Pavement Condition Index Distress Identification Manual For

Asphalt and Surface Treatment Pavements

February 1986 2nd Edition

MTC
METROPOLITAN TRANSPORTATION COMMISSION

PAVEMENT CONDITION INDEX DISTRESS IDENTIFICATION MANUAL FOR

ASPHALT AND SURFACE TREATMENT PAVEMENTS

Prepared by: METROPOLITAN TRANSPORTATION COMMISSION &
ERES CONSULTANTS, INC.

2ND EDITION

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Preface

This manual is prepared to assist users of the Bay Area Pavement Management System (PMS) in identifying surface distress in a uniform and repeatable manner. The distresses included in this manual are used to calculate the Pavement Condition Index (PCI) for pavements surfaced with asphalt concrete and surface treatments. It was prepared for the Metropolitan Transportation Commission (MTC) as part of their project to assist local agencies in implementing pavement management systems (PMS) (Ref. 1). It presents descriptions of the distress types to be inspected accompanied by photographs to aid the inspector in identifying the distress types and severity levels.

This rating procedure was developed by ERES Consultants, Inc. It is derived from the rating methods developed by Dr. M. Y. Shahin and his team at the U.S. Army Corps of Engineers Construction Engineering Research Laboratory (CERL) (Ref. 2) and adopted by the American Public Works Association (Ref. 3). This procedure uses only the distress types found to be significant in the San Francisco Bay Area.

Inspection Procedures

Pavement inspection is conducted on inspection units. An inspection unit is a small segment of a pavement section or management unit selected of convenient size which is then inspected in detail. The distress found in the inspection unit is used to calculate the PCI for the inspection unit inspected. The PCI of the inspected inspection units in the section are then used to represent the condition of the entire section.

An inspection unit can vary from 50 to 200 feet long by one to four lanes wide. Generally, they should be 1000 to 4000 square feet in area. Generally, inspection units should have a relatively uniform size within a uniform section. For instance, if a a two lane road 26 feet wide is being inspected, the inspection units could all be approximately 100 feet long. For a four lane road 52 feet wide, the inspection units can be 100 feet long by 26 feet wide and only go to the centerline. The units selected for inspection can be alternated between lanes.

The units inspected should be selected at random when more than two inspection units are to be inspected; when less than two inspection units are inspected, those selected should be "representative of the condition of the section."

When a small area of pavement is found to be much worse than the majority of the pavement, it can be inspected and identified as a "special" inspection unit. This is used to identify areas of localized deterioration such as an area damaged by utility cuts, crossing of construction traffic, or other localized problems. A weighted average is used to calculate the PCI when special inspection units are inspected.

The inspector inspects the sample unit by walking the inspection unit, or standing on the curb/shoulder, and recording the type, severity and amount of each distress present in the inspection unit. The type, severity and amount must correspond to those defined in this Distress Identification Manual. The quantities and severities should normally be estimated using measuring techniques as accurate as pacing when the inspector can walk the inspection unit and by visual estimation when he stands on the curb or shoulder.

The inspection method is designed to allow the calculation of a composite rating index called the Pavement Condition Index (PCI). The steps for determining the PCI of an inspection unit are shown in Figure 1. The PCI scale is shown in Figure 2. The distress types, severity levels, and methods of estimating quantities are keyed to the deduct curves presented in the Bay Area PMS User's Guide (1). These distress and severity level descriptions must be carefully followed since they were used in the development of the deduct curves. Failure to do so could invalidate the PCI calculated.

Significant change in the severity levels for rutting and depressions along with the inclusion of surface seal loss are changes found in this manual from the 1984 version. For more information on the use of this manual, please contact MTC.

REFERENCES

1. Smith, R. E., S. Rodenborn, & J. Wiggins, "Bay Area PMS User Guide," The Metropolitan Transportation Commission, Oakland, CA 1986.
2. Shahin, M. Y., and S. D. Kohn, "Pavement Maintenance Management for Roads and Parking Lots," U.S. Army Corps of Engineers, Technical Report M-294, October 1981.
3. APWA, "APWA-COE PAVER Pavement Condition Index Field Manual, Asphalt," American Public Works Association, 1983.

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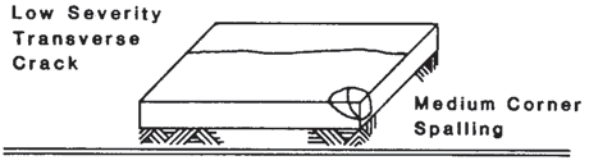
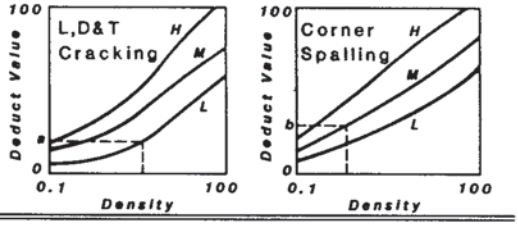
Figure 1

Computing the Pavement Condition Index

Step 1 Inspect sample units. Determine distress types, severity levels and measure density.

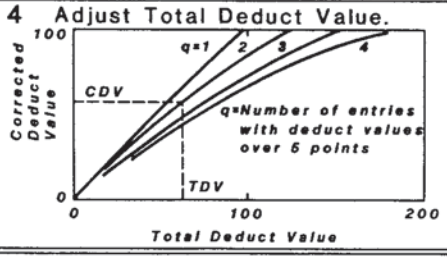


Step 2 Determine deduct values.



Step 3 Adjust Total Deduct Value, TDV = a+b

Step 4 Adjust Total Deduct Value.



Step 5 Compute Pavement Condition Index, PCI=100-CDV, for each sample unit inspected.

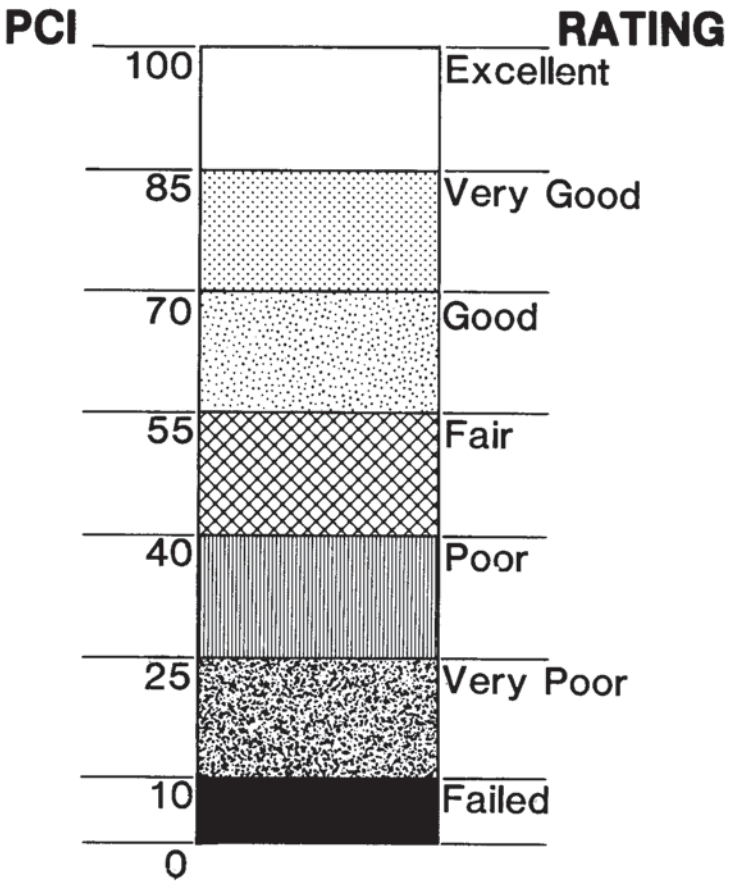


Figure 2

1 Alligator Cracking

Description:

Alligator fatigue cracking is a series of interconnecting cracks caused by fatigue failure of the asphalt concrete surface under repeated traffic loading. Cracking begins at the bottom of the asphalt surface (or stabilized base) where tensile stress and strain are highest under a wheel load. The cracks propagate to the surface initially as a series of parallel longitudinal cracks. After repeated traffic loading, the cracks connect, forming many-sided, sharp-angled pieces that develop a pattern resembling chicken wire or the skin of an alligator. The pieces are less than 2 ft. (.6m) on the longest side.

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

Alligator cracking is considered a major structural distress and is often accompanied by rutting.

Potholes, which are recorded as high severity alligator cracking, are bowl shaped depressions in the pavement surface. They generally have sharp edges and vertical sides near the top. They are produced when traffic abrades small pieces of the pavement surface.

Severity Levels:

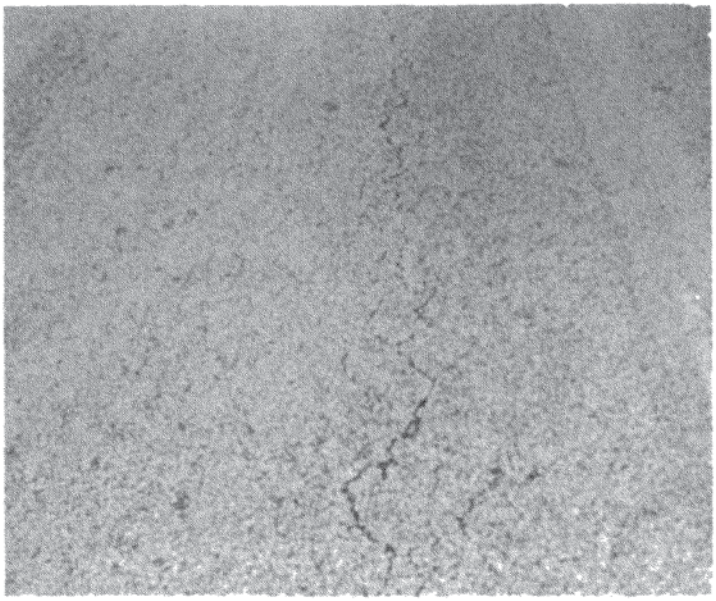
L Fine, longitudinal hairline cracks running parallel to each other with one or only a few interconnecting cracks. The cracks are not spalled.*

M Further development of light alligator cracks into a pattern or network of cracks that may be lightly spalled.

H Network or pattern cracking has progressed so that the pieces are well defined and spalled at the edges. Some of the pieces may rock under traffic. Potholes of all sizes are recorded as high severity alligator cracking.

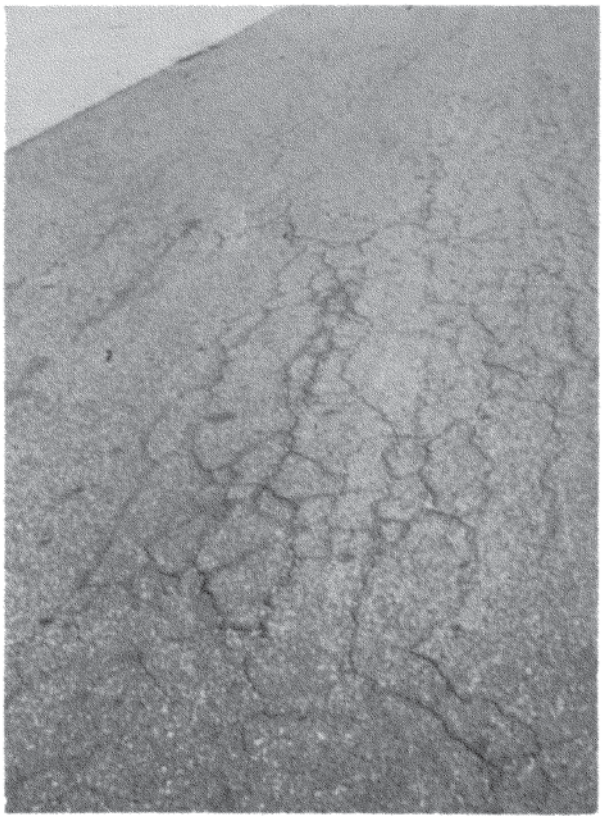
*Crack spalling is the breakdown of material along the side of the crack.

Low Severity



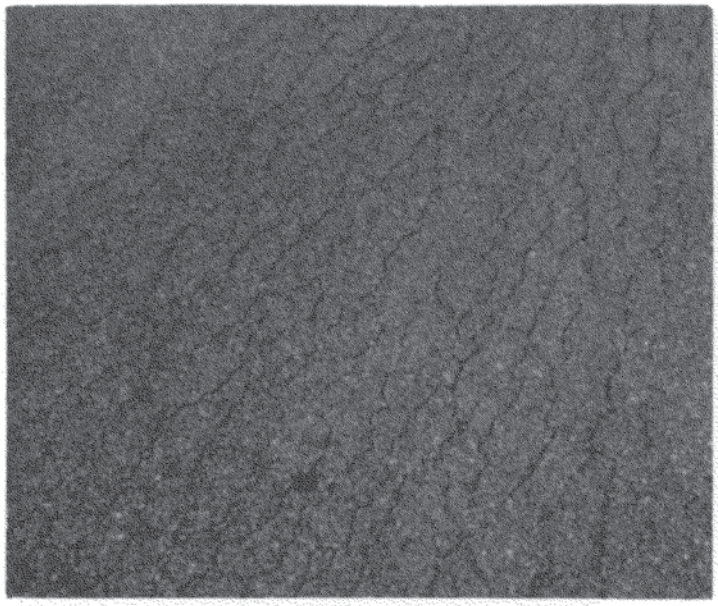
Low Severity

How to Measure: Alligator cracking is measured in square feet of surface area. The major difficulty in measuring this type of distress is that two or three levels of severity often 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 divided easily, the entire area should be rated at the highest severity level present.



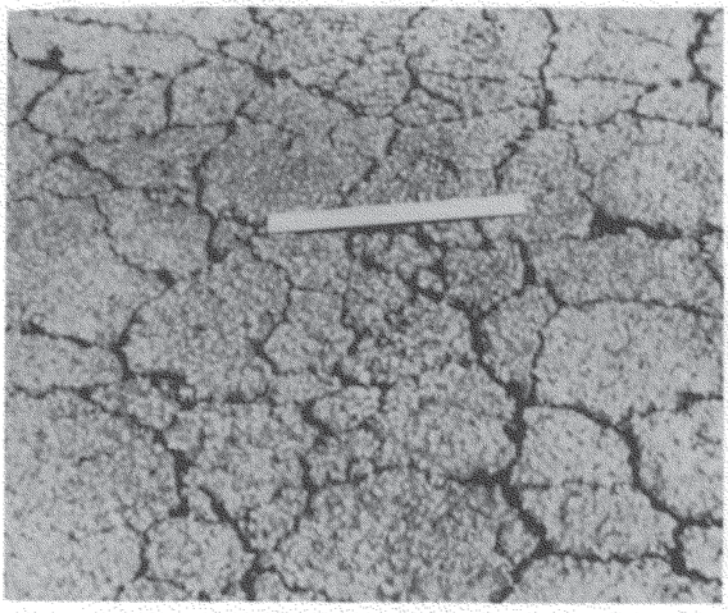
Medium Severity

Medium Severity

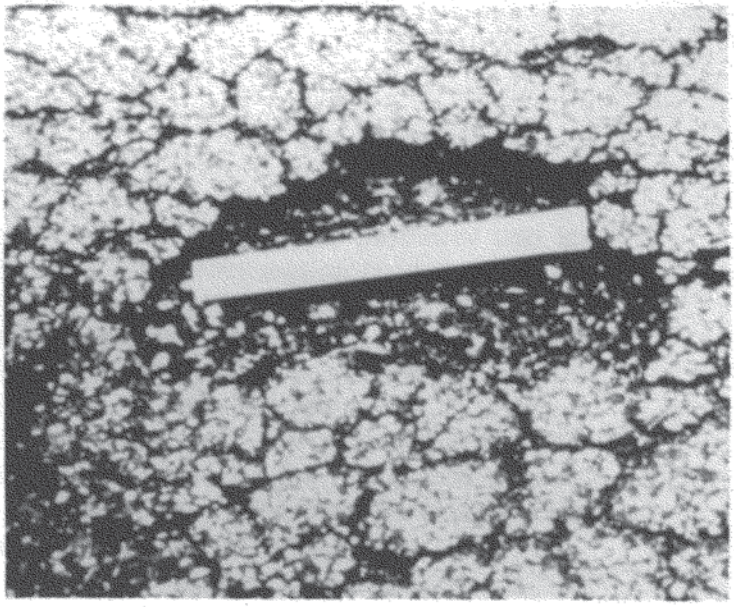


Medium Severity

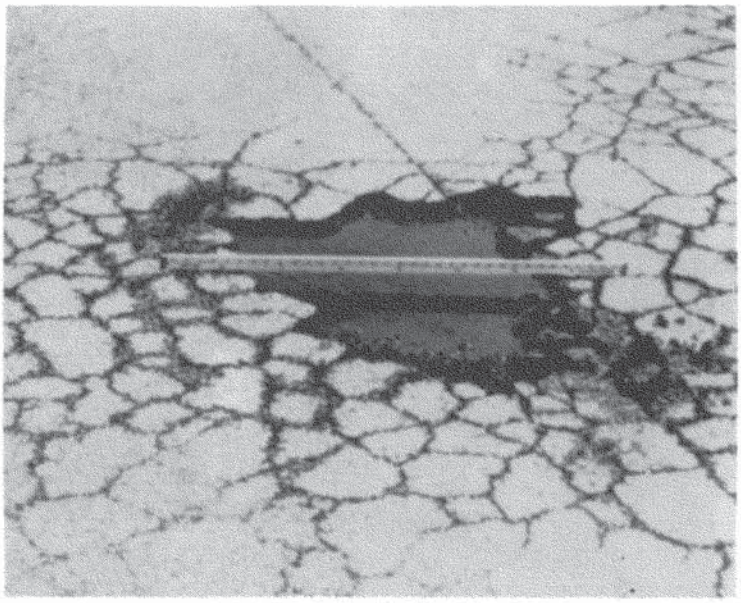
High Severity



High Severity



High Severity



High Severity

2 Block Cracking

Description: Blocks are interconnected cracks that divide the pavement into approximately rectangular pieces. The blocks may range in size from approximately 1 by 1 ft (.3 by .3m) to 10 by 10 ft (3 by 3m). Block cracking usually indicates that the asphalt has hardened significantly. Block cracking normally occurs over a large proportion of pavement area, but sometimes will occur only in nontraffic areas. This type of distress differs from alligator cracking in that alligator cracks form smaller, many-sided pieces with sharp angles. Also, unlike block cracks, alligator cracks are caused by repeated traffic loadings, and are therefore found only in traffic areas (ie., wheel paths).

Severity Levels:

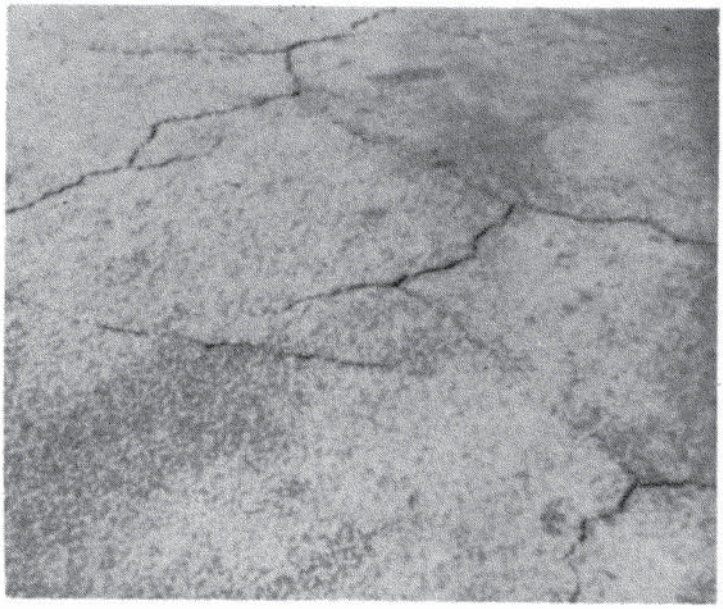
L Blocks are defined by low* severity cracks.

M Blocks are defined by medium* severity cracks.

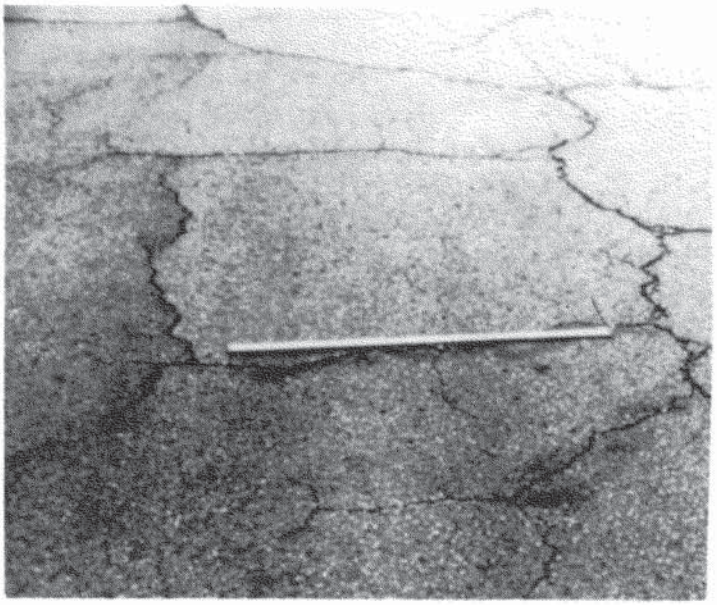
H Blocks are defined by high* severity cracks.

*See severity levels of longitudinal and transverse cracking.

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



Low Severity



Medium Severity

Medium Severity

High Severity

3 Distortions

Description: Distortions are usually caused by corrugations, bumps, sags, and shoving. They are localized abrupt upward or downward displacements in the pavement surface, series of closely spaced ridges and valleys, or localized longitudinal displacements of the pavement surface. Distortions affect ride quality.

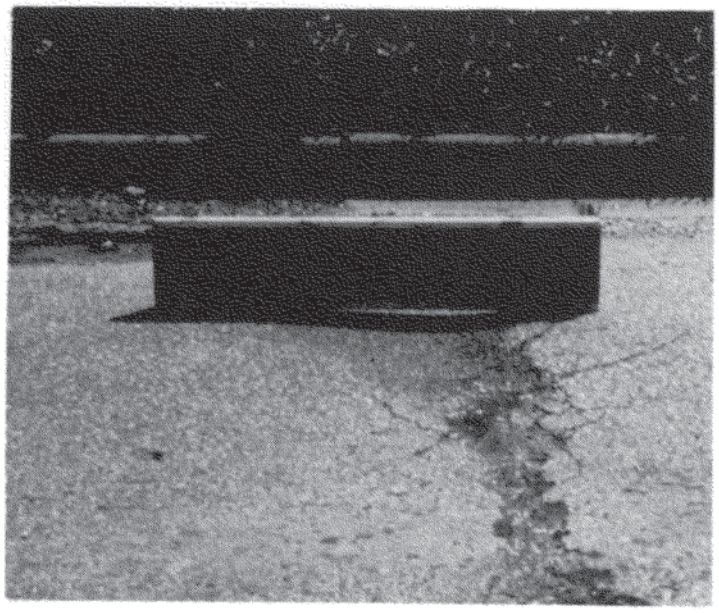
Severity Levels:

L Distortion produces vehicle vibrations which are noticeable, but no reduction in speed is necessary for comfort or safety, and/or individual distortions cause the vehicle to bounce slightly, but create little discomfort.

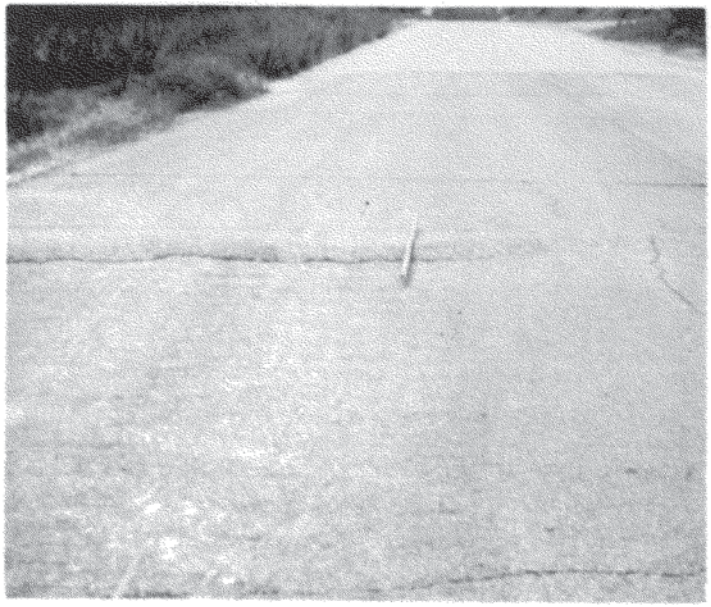
M Distortion produces vehicle vibrations which are significant and some reduction in speed is necessary for safety and comfort.

H Distortion produces vehicle vibrations which are so excessive that speed must be reduced considerably for safety and comfort.

How to Measure: Distortion is measured in square feet of surface area affected. Severity is determined by riding in a standard sized automobile over the pavement at the posted speed limit. Pavement near traffic control devices should be rated at the normal acceleration or deceleration rate. If a large area is affected and distinctly different severity levels are present, each area having a different severity level should be recorded separately.

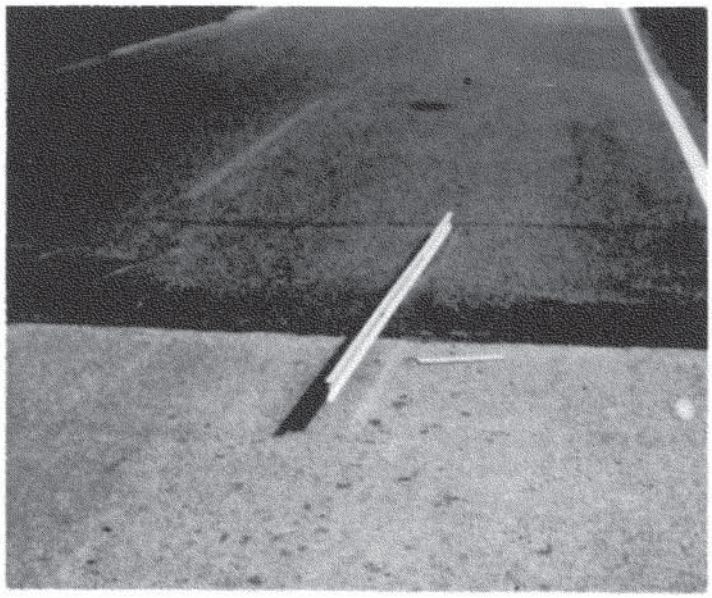


Medium Severity Sag

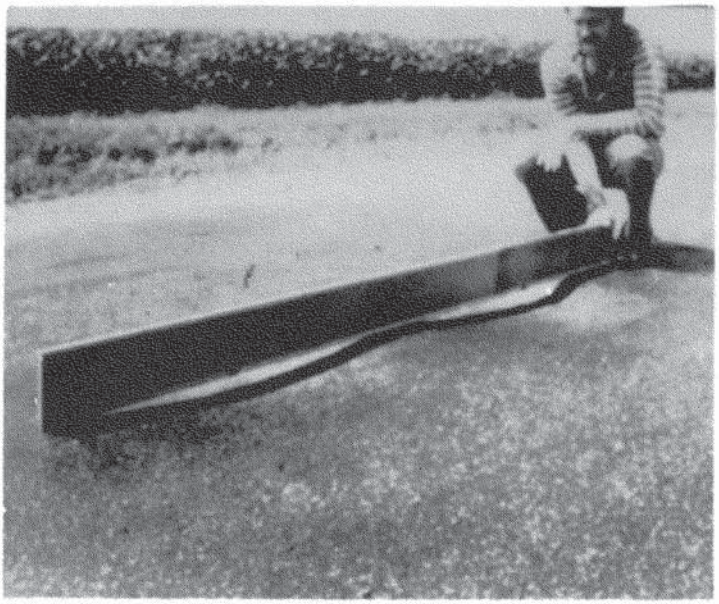


Medium Severity Bump

Medium Severity Shoving



High Severity Shoving



High Severity Corrugation

4 Longitudinal and Transverse Cracking

Description:

Longitudinal cracks are parallel to the pavement's centerline or laydown direction. They may be adjacent to the pavement edge. 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 and/or daily temperatures cycling.
3. A reflective crack caused by joints and cracks beneath the surface course, including joints and cracks in PCC slabs.
4. Decreased support or thickness near the edge of the pavement.

Transverse cracks extend across the pavement at approximately right angles to the pavement centerline or laydown direction. These may be caused by conditions (2) and (3) above. These types of cracks are not normally load-associated.

Severity Levels:

L One of the following conditions exist.

1. Nonfilled crack width is less than 3/8 in (10mm), or
2. Filled crack of any width (filler in satisfactory condition).

M One of the following conditions exist.

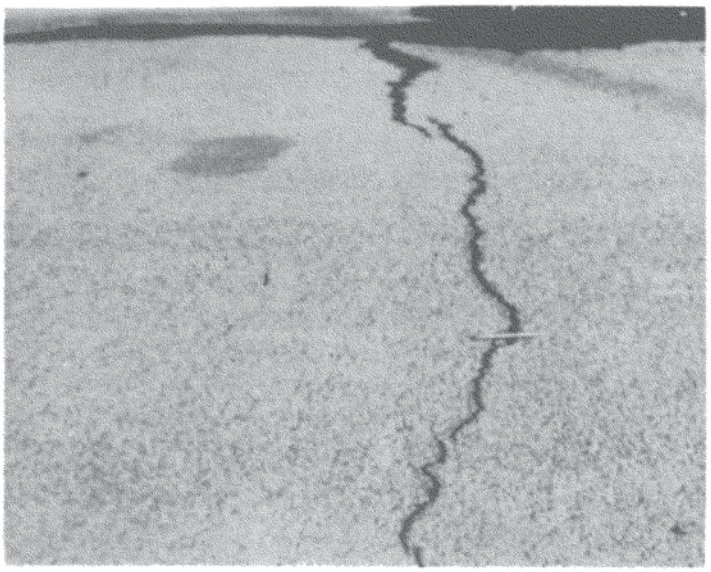
1. Nonfilled crack width is 3/8 to 3 in (10 to 76mm), measured on the pavement surface.
2. Nonfilled crack of any width up to 3 in (76mm) surrounded by light and random cracking.
3. Filled crack of any width surrounded by light random cracking.

H One of the following conditions exist.

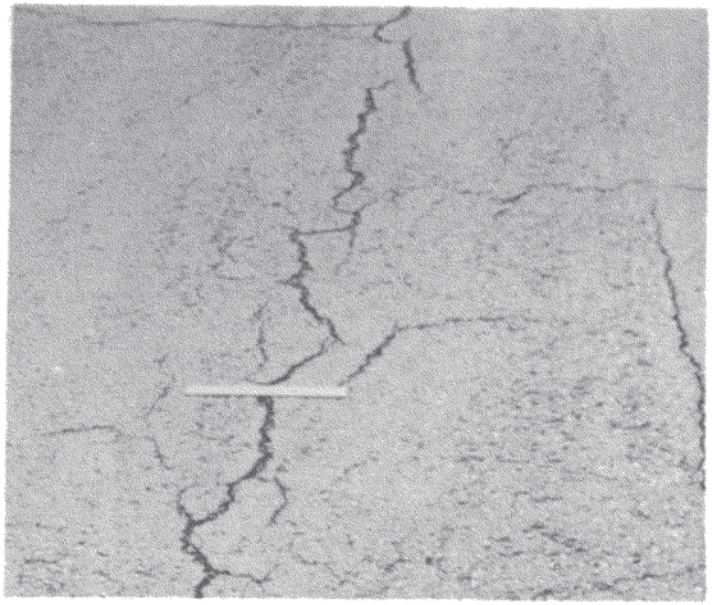
1. Any crack filled or nonfilled surrounded by medium or high severity random cracking.
2. Nonfilled crack over 3 in (76mm), measured on the pavement surface.
3. A crack of any width where a few inches of pavement around the crack is severely broken.

How to Measure: Longitudinal and transverse cracks are measured in linear feet. The length and severity of each crack should be recorded after identification. 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. If a bump or sag occurs at a crack it is also recorded as a distortion.

Low Severity



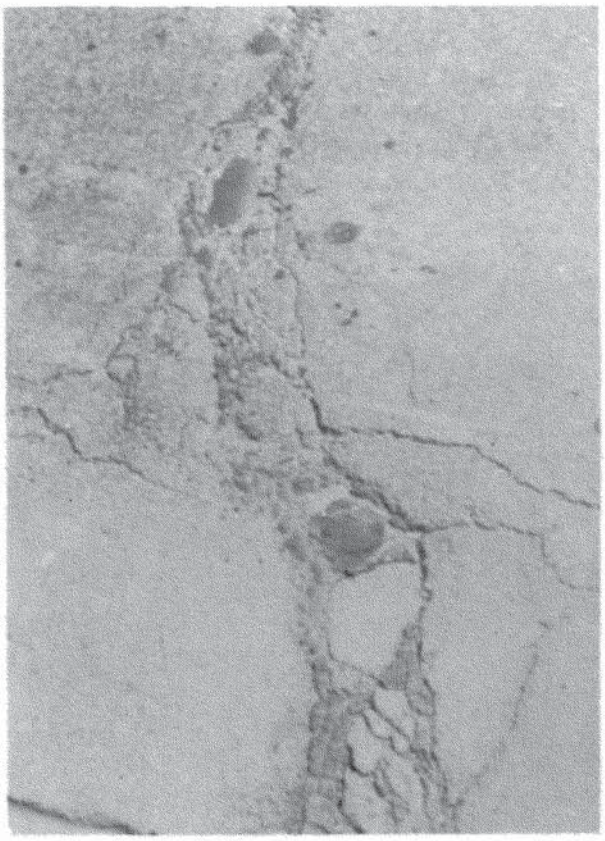
Medium Severity



Medium Severity

Medium Severity

Medium Severity



High Severity

5 Patching and Utility Cut Patching

Description:

A patch is an area of pavement which has been replaced with new material to repair the existing pavement.

A patch is considered a defect no matter how well it is performing (a patched area or adjacent area usually does not perform as well as an original pavement section). Generally, some roughness is associated with this distress.

Severity Levels:

L Patch is in good condition and is satisfactory. Ride quality* is rated as low severity or better.

M Patch is moderately deteriorated and/or ride quality is rated as medium severity.

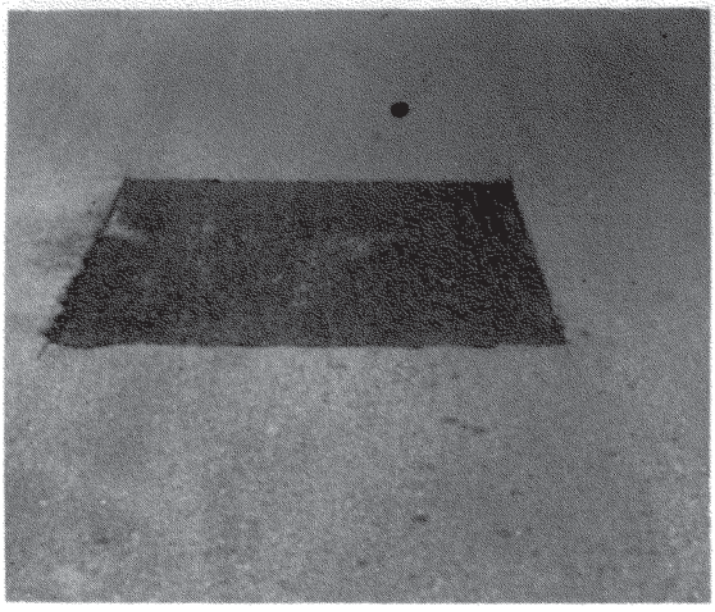
H Patch is badly deteriorated and/or ride quality is rated as high severity. Patch needs replacement.

*Ride quality is defined in the severity levels of distortions.

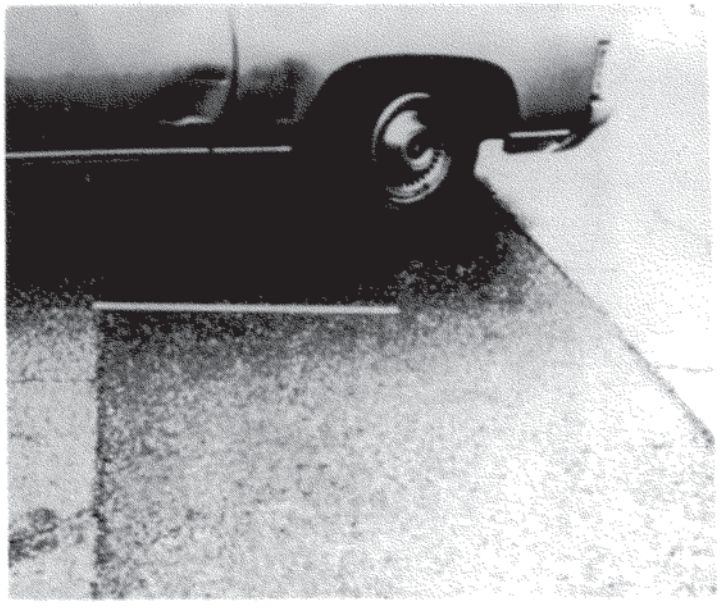
How to Measure:

Patching is measured in square feet of surface area. However, if a single patch has areas of differing severity, these areas should be measured and recorded separately. For example, a 25 sq ft (2.32 m^2) patch may have 10 sq ft (.9 m^2) of medium severity and 15 sq ft (1.35 m^2) of low severity. These areas would be recorded separately. No other distresses (e.g., rutting or cracking) are recorded within a patch. Other distresses in the patch area are used to determine the severity level of the patch.

If a large amount of pavement has been replaced, it should not be recorded as a patch, but considered as new pavement (e.g., replacement of full intersection or a patch covering several hundred feet of the pavement length).



Low Severity



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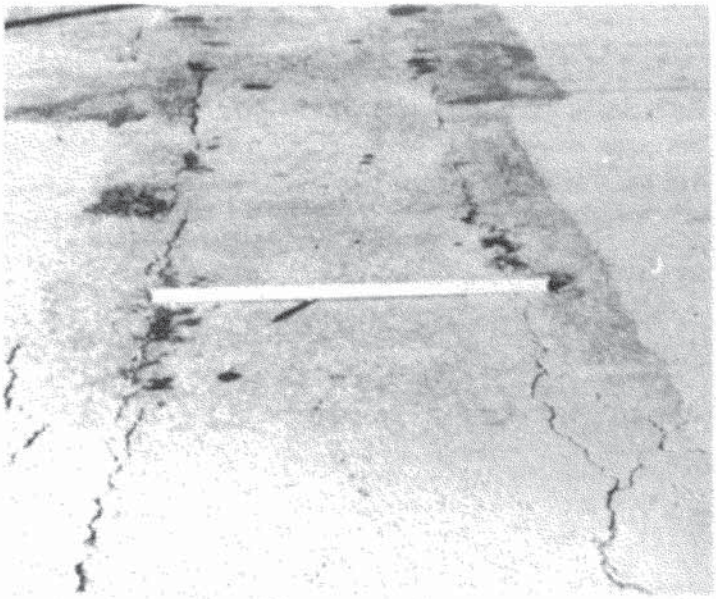


Low Severity

Medium Severity

High Severity

6 Rutting and Depressions

Description:

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

Depressions are localized areas where the pavement surface is lower than the surrounding area but the transition is not abrupt enough to be considered a distortion. They are ofen referred to bird baths.

Severity Levels:

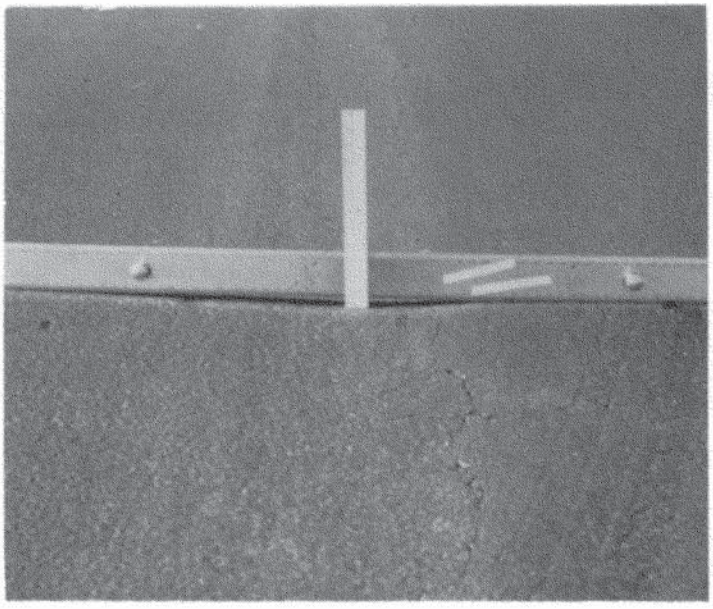
L 1/2 to less than 1 in (13 to 25mm)

M 1 to less than 2 in (25 to 50mm)

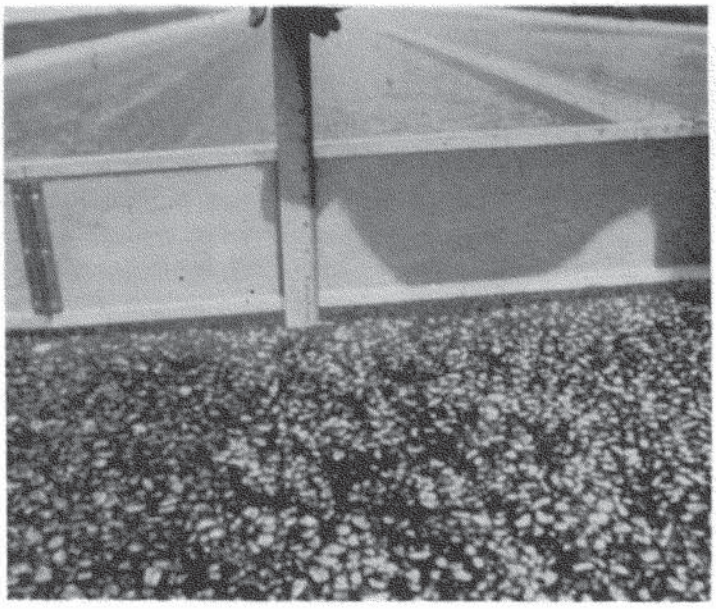
H equal to or greater than 2 in (over 50mm)

How to Measure:

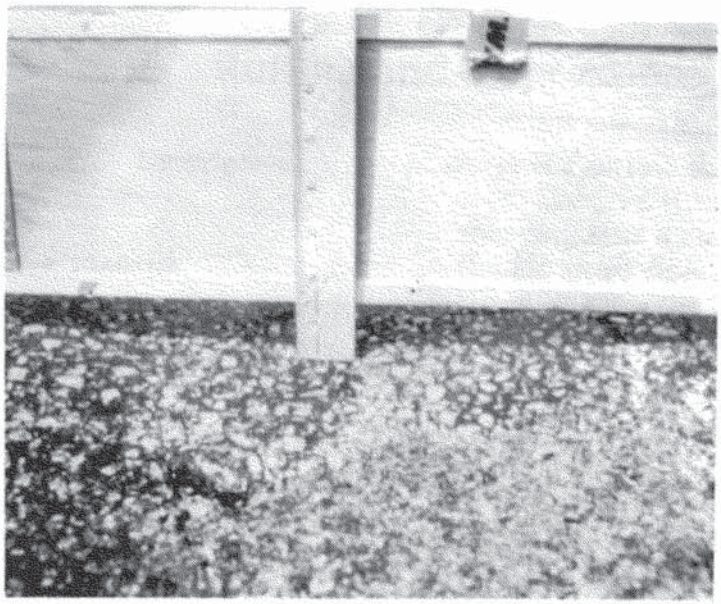
Rutting and depressions are measured in square feet of surface area. The rut depth is determined by laying a 10 ft (3m) straight-edge across the rut and measuring its depth.



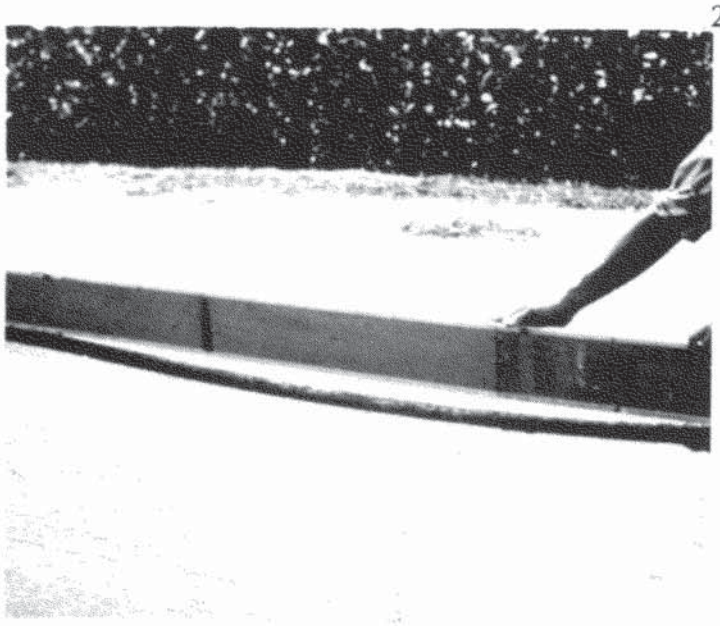
Low Severity



Medium Severity



High Severity



High Severity

7 Weathering and Raveling

Description: Weathering and raveling are the wearing away of the pavement surface caused by the loss of asphalt or tar binder and dislodged aggregate particles. This distress indicates that either the asphalt binder has hardened appreciably or that a poor quality mixture is present. In addition, raveling may be caused by certain types of traffic (e.g., tracked vehicles). Softening of the surface and dislodging of the aggregates due to oil or fuel spillage and surface seal loss are also included under raveling.

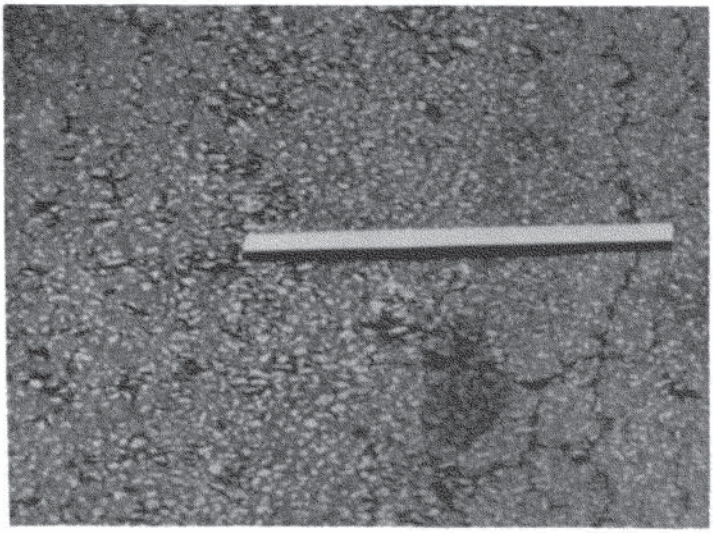
Severity Levels:

L Aggregate or binder of the pavement or surface seal has started to wear away. In some areas, the surface is starting to pit. In the case of oil spillage, the oil stain can be seen, but the surface is hard and cannot be penetrated with a coin.

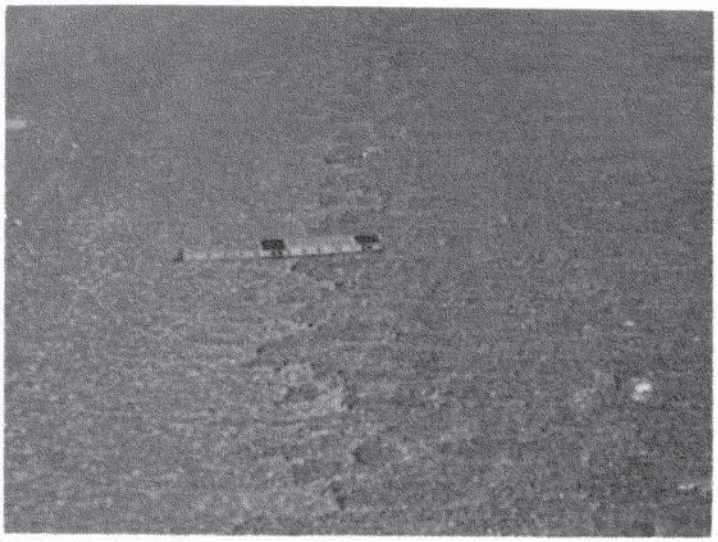
M Aggregate and/or binder has worn away or the original pavement is showing through the surface seal in a few places. The surface texture is moderately rough and pitted. In the case of oil spillage, the surface is soft and can be penetrated with a coin.

H Aggregate and/or binder has been considerably worn away or much of the surface seal has been lost. The surface texture is very rough and severely pitted. The edge of the pavement has broken up to the extent that pieces are missing within 1 to 2 ft (.3 to .6 m) of the edge. In the case of oil spillage, the asphalt binder has lost its binding effect and the aggregate has become loose.

How to Measure: Weathering and raveling are measured in square feet of surface area.



Low Severity



Low Severity

Medium Severity

Medium Severity

Helpful Hints (con't)

7. Longitudinal and transverse cracking is the only distress type not recorded in square feet.

8. When an area is completely destroyed, do not waste time trying to determine exact areas of each distress type and severity level. The condition level should indicate a need for major rehabilitation and the need for detailed distress quantities is of less importance. Pick out the two or three of the most severe distress types present (e.g. alligator cracking, rutting, and patching), quickly estimate quantities and severities (i.e. 100% high severity alligator cracking, 30% high severity rutting, and 20% medium severity patching), record the data and continue on.

9. Surface seal loss is considered under weathering and raveling.

Asphalt Concrete
Pavement Distress Identification
CRIB SHEET

NO.	TYPE	LOW	MEDIUM	HIGH
1 (p. 3)	**Alligator Cracking**	fine; few interconnecting cracks	network of cracks	well-defined network with spalling; potholes
2 (p. 10)	**Block Cracking**	< 3/8"; any filled crack	3/8" to 3"; any filled crack with light, random cracking	> 3"; any crack with medium to high random cracking
3 (p. 13)	**Distortions**	noticeable vehicle vibrations	significant vehicle vibrations	excessive vehicle vibration; must reduce speed
4 (p. 17)	**Longitudinal & Transverse Cracking**		— same as #2 —	
5 (p. 22)	**Patching & Utility Cut Patching**	good condition; low ride quality	moderate deterioration; medium ride quality	patch needs to be replaced
6 (p. 27)	**Rutting & Depressions**	1/2" to < 1"	1" to < 2"	> 2"
7 (p. 30)	**Weathering & Raveling**	aggregate/binder starting to wear away; some pitting	moderately rough surface texture; pitted	aggregate/binder worn away; seal loss

HINTS:

1. Rate all patches in an inspection unit.
2. If alligator cracking and rutting are found in same area, rate both.
3. Don't rate distresses in a patch — just determine severity.
4. Don't confuse low severity alligator cracking with low severity longitudinal cracking; alligator cracks are in the wheel path.
5. Know the impact of various distress/severity combinations on the PCI. The following table shows the deduct points for 50 square feet of distress in a 2800 square foot inspection unit:

	Alligator Cracking	Block Cracking	Distortions	Longitudinal & Transverse Cracking	Patching & Utility Cut Patching	Rutting & Depressions	Weathering & Raveling
Low	15	1	3	4	4	10	2
Medium	27	4	17	11	12	21	9
High	38	10	36	22	23	30	18

MTC Graphics mlf 4/9/96