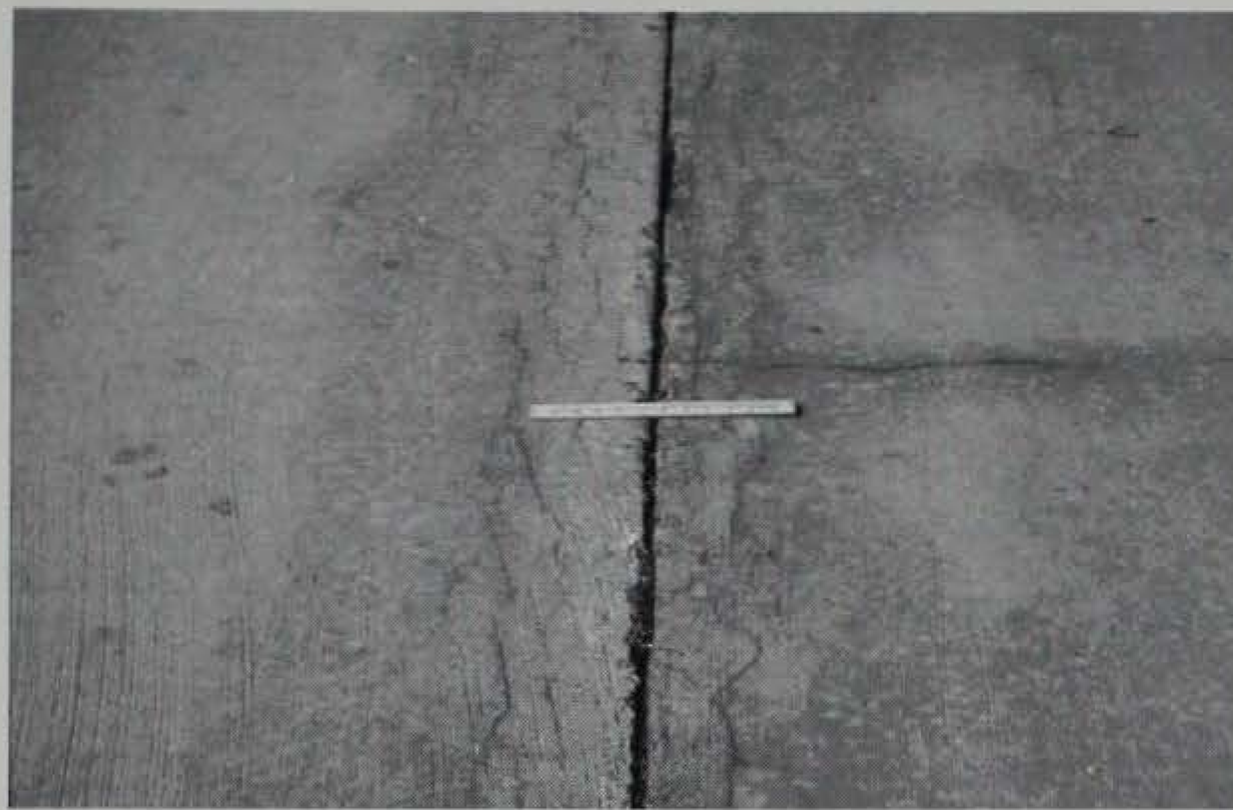

Figure 24a. Low-Severity Durability Cracking.

Figure 24b. Medium-Severity Durability Cracking.

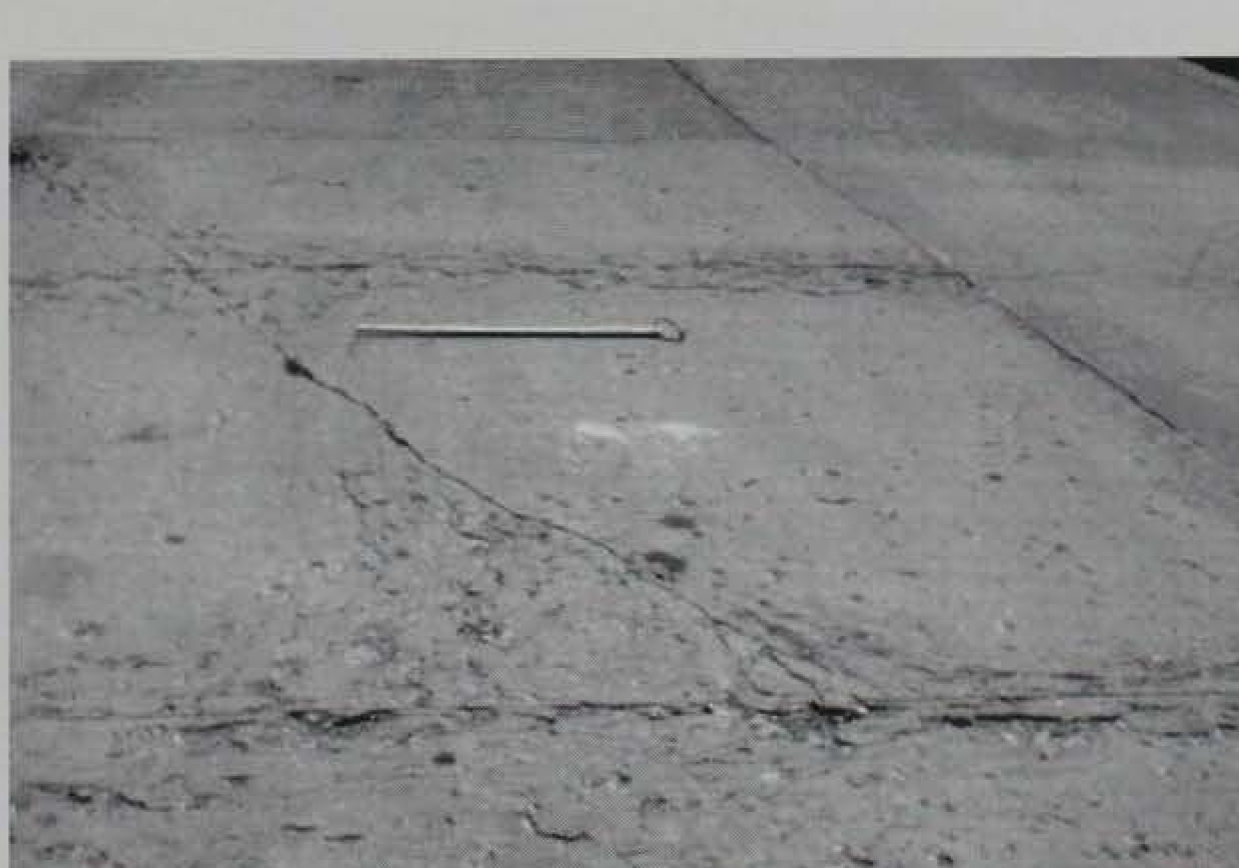

Figure 24c. High-Severity Durability Cracking.

Faulting

Description

Faulting is the difference in elevation across a joint. Some common causes of faulting are:

1. Settlement because of soft foundation.
2. Pumping or eroding of material from under the slab.
3. Curling of the slab edges due to temperature and moisture changes.

Severity Levels

Severity levels are defined by the difference in elevation across the joint as indicated in Table 2. Figures 25a through 25c show examples of the different severity levels.

Table 2. Levels of Severity for Faulting.

Severity Level	Difference in Elevation
L	> 3 and < 10 mm (> 1/8 and < 3/8 in.)
M	> 10 and < 20 mm (> 3/8 and < 3/4 in.)
H	> 20 mm (> 3/4 in.)

How to Count

Faulting across a joint is counted as one slab. Only affected slabs are counted. Faults across a crack are not counted as distress, but are considered when defining crack severity.

Figure 25a. Low-Severity Faulting.

Figure 25b. Medium-Severity Faulting.

Figure 25c. High-Severity Faulting

Joint Seal Damage

Description

Joint seal damage is any condition that enables soil or rocks to accumulate in the joints or allows significant water infiltration. Accumulation of incompressible materials prevents the slab 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 material accumulation and prevents water from seeping down and softening the foundation supporting the slab. Typical types of joint seal damage are:

1. Stripping of joint sealant.
2. Extrusion of joint sealant.
3. Weed growth.
4. Hardening of the filler (oxidation).
5. Loss of bond to the slab edges.
6. Lack or absence of sealant in the joint.

Severity Levels

L Joint sealant is in generally good condition throughout section (Figure 26a). Sealant is performing well, with only minor damage (see above). Joint seal damage is at low severity if a few of the joints have sealer which has debonded from, but is still in contact with the joint edge. This condition exists if a knife blade can be inserted between sealer and joint face without resistance.

M Joint sealant is in generally fair condition over the entire section, with one or more of the above types of damage to a moderate degree. Sealant needs replacement within 2 years (Figure 26b). Joint seal damage is at medium severity if a few of the joints have any of the following conditions: (a) joint sealer is in place, but water access is possible through visible openings no more than 3 mm (1/8 in.) wide. If a knife blade cannot be inserted easily between sealer and joint face, this condition does not exist; (b) pumping debris are evident at the joint; (c) joint sealer is oxidized and "lifeless" but pliable (like a rope), and generally fills the joint opening; or (d) vegetation in the joint is obvious, but does not obscure the joint opening.

H Joint sealant is in generally poor condition over the entire section, with one or more of the above types of damage to a severe degree. Sealant needs immediate replacement (Figure 26c). Joint seal damage is at high severity if 10% or more of the joint sealer exceeds limiting criteria listed above, or if 10% or more of sealer is missing.

How to Count

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

Figure 26a. Low-Severity Joint Seal Damage.

Figure 26b. Medium-Severity Joint Seal Damage.

Figure 26c. High-Severity Joint Seal Damage.

Lane/Shoulder Drop-Off

Description

Lane/shoulder drop-off is the difference between the settlement or erosion of the shoulder and the pavement travel-lane edge. The elevation difference can be a safety hazard; it can also cause increased water infiltration.

Severity Levels

L The difference between the pavement edge and shoulder is >25 and ≤50 mm (>1 and ≤2 in.). (Figure 27a).

M The difference in elevation is >50 and ≤100 mm (>2 and ≤4 in.) (Figure 27b).

H The difference in elevation is >100 mm (>4 in.) (Figure 27c).

How to Count

The mean lane/shoulder drop-off is computed by averaging the maximum and minimum drop along the slab. Each slab exhibiting distress is measured separately and counted as one slab with the appropriate severity level.

Figure 27a. Low-Severity Lane/Shoulder Drop-Off.

Figure 27b. Medium-Severity Lane/Shoulder Drop-Off.

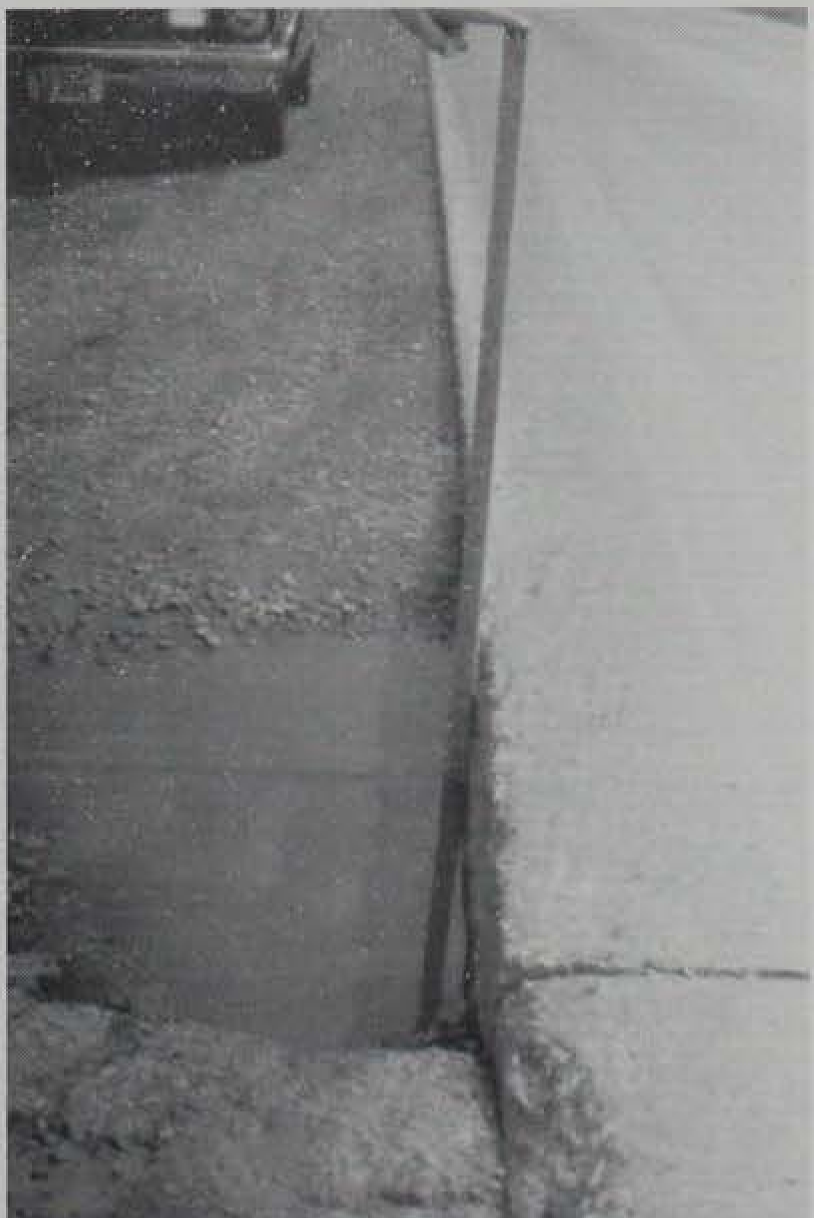

Figure 27c. High-Severity Lane/Shoulder Drop-Off.

Linear Cracking
(Longitudinal, Transverse, and Diagonal Cracks)

Description

These cracks divide the slab into two or three pieces and are usually caused by a combination of repeated traffic loading, thermal gradient curling, and repeated moisture loading. (Slabs divided into four or more pieces are counted as divided slabs.) Hairline cracks only a few feet long and not extending across the entire slab are counted as shrinkage cracks.

Severity Levels

Non-reinforced Slabs

L Non-filled* cracks ≤ 13 mm (≤ 1/2 in.) or filled cracks of any width with the filler in satisfactory condition. No faulting exists (Figure 28a).

M One of the following conditions exists: (1) non-filled crack with a width >13 and ≤ 50 mm (>l/2 and ≤ 2 in.); (2) non-filled crack of any width ≤ 50 mm (2 in.) with faulting of <10 mm (3/8 in.), or (3) filled crack of any width with faulting <10 mm (3/8 in.) (Figure 28b).

H One of the following conditions exists: (1) non-filled crack with a width >50 mm (2 in.), or (2) filled or non-filled crack of any width with faulting >10 mm (3/8 in.) (Figure 28c).

Reinforced Slabs

L Non-filled cracks ≥ 3 and <25 mm (≥ 1/8 to <1 in.) wide; filled crack of any width with the filler in satisfactory condition. No faulting exists.

M One of the following conditions exists: (1) non-filled cracks with a width ≥ 25 and <75 mm (≥ 1 and <3 in.) and no faulting; (2) non-filled crack of any width ≤ 75 mm (3 in.) with ≤ 10mm (3/8 in.) of faulting, or (3) filled crack of any width with ≤ 10mm (3/8 in.) faulting.

H Once of the following conditions exists: (1) non-filled crack >75 mm (3 in.) wide, or (2) filled or non-filled crack of any width with faulting >10 mm (3/8 in.).

How to Count

After severity has been identified, the distress is recorded as one slab. If two medium-severity cracks fall within one slab, the slab is counted as having one high-severity crack. Slabs divided into four or more pieces are counted as divided slabs. In reinforced slabs, cracks <3 mm (1/8 in.) wide are counted as shrinkage cracks. Slabs longer than 9 m (29.5 ft) are divided into 'virtual slabs' of approximately equal length, with joints assumed to be in perfect condition.

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* Filled cracks with unsatisfactory filler are treated as non-filled cracks.

Figure 28a. Low-Severity Linear Cracking.

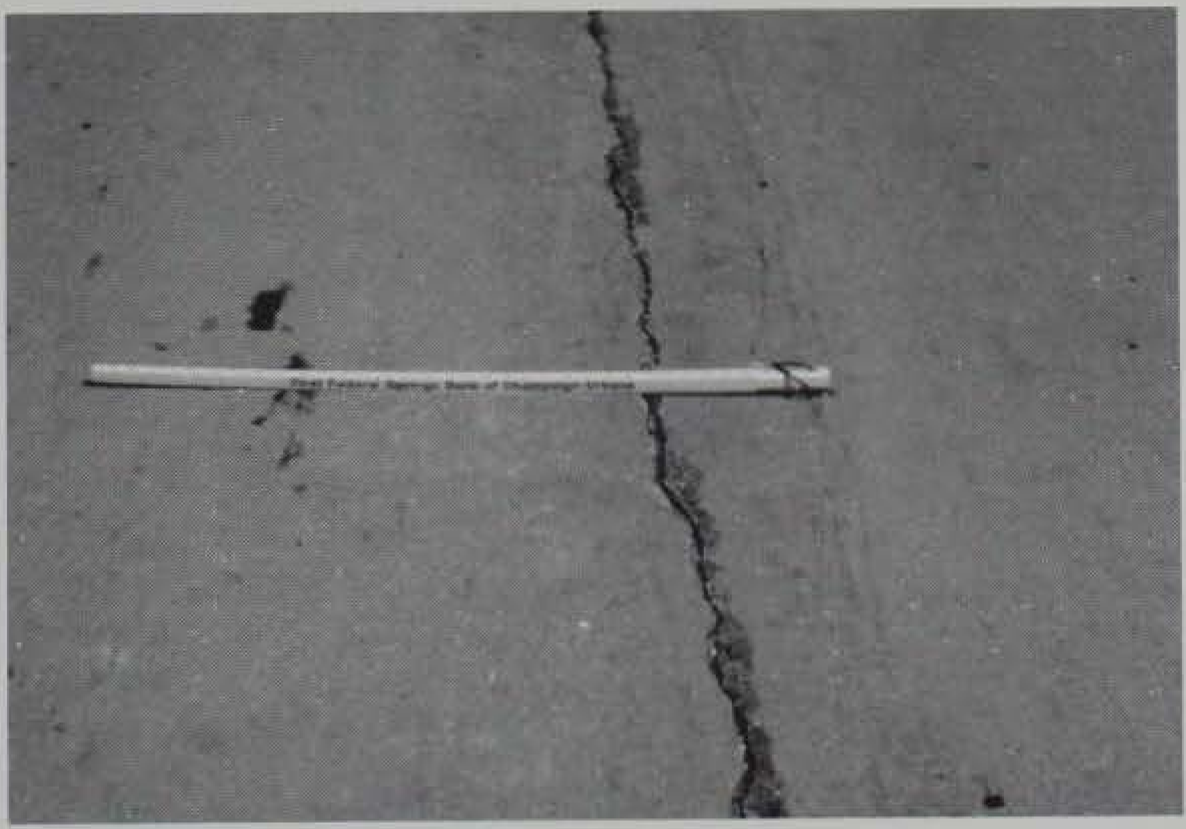

Figure 28b. Medium-Severity Linear Cracking.

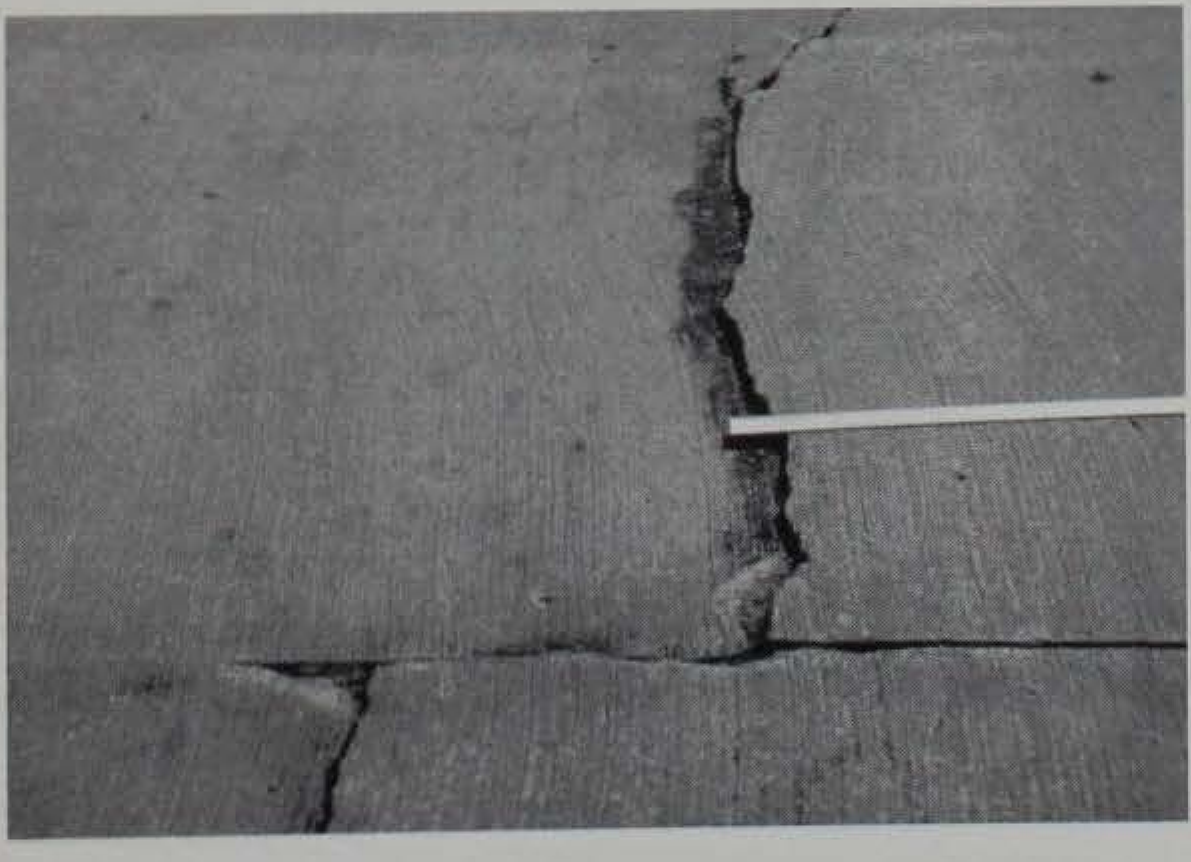

Figure 28c. High-Severity Linear Cracking.

Patching, Large (More Than 0.5 m^2 [5.5 sq ft]) and Utility Cuts

Description

A patch is an area where the original pavement has been removed and replaced by filler material. A utility cut is a patch that has replaced the original pavement to allow the installation or maintenance of underground utilities. The severity levels of a utility cut are assessed according to the same criteria as large patching.

Severity Levels

L Patch is functioning well, with little or no deterioration (Figure 29a).

M Patch is moderately deteriorated and/or moderate spalling can be seen around the edges. Patch material can be dislodged with considerable effort (Figure 29b).

H Patch is badly deteriorated. The extent of the deterioration warrants replacement (Figure 29c).

How to Count

If a single slab has one or more patches with the same severity level, it is counted as one slab containing that distress. If a single slab has more than one severity level, it is counted as one slab with the higher severity level.

Figure 29a. Low-Severity Patching, Large and Utility Cuts.

Figure 29b. Medium-Severity Patching, Large and Utility Cuts.

Figure 29c. High-Severity Patching, Large and Utility Cuts.

Patching, Small (Less than 0.5 m^2 [5.5 sq ft])

Description

A patch is an area where the original pavement has been removed and replaced by a filler material.

Severity Levels

L Patch is functioning well with little or no deterioration (Figure 30a).

M Patch is moderately deteriorated. Patch material can be dislodged with considerable effort (Figure 30b).

H Patch is badly deteriorated. The extent of deterioration warrants replacement (Figure 30c).

How to Count

If a single slab has one or more patches with the same severity level, it is counted as one slab containing that distress. If a single slab has more than one severity level, it is counted as one slab with the higher severity level.

Figure 30a. Low-Severity Patching, Small.

Figure 30b. Medium-Severity Patching, Small.

Figure 30c. High-Severity Patching, Small.

Polished Aggregate

Description

This distress 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.

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 31).

How to Count

A slab with polished aggregate is counted as one slab.

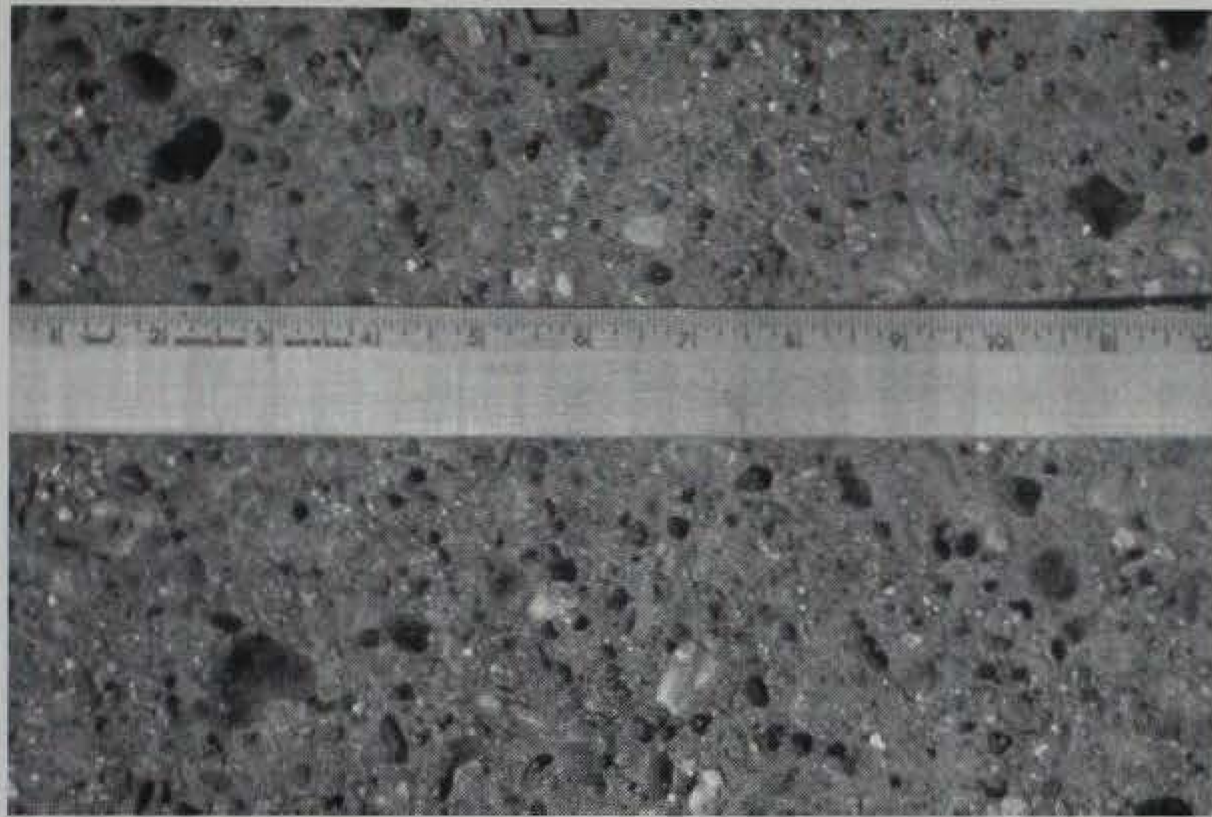

Figure 31. Polished Aggregate.

Popouts

Description

A popout is a small piece of pavement that breaks loose from the surface due to freeze-thaw action, combined with expansive aggregates. Popouts usually range in diameter from approximately 25 to 100 mm (1 to 4 in.) and in depth from 13 to 50 mm (1/2 to 2 in.).

Severity Levels

No degrees of severity are defined for popouts. However, popouts must be extensive before they are counted as a distress. Average popout density must exceed approximately three popouts per m^2 over the entire slab area (Figure 32).

How to Count

The density of the distress must be measured. If there is any doubt that the average is greater than three popouts per square yard, at least three random 1 m^2 (11 sq ft) areas should be checked. When the average is greater than this density, the slab should be counted.

Figure 32. Popouts.

Pumping

Description

Pumping is the ejection of material from the slab foundation through joints or cracks. This is caused by deflection of the slab with passing loads. As a load moves across the joint between the slabs, water is first forced under the leading slab, and then forced back under the trailing slab. This action erodes and eventually removes soil particles, resulting in progressive loss of pavement support. Pumping can be identified by surface stains and evidence of base or subgrade material on the pavement close to joints or cracks. Pumping near joints is caused by poor joint sealer and indicates loss of support; repeated loading will eventually produce cracks. Pumping can also occur along the slab edge, causing loss of support.

Severity Levels

No degrees of severity are defined. It is enough to indicate that pumping exists (Figures 33a and 33b).

How to Count

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 33a. Pumping.

Figure 33b. Pumping.

Punchout

Description

This distress is a localized area of the slab that is broken into pieces. The punchout can take many different shapes and forms, but it is usually defined by a crack and a joint. The distance between the join and the crack or two closely spaced cracks is $\leq$ 1.5 m (5 ft) wide. This distress is caused by heavy repeated loads, inadequate slab thickness, loss of foundation support, and/or a localized concrete construction deficiency (e.g., honeycombing).

Severity Levels

Table 3 lists the severity levels for punchouts, and Figures 34a through 34c show examples.

Table 3. Levels of Severity for Punchouts.

Severity of Majority of Cracks	Number of Pieces		
	2 to 3	4 to 5	> 5
L	L	L	M
M	L	M	H
H	M	H	H

How to Count

If a slab contains more than one punchout or a punchout and a crack, it is counted as shattered.

Figure 34a. Low-Severity Punchout.

Figure 34b. Medium-Severity Punchout.

Figure 34c. High-Severity Punchout.

35 RAILROAD
34 PUNCHOUT
38 SPALLING, CORNER
37 SHRINKAGE
36 SCALING

Railroad Crossing

Description

Railroad crossing distress is characterized by depressions or bumps around the tracks.

Severity Levels

L Railroad crossing causes low-severity ride quality (Figure 35a).

M Railroad crossing causes medium-severity ride quality (Figure 35b).

H Railroad crossing causes high-severity ride quality (Figure 35c).

How to Count

The number of slabs crossed by the railroad tracks is counted. Any large bump created by the tracks should be counted as part of the crossing.

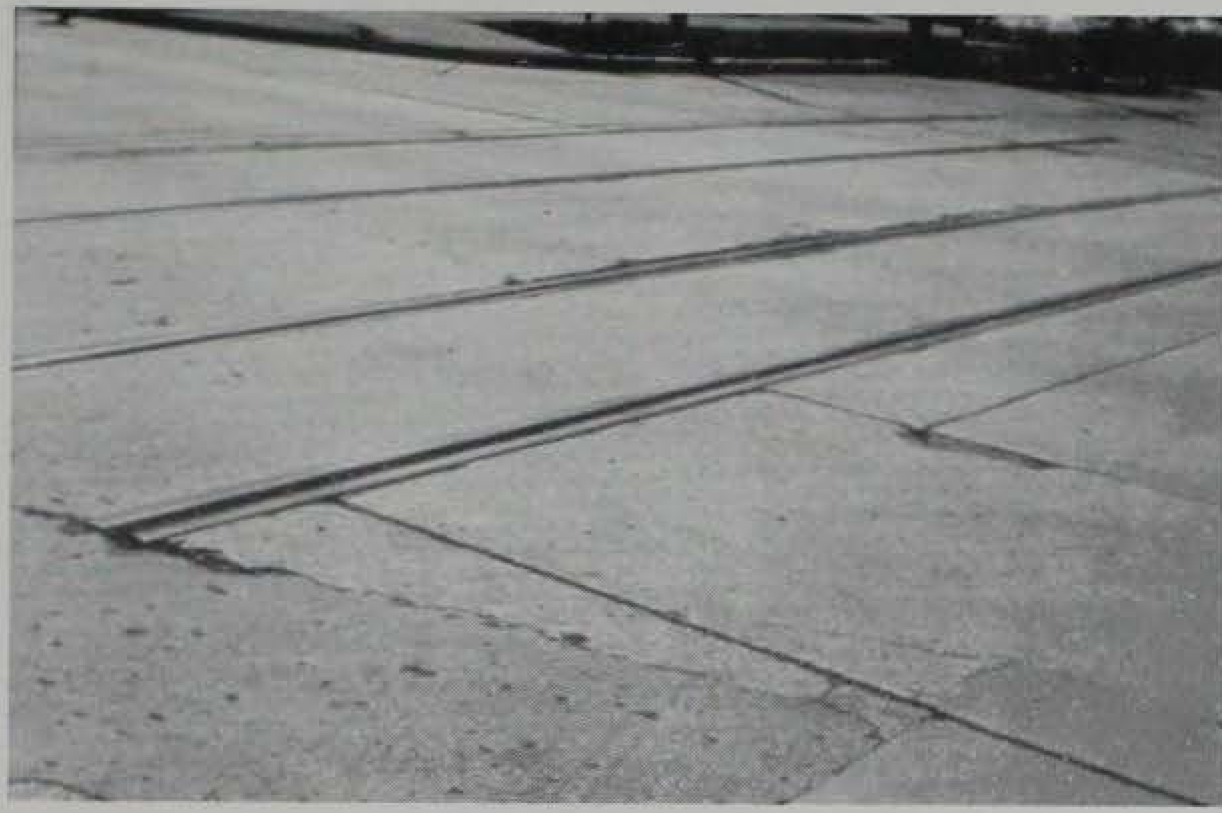

Figure 35a. Low-Severity Railroad Crossing.

Figure 35b. Medium-Severity Railroad Crossing.

Figure 35c. High-Severity Railroad Crossing.

Scaling, Map Cracking, and Crazing

Description

Map cracking or crazing refers to a network of shallow, fine, or hairline cracks that 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 concrete over-finishing, and may lead to surface scaling, which is the breakdown of the slab surface to a depth of approximately 6 to 13 mm (1/4 to 1/2 in.). Scaling may also be caused by deicing salts, improper construction, freeze-thaw cycles, and poor aggregate. The type of scaling defined here is not caused by "D cracking. If scaling is caused by "D" cracking, it should be counted under that distress only.

Severity Levels

L Crazing or map cracking exists over most of the slab area; the surface is in good condition, with only minor scaling present (Figure 36a).

M Slab is scaled, but less than 15 percent of the slab is affected (Figure 36b).

H Slab is scaled over more than 15 percent of its area (Figure 36c).

How to Count

A scaled slab is counted as one slab. Low-severity crazing should only be counted if the potential for scaling appears to be imminent, or a few small pieces come out.

Figure 36a. Low-Severity Scaling, Map Cracking, and Crazing.

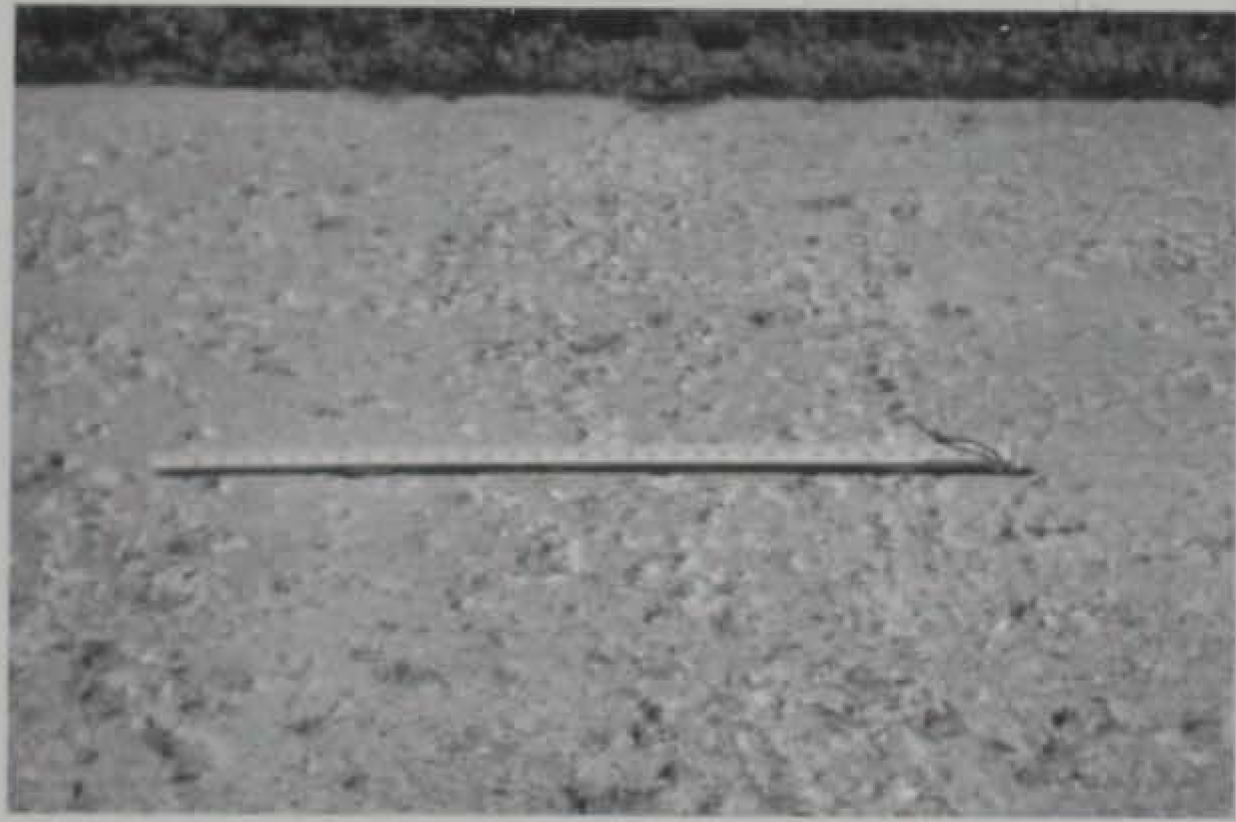

Figure 36b. Medium-Severity Scaling, Map Cracking, and Crazing.

Figure 36c. High-Severity Scaling, Map Cracking, and Crazing.

Shrinkage Cracks

Description

Shrinkage cracks are hairline cracks that are usually less than 2m long and do not extend across the entire slab. They are formed during the setting and curing of the concrete and usually do not extend through the depth of the slab.

Severity Levels

No degrees of severity are defined. It is enough to indicate that shrinkage cracks are present (Figure 37).

How to Count

If any shrinkage cracks exist on a particular slab, the slab is counted as one slab with shrinkage cracks.

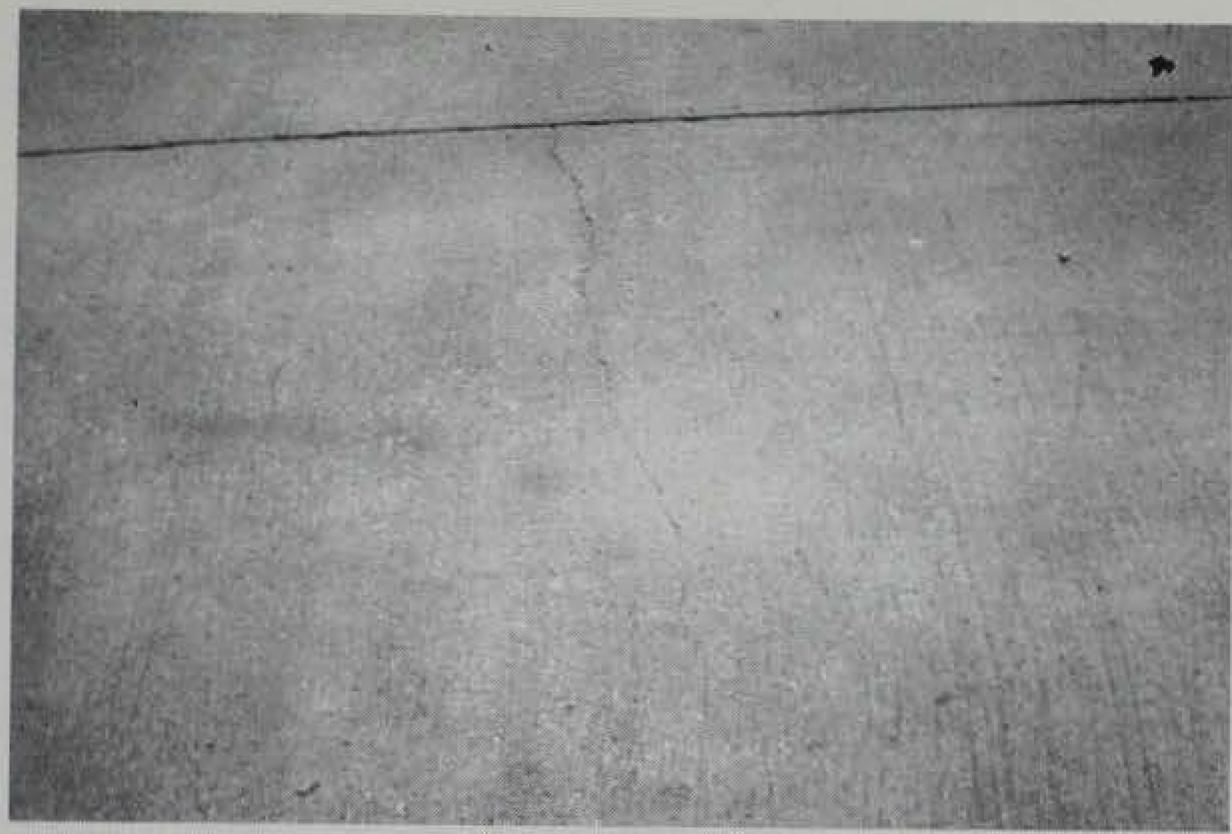

Figure 37. Shrinkage Cracks.

Spalling, Corner

Description

Corner spalling is the breakdown of the slab within approximately 0.5 m (1.5 ft) of the corner. A corner spall differs from a corner break in that the spall usually angles downward to intersect the joint, whereas a break extends vertically through the slab comer. Spalls less than 130 mm (5 in.) from the crack to the corner on both sides should not be counted.

Severity Levels

Table 4 lists the levels of severity for corner spalling. Figures 38a through 38c show examples. Corner spalling with an area of less than 650 cm (l0 sq in.) from the crack to the corner on both sides should not be counted.

Table 4. Levels of Severity for Corner Spalling.

Depth of Spall	Dimensions of Sides of Spall	
	130 x 130 mm to 300 x 300 mm (5 x 5 in.) to (12 x 12 in.)	>300 x 300 mm (>12 x 12 in.)
< 25 mm (< 1 in.)	L	L
> 25 mm to 50 mm (> 1 to 2 in.)	L	M
> 50 mm (> 2 in.)	M	H

How to Count

If one or more corner spalls with the same severity level are 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 with the higher severity level.

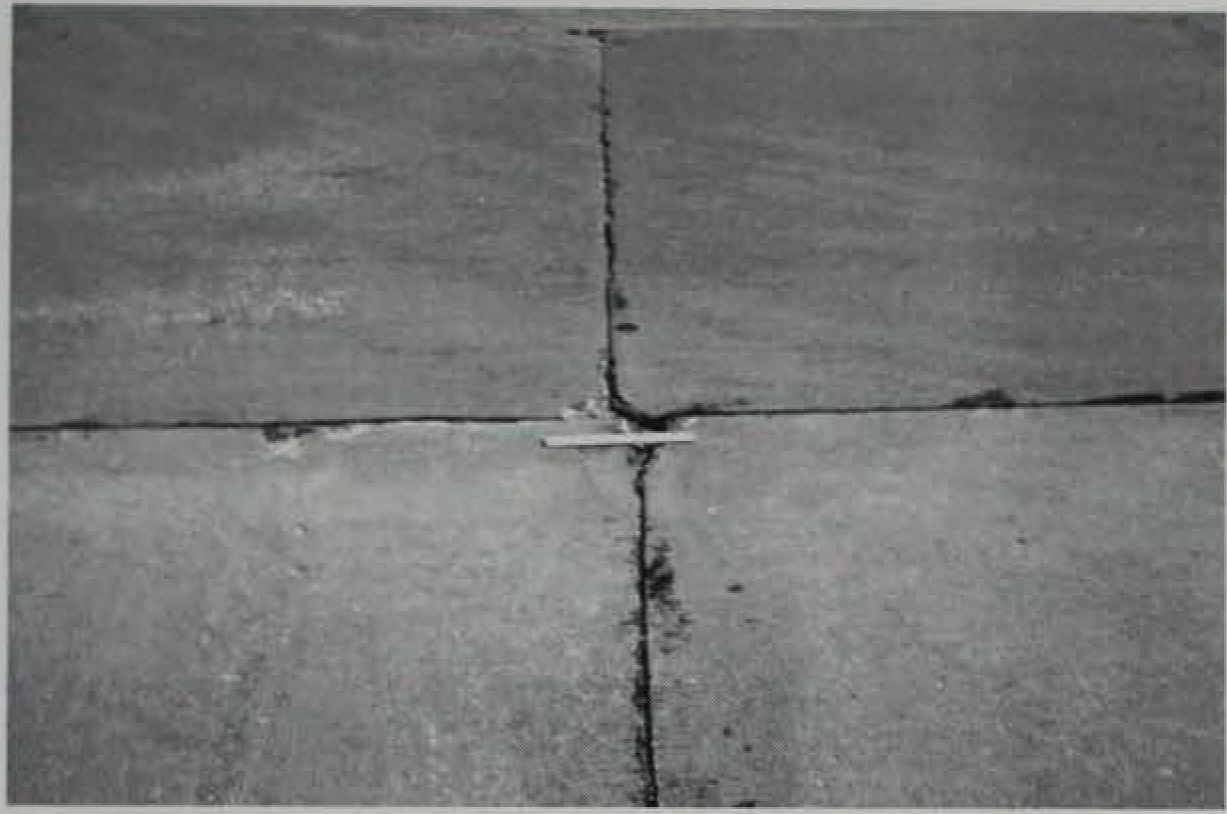

Figure 38a. Low-Severity Spalling, Corner.

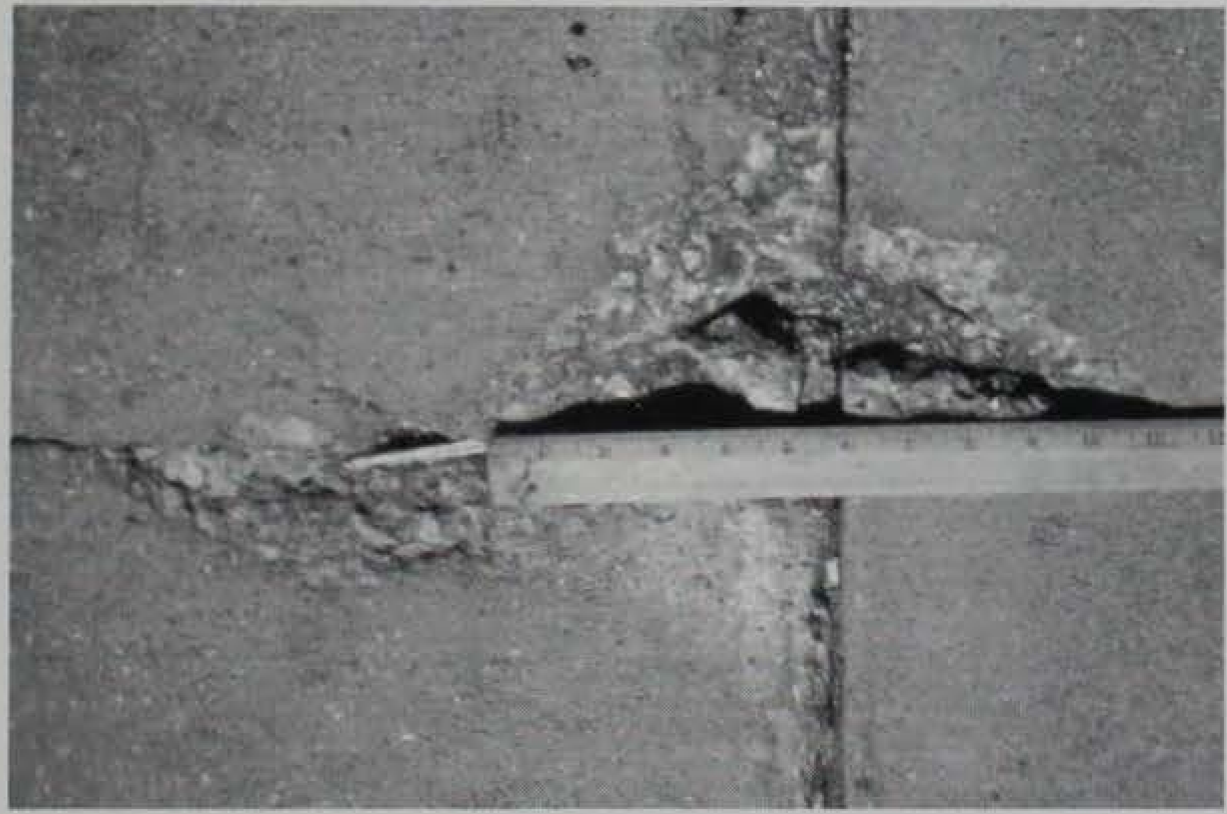

Figure 38b. Medium-Severity Spalling, Corner.

Figure 38c. High-Severity Spalling, Corner.

Spalling, Joint

Description

Joint spalling is the breakdown of the slab edges within 0.5 m (1.5 ft) of the joint. A joint spall usually does not extend vertically through the slab, but intersects the joint at an angle. Spalling results from:

1. Excessive stresses at the joint caused by traffic loading or by infiltration of incompressible materials.
2. Weak concrete at the joint caused by overworking.
3. Water accumulation in the joint and freeze-thaw action.

Severity Levels

Table 5 and Figures 39a through 39c show the severity levels of joint spalling. A frayed joint where the concrete has been worn away along the entire joint is rated as low severity.

Table 5. Levels of Severity for Joint Spalling.

Spall Pieces	Width of Spall	Length of Spall	
		< 0.5 m (1.5 ft)	> 0.5 m (1.5 ft)
Tight: cannot be easily removed (may be a few pieces missing)	< 100 mm (4 in.)	L	L
	> 100 mm	L	L
Loose: can be removed and some pieces are missing; if most or all pieces are missing, spall is shallow, less than 25 mm (1 in.)	< 100 mm	L	M
	> 100 mm	L	M
Missing: most or all pieces have been removed	< 100 mm	L	M
	> 100 mm	M	H

How to Count

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

Figure 39a. Low-Severity Spalling, Joint.

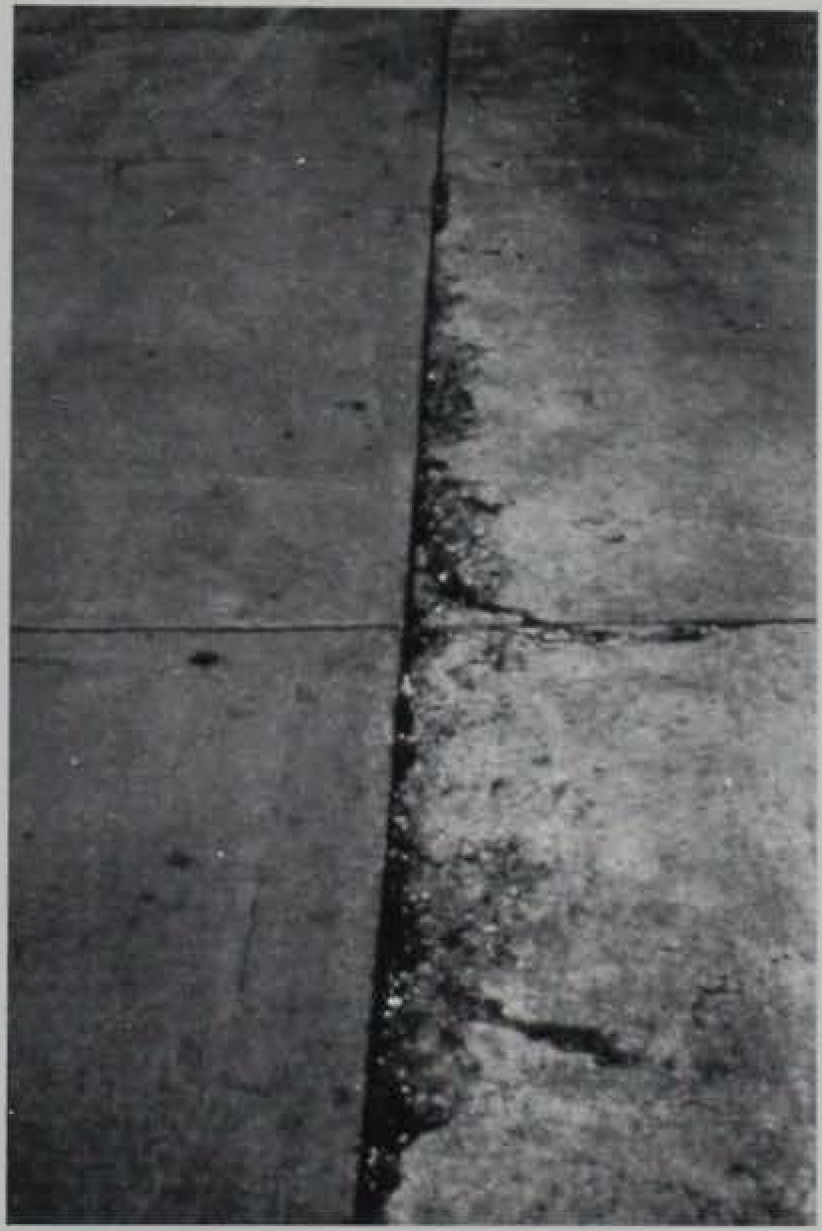

Figure 39b. Medium-Severity Spalling, Joint.

Figure 39c. High-Severity Spalling, Joint.

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Shahin, M.Y., and J.A. Walther, *Pavement Maintenance Management for Roads and Streets Using the PAVER System*, Technical Report (TR) M-90/05ADA227464 (U.S. Army Construction Engineering Research Laboratory [USACERL], July 1990).

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This document is a revision and technical update of the original PAVER Concrete Distress Manual published by the U.S. Army Construction Engineering Research Laboratories (USACERL) in June 1989. It comprises an illustrated concrete pavement distress manual suitable for use by pavement inspection personnel in the field or in pavement inspection training courses. The manual defines distresses and measurement methods for inspecting the condition of concrete-surfaced roads and parking lots, and is intended for use in conjunction with the PAVER Engineered Management System (EMS). The definitions and methods are keyed for use in determining a Pavement Condition Index (PCI), which is a central component of the PAVER EMS.

A companion document addressing asphalt-surfaced roads and parking lots, USACERL Technical Report 97/104, is also available.

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