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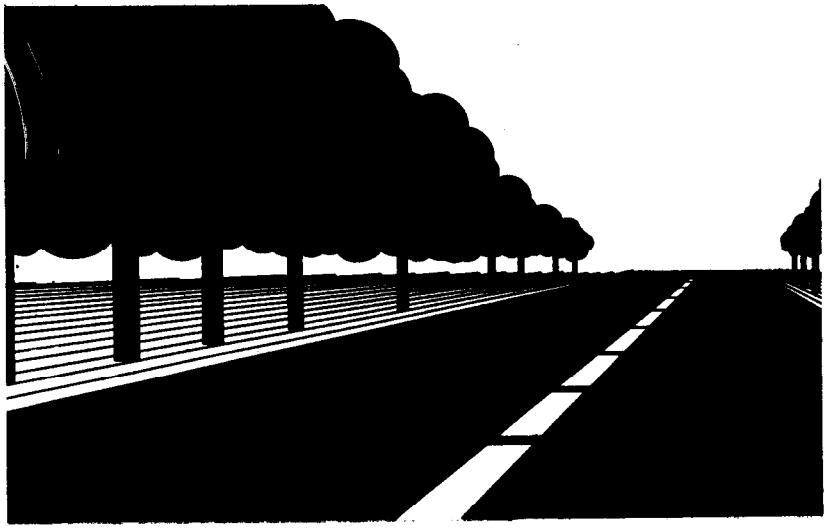

Maintenance & Repair Alternatives Pavement Condition Index (PCI) Field Manual

November 1988

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ABSTRACT

This field manual contains distress definition and measuring methods for jointed concrete roads and parking lots. These definitions and measuring methods are keyed to the determination of the Pavement Condition Index (PCI). This field manual was written for Engineers, Planners and Estimators, and Inspectors to be used on-site. Total list of field manuals:

No.	Title	Est. Compl. Date
MO-102	Maintenance and Repair of Surfaced Areas	09/89
MO-102.1	Asphalt Surfaced Roads & Parking Lots	04/89
MO-102.2	Jointed Concrete Roads & Parking Lots	04/89
MO-102.3	Asphalt Surfaced Airfields	08/89
MO-102.4	Jointed Concrete Airfields	08/89
MO-102.5	Pavement Maintenance Management	08/90
MO-102.6	Asphalt Crack Repair	12/89
MO-102.7	Concrete Repair	03/90
MO-102.8	Asphalt Repair	12/90

FOREWORD

This field manual contains information on distress definition and measuring methods for asphalt surfaced roads and parking lots. These definitions and measuring methods are keyed to the determination of the Pavement Condition Index (PCI) that will be explained in Manual, MO-102.5, "Pavements Maintenance Management" (scheduled for August 1990). The pavement condition rating is based on the PCI, which is a numerical indicator based on a scale of 0 to 100. The PCI measures the pavement's structural integrity and surface operational condition. The method presented is intended to accomplish pavement inspection in the most efficient and cost effective manner.

Recommendations or suggestions for modification, or additional information and instruction that will improve the publication and motivate its use, are invited and should be forwarded to the Commander, Naval Facilities Engineering Command (Attention: Code 163), 200 Stovall Street, Alexandria, VA. 22332-2300. Telephone: Commercial (202) 325-0045, Autovon 221-0045.

This publication has been reviewed and is approved for certification as an official publication of this Command in accordance with SECNAV Instruction 5600.16.

G. F. EVERHART
CAPT, CEC, US NAVY
Assistant Commander for
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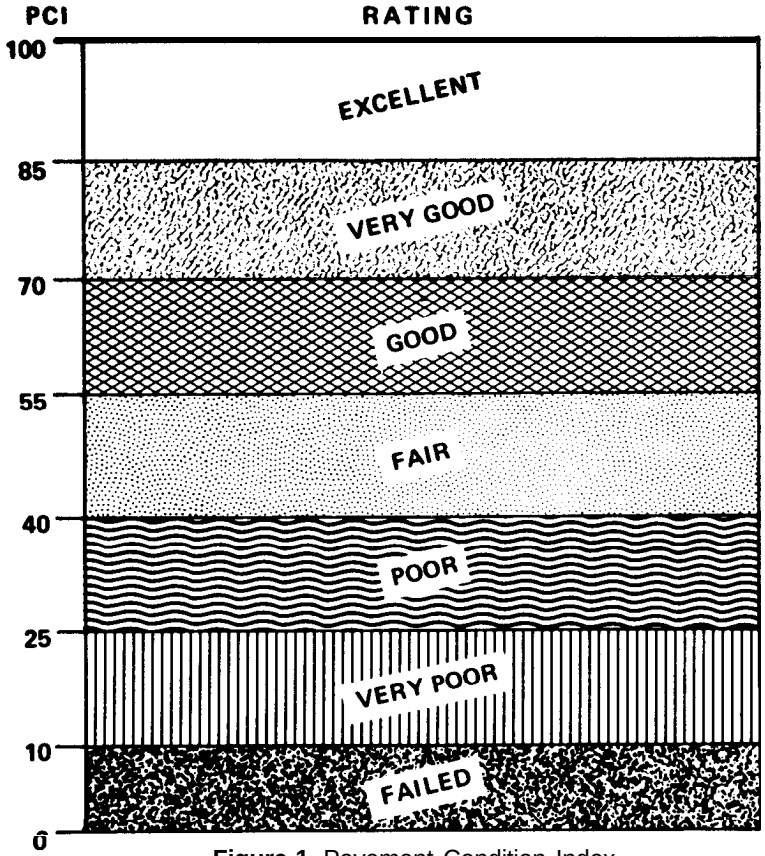

Figure 1. Pavement Condition Index

DISTRESS IN ASPHALT PAVEMENTS

During the field condition surveys and validation of the PCI, several questions were commonly asked regarding the identification and measurement of some of the distresses. The answers to these questions are included under the section titled “How to Measure” for each distress. For convenience, however, items that are frequently referenced are listed below:

1. If alligator cracking and rutting occur in the same area, each is recorded separately at its respective severity level.
2. If bleeding is counted, polished aggregate is not counted in the same area.
3. Bumps and sags are measured in units of linear feet.
4. If a crack occurs at the ridge or edge of a bump, the crack and bumps are recorded separately
5. If any distress (including cracking and potholes) is found in a patched area, it is not recorded; its effect on the patch, however, is considered in determining the severity level of the patch.
6. A significant amount of polished aggregate should be present before it is counted.
7. Potholes are measured by the number of holes having a certain diameter, not in units of square feet.

The above is not intended to be a complete list. To properly measure each distress type, the inspector must be familiar with its individual measurement criteria.

Nineteen distress types for asphalt-surfaced pavements are listed alphabetically following the end of this introductory section.

RIDE QUALITY

Ride quality must be evaluated in order to establish a severity level for the following distress types:

1. Bumps
2. Corrugation
3. Railroad crossings
4. Shoving
5. Swells

To determine the effect these distresses have on ride quality, the inspector should use the following severity-level definitions of ride quality:

1. 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.
2. 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.
3. H (high). Vehicle vibrations are so excessive that speed must be reduced considerably for safety and comfort, and/or individual bumps or settlements cause the vehicle to bounce excessively, creating substantial discomfort, and/or a safety and/or high potential vehicle damage.

Ride quality is determined by riding in a standard-sized automobile over the pavement section at the posted speed limit. Pavement sections near stop signs should be rated at the normal deceleration speed used when approaching the sign.

DEFINITIONS OF REPAIR OPTIONS as used in this manual

1. Cold Milling-Carbide teeth cutting bits are used to chip off the surface of the pavement to remove material.

2. Heater Scarify-3/4 inch of the pavement is heated and scarified to provide a smooth, crack free surface. Can be used before overlaying to slow reflective cracking.

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

4. Patching:
   Shallow -A stable, compacted leveling course is placed in depressions to level off the surface.

   Partial Depth -The deteriorated area of the asphalt surface course is removed and replaced.

   Full Depth -The deteriorated area of the asphalt surface course and the base course is removed and replaced. The subgrade should be recompacted.

5. Reconstruction-Complete replacement of the pavement.

6. Recycle-The reworking of a pavement structure or its component material to improve their performance and correct noted deficiencies.

7. Seal Cracks-Cracks are often routed to remove debris before sealing.

8. Surface Seal-An application of bituminous spray, such as fog seals, and rejuvenators.

9. Surface Treatment-An application of bituminous binder with aggregate, such as sand seals, slurry seals, and chip seals.

ALLIGATOR CRACKING

Description: Alligator or-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 generally 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 usually accompanied by rutting.

Severity Levels:

L - Fine, longitudinal hairline cracks running parallel to each other with none or only a few interconnecting cracks. The cracks are not spalled.* (Figures 2 and 3)

M - Further development of light alligator cracks into a pattern or network of cracks that may be lightly spalled. (Figures 4, 5, and 6)

1 **Alligator**

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. (Figures 7 and 8)

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 present.

**Crack spalling is a breakdown of the material along the sides of the crack.*

Options for Repair:

L - Do nothing; Surface seal; Overlay.

M - Partial or full depth patch; Overlay; Reconstruct.

H - Partial or full depth patch; Overlay; Reconstruct.

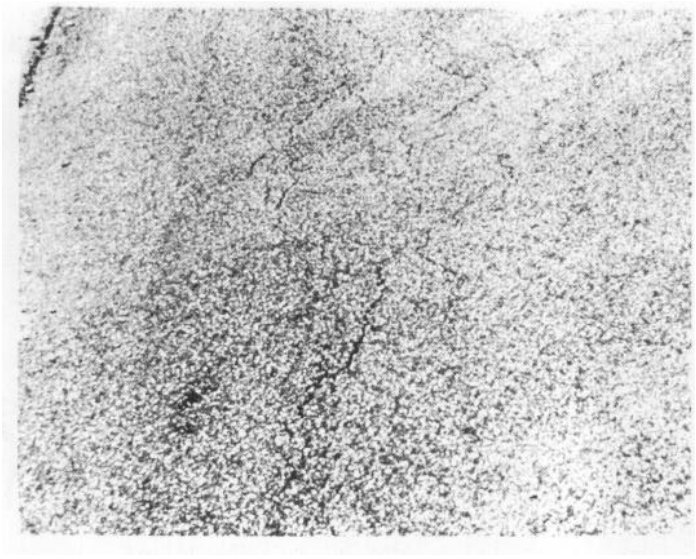

Figure 2. Low-severity alligator cracking

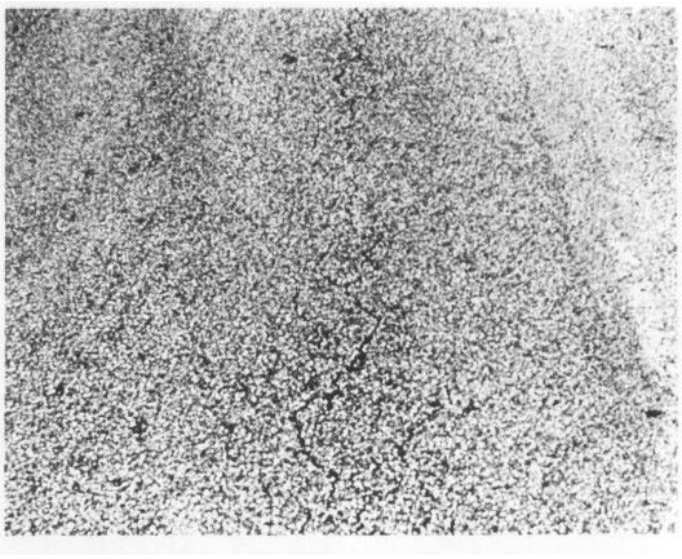

Figure 3. Low-severity alligator cracking

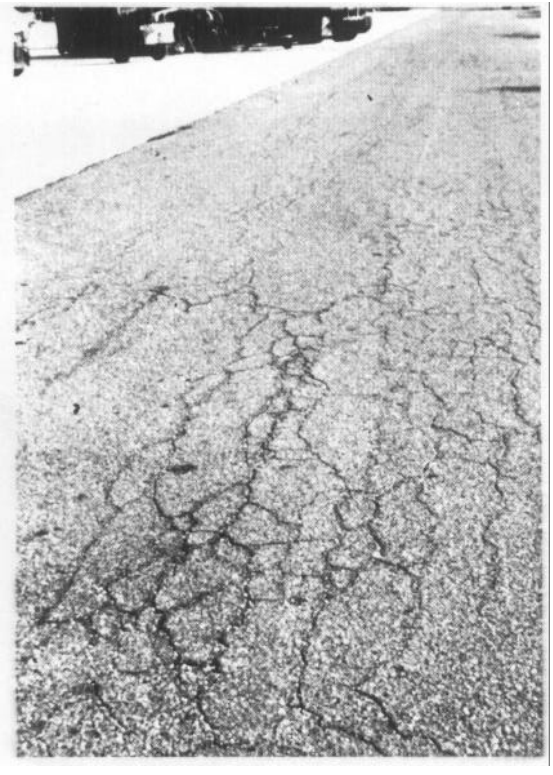

Figure 4. Medium-severity alligator cracking

Figure 5. Medium-severity alligator cracking

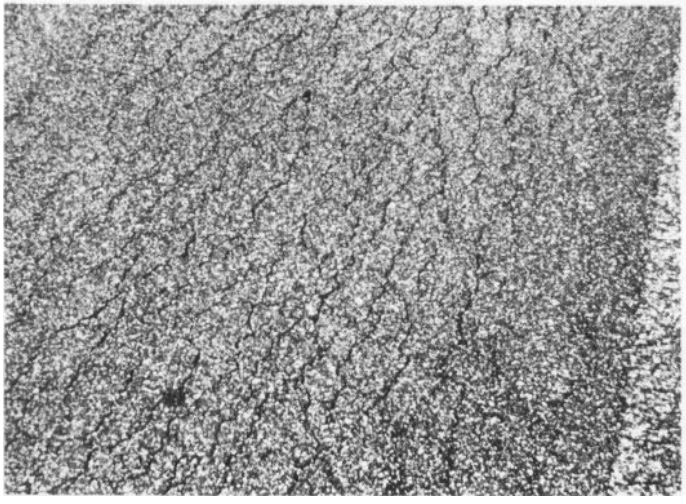

Figure 6. Medium-severity alligator cracking

Figure 7. High-severity alligator cracking

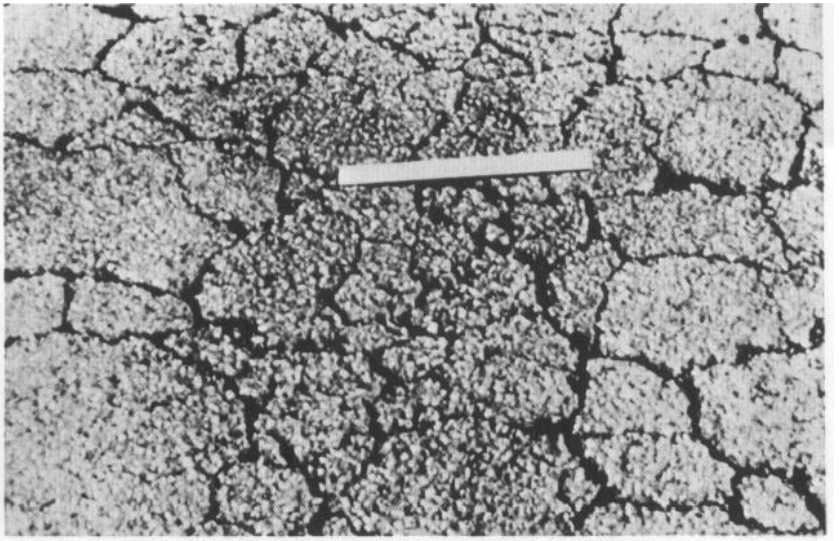

Figure 8. High-severity alligator cracking

BLEEDING

Description: Bleeding is a film of bituminous material on the pavement surface which creates a shiny, glasslike, reflecting surface that usually becomes quite sticky. Bleeding is caused by excessive asphalt cement or tars in the mix, excess application of a bituminous sealant, and/or low air void content. It occurs when asphalt fills the voids of the mix during hot weather and then expands onto the pavement surface. Since the bleeding process is not reversible during cold weather, asphalt or tar will accumulate on the surface.

Severity Levels:

L - Bleeding has only occurred to a very slight degree and it is noticeable only during a few days of the year. Asphalt does not stick to shoes or vehicles (Figure 9)

M - Bleeding has occurred to the extent that asphalt sticks to shoes and vehicles during only a few weeks of the year. (Figure 10)

H - Bleeding has occurred extensively and considerable asphalt sticks to shoes and vehicles during at least several weeks of the year. (Figure 11)

How to Measure: Bleeding is measured in square feet of surface area.

If bleeding is counted, polished aggregate should not be counted.

Options for Repair:

L - Do nothing.

M* - Apply sand/aggregate and roll.

H* - Apply sand/aggregate and roll.

**Preheat if necessary.*

Figure 9. Low-severity bleeding

Figure 10. Medium-severity bleeding

Figure 11. High-severity bleeding

BLOCK CRACKING

Description: Block cracks are interconnected cracks that divide the pavement into approximately rectangular pieces. The blocks may range in size from approximately 1 by 1 ft (.3 by .3 m) to 10 by 10 ft (3 x 3 m). Block cracking is caused mainly by shrinkage of the asphalt concrete and daily temperature cycling (which results in daily stress/strain cycling). It is not load-associated. 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 blocks, alligator cracks are caused by repeated traffic loadings, and are therefore found only in traffic areas (i.e., wheel paths).

Severity Levels:

L - Blocks are defined by low-severity* cracks. (Figure 12)

M - Blocks are defined by medium-severity* cracks. (Figures 13 and 14)

H - Blocks are defined by high-severity cracks. (Figure 15)

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.

**See definition of longitudinal and transverse cracking, p 47.*

Options for Repair:

L - Seal cracks over 1/8 in.; Surface seal.

M - Seal cracks; Recycle surface; Heater scarify and overlay.

H - Seal cracks; Recycle surface; Heater scarify and overlay.

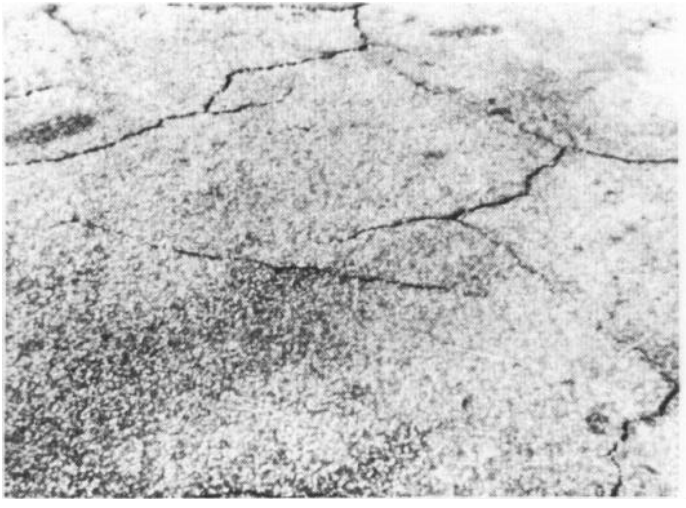

Figure 12. Low-severity block cracking

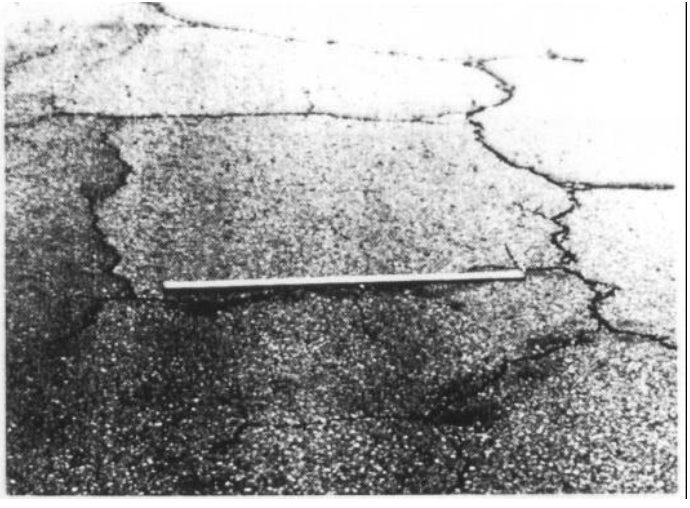

Figure 13. Medium-severity block cracking

Figure 14. Medium-severity block cracking

Figure 15. High-severity block cracking (a few inches around the crack are severely broken)

BUMPS AND SAGS

Description: Bumps are small, localized, upward displacements of the pavement surface. They are different from shoves in that shoves are caused by unstable pavement. Bumps, on the other hand, can be caused by several factors, including:

1. Buckling or bulging of underlying portland cement concrete (PCC) slabs in asphalt concrete (AC) overlay over PCC pavement.

2. Frost heave (ice, lens growth).

3. Infiltration and buildup of material in a crack in combination with traffic loading (sometimes called tenting).

Sags are small, abrupt, downward displacements of the pavement surface.

Distortion and displacement which occurs over large areas of the pavement surface, causing large and/or long dips in the pavement is called swelling (see p 85).

Severity Levels:

L - Bump or sag causes low-severity ride quality. (Figure 16)

M - Bump or sag causes medium-severity ride quality. (Figures 17, 18, and 19)

H - Bump or sag causes high-severity ride quality. (Figure 20)

How to Measure: Bumps or sags are measured in linear feet. If bumps appear in a pattern perpendicular to traffic flow and are spaced at less than 10 ft (3 m), the distress is called corrugation. If the bump occurs in combination with a crack, the crack is also recorded.

Options for Repair:

L - Do nothing.

M - Cold mill; Shallow, partial or full depth patch.

H - Cold mill: Shallow, partial or full depth patch; Overlay.

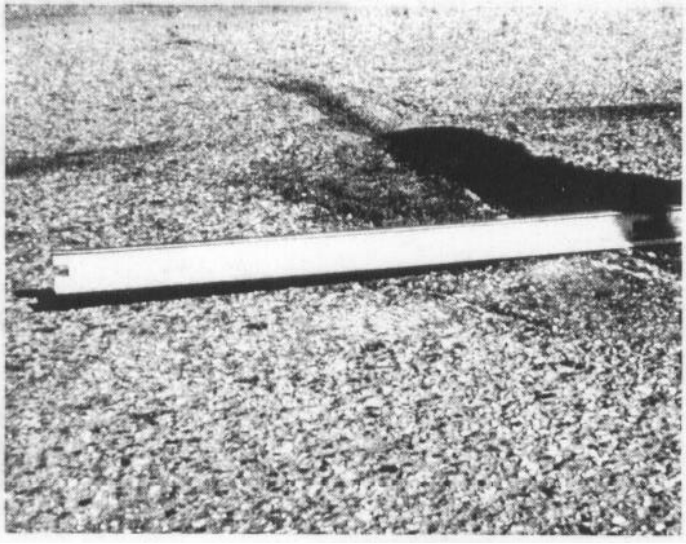

Figure 16. Low-severity bumps and sags

Figure 17. Medium-severity bumps and sags

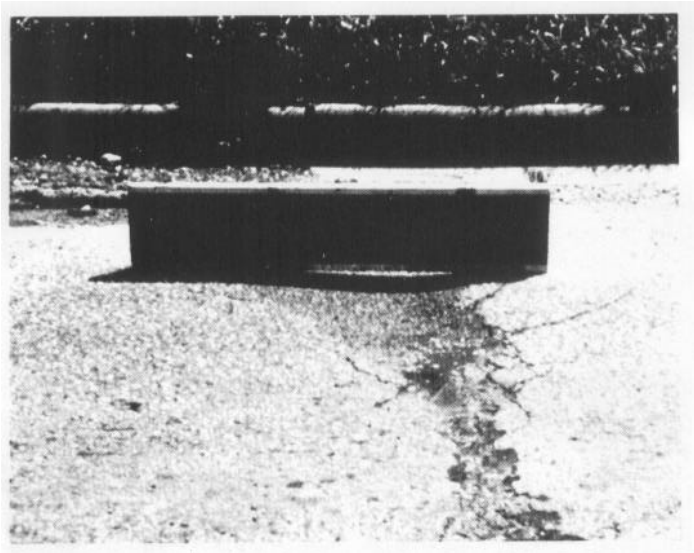

Figure 18. Medium-severity bumps and sags

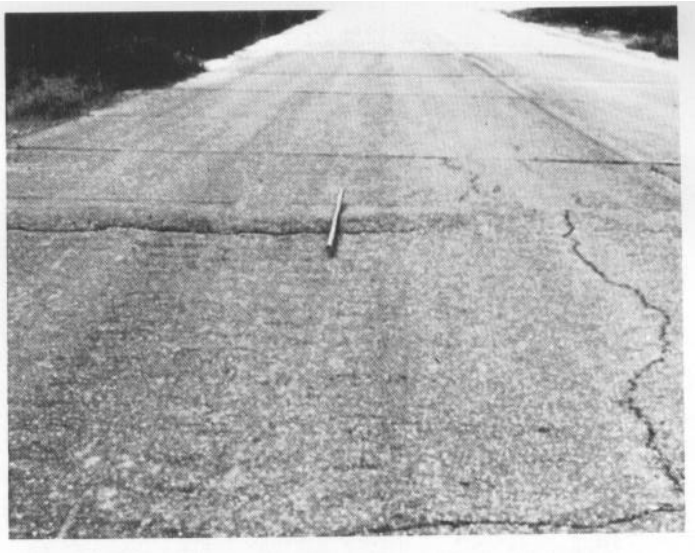

Figure 19. Medium-severity bumps and sags

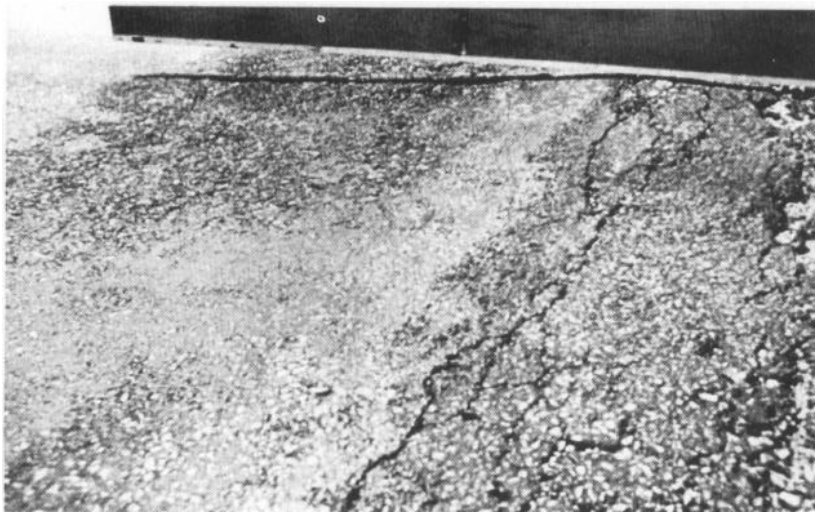

Figure 20. High-severity bumps and sags

CORRUGATION

Description: Corrugation (also known as washboarding) is a series of closely spaced ridges and valleys (ripples) occurring at fairly regular intervals usually less than 10 ft (3 m) along the pavement. The ridges are perpendicular to the traffic direction. This type of distress is usually caused by traffic action combined with an unstable pavement surface or base. If bumps occur in a series of less than 10 ft (3 m), due to any cause, the distress is considered corrugation.

Severity Levels:

L - Corrugation produces low-severity ride quality. (Figure 21)

M - Corrugation produces medium-severity ride quality. (Figures 22 and 23)

H - Corrugation produces high-severity ride quality. (Figure 24)

How to Measure: Corrugation is measured in square feet of surface area.

Options for Repair:

L - Do nothing.

M - Reconstruct.

H - Reconstruct.

Figure 21. Low-severity corrugation

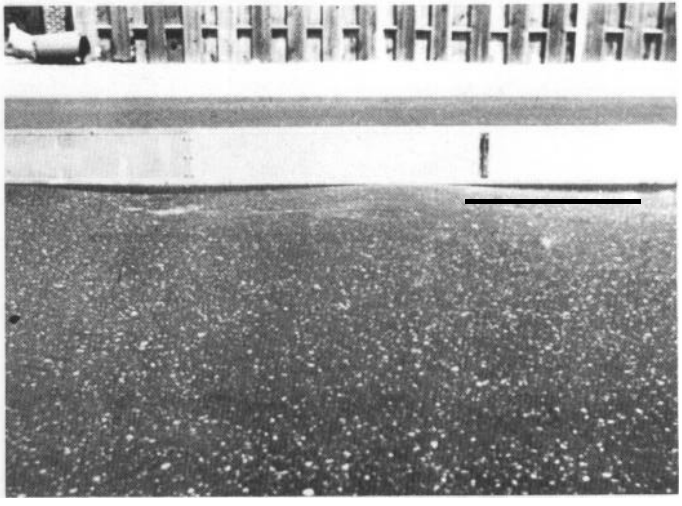

Figure 22. Medium-severity corrugation

Figure 23. Medium-severity corrugation

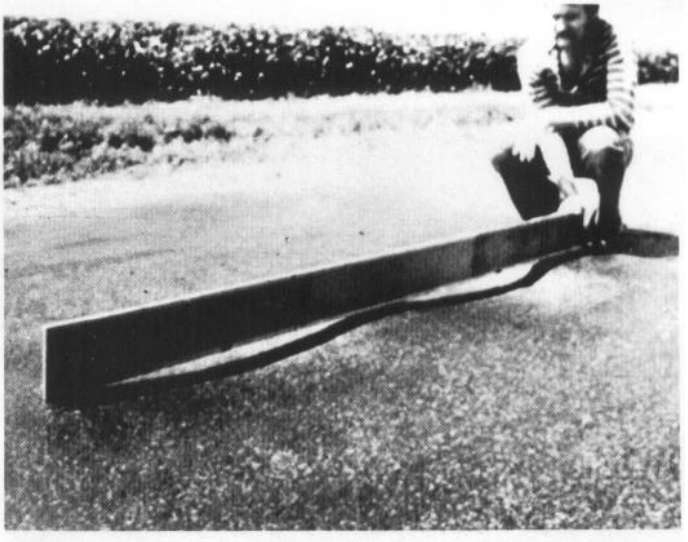

Figure 24. High-severity corrugation

DEPRESSION

Description: Localized pavement surface areas with elevations slightly lower than those of the surrounding pavement are called depressions. In many instances, light depressions are not noticeable until after a rain, when ponding water creates “birdbath” areas; on dry pavement, depressions can be spotted by looking for stains caused by ponding water. Depressions are created by settlement of the foundation soil or are a result of improper construction. Depressions cause some roughness, and when filled with water of sufficient depth, can cause hydroplaning.

Sags, unlike depressions, are abrupt drops in elevations (see p 23).

Severity Levels: Maximum Depth of Depression

L - ½ to 1 in (13 to 25 mm) (Figure 25)

M - 1 to 2 in. (25 to 51 mm) (Figure 26)

H - more than 2 in. (51 mm) (Figure 27)

How to Measure: Depressions are measured in square feet of surface area.

Options for Repair:

L - Do nothing.

M - Shallow, partial, or full depth patch.

H - Shallow, partial, or full depth patch.

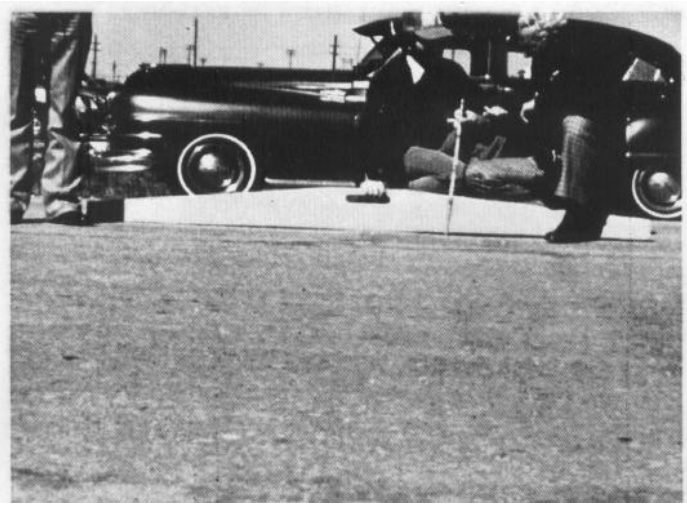

Figure 25. Low-severity depression

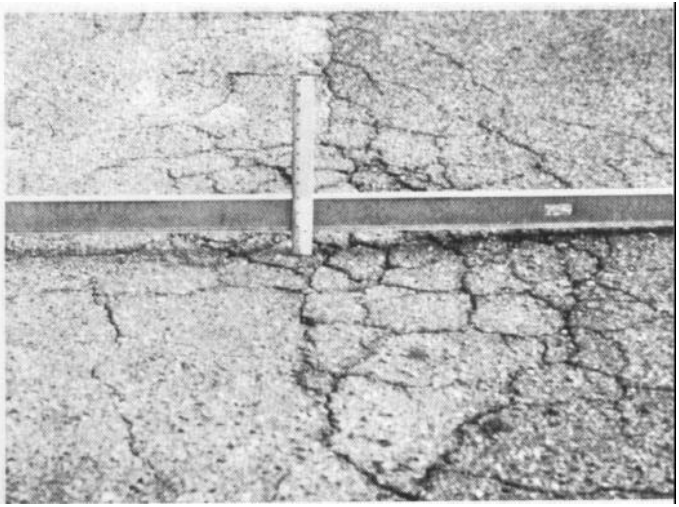

Figure 26. Medium-severity depression

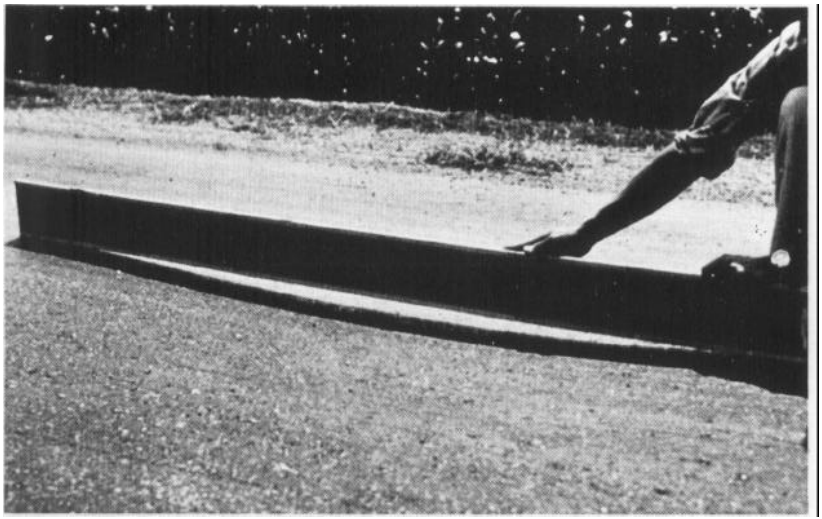

Figure 27. High-severity depression

EDGE CRACKING

Description: Edge cracks are parallel to and usually within 1 to 2 ft (.3 to .6 m) of the outer edge of the pavement. This distress is accelerated by traffic loading and can be caused by frost weakened base or subgrade near the edge of the pavement. The area between the crack and pavement edge is classified as raveled if it breaks up (sometimes to the extent that pieces are removed).

Severity Levels:

L - Low or medium cracking with no breakup or raveling. (Figure 28)

M - Medium cracks with some breakup and raveling. (Figure 29)

H - Considerable breakup or raveling along the edge. (Figures 30 and 31)

How to Measure: Edge cracking is measured in linear feet.

Options for Repair:

L - Do nothing; Seal cracks over 1/8 in.

M - Seal cracks; Partial depth patch.

H - Partial depth patch.

Figure 28. Low-severity edge cracking

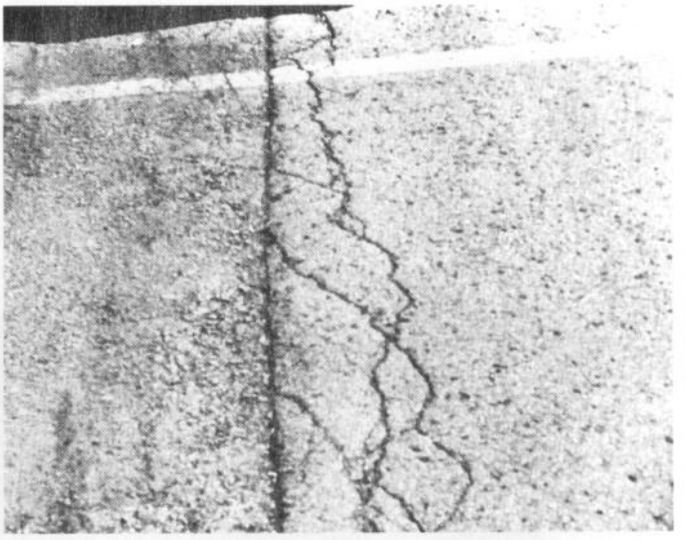

Figure 29. Medium-severity edge cracking

Figure 30. High-severity edge cracking

Figure 31. High-severity edge cracking

JOINT REFLECTION CRACKING (FROM LONGITUDINAL AND TRANSVERSE PCC SLABS)

Description: This distress occurs only on asphalt-surfaced pavements which have been laid over a PCC slab. It does not include reflection cracks from any other type of base (i.e., cement- or lime-stabilized); such cracks are mainly caused by thermal- or moisture-induced movement of the PCC slab beneath the AC surface. This distress is not load-related; however, traffic loading may cause a breakdown of the AC surface near the crack. If the pavement is fragmented along a crack, the crack is said to be spalled. A knowledge of slab dimensions beneath the AC surface will help to identify these distresses.

Severity Levels:

L - One of the following conditions exist (Figure 32):

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

M - One of the following conditions exist (Figure 33):

1. Nonfilled crack width is 3/8 to 3 in. (10 to 76 mm).
2. Nonfilled crack of any width up to 3 in. (76 mm) surrounded by light random cracking (Figure 33).
3. Filled crack of any width surrounded by light random cracking.

H - One of the following conditions exist (Figure 34):

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

How to Measure: Joint reflection cracking is measured in linear feet. The length and severity level of each crack should be recorded separately. For example, a crack that is 50 ft (15 m) long may-have 10 ft (3 m) of high severity; these would all be recorded separately. If a bump occurs at the reflection crack, it is also recorded.

Options for Repair:

L - Seal cracks over 1/8 in.

M - Seal cracks; Partial depth patch.

H - Partial depth patch; Reconstruct joint.

Figure 32. Low-severity joint reflection cracking

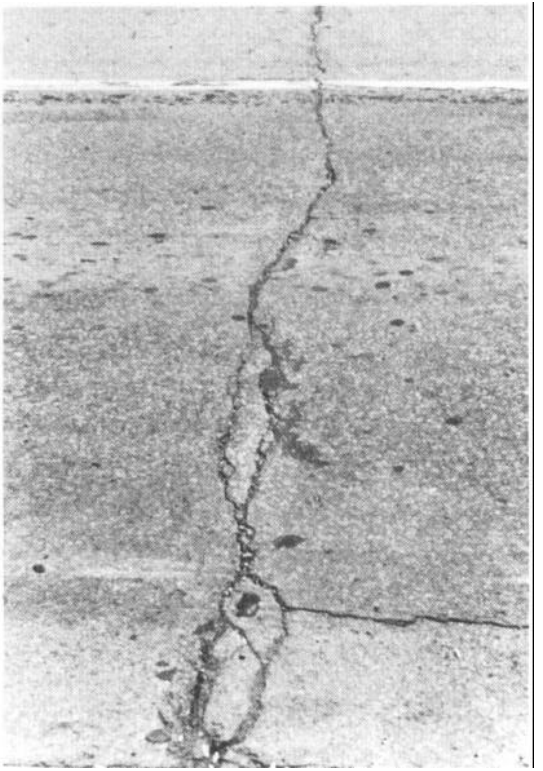

Figure 33. Medium-severity joint reflection cracking

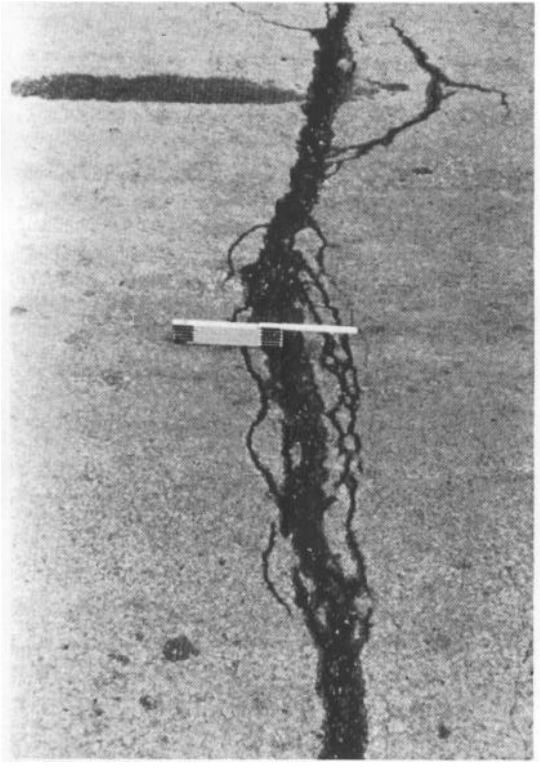

Figure 34. High-severity joint reflection cracking

LANE/SHOULDER DROP-OFF

Description: Lane/shoulder drop-off is a difference in elevation between the pavement edge and the shoulder. This distress is caused by shoulder erosion, shoulder settlement, or by building up the roadway without adjusting the shoulder level.

Severity Levels:

L - The difference in elevation between the pavement edge and shoulder is 1 to 2 in. (25 to 51 mm). (Figure 35)

M - The difference in elevation is over 2 to 4 in. (51 to 102 mm). (Figure 36)

H - The difference in elevation is greater than 4 in. (102 mm). (Figures 37 and 38)

How to Measure: Lane/shoulder drop-off is measured in linear feet.

Options for Repair: L, M, H - Regrade and fill shoulders to match lane height.

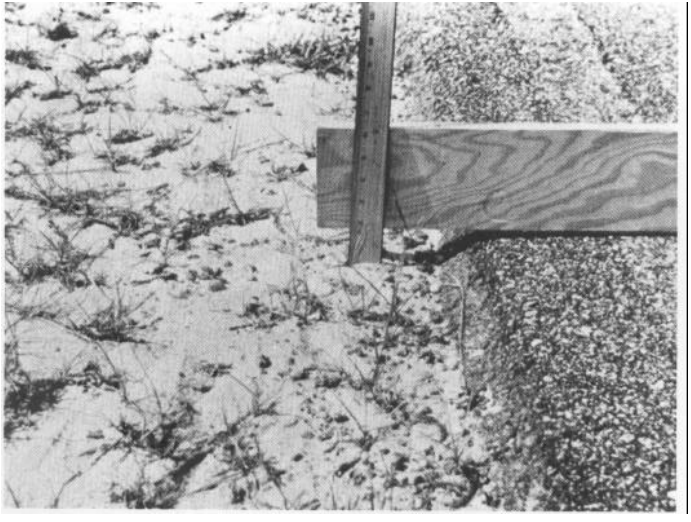

Figure 35. Low-severity lane/shoulder drop off

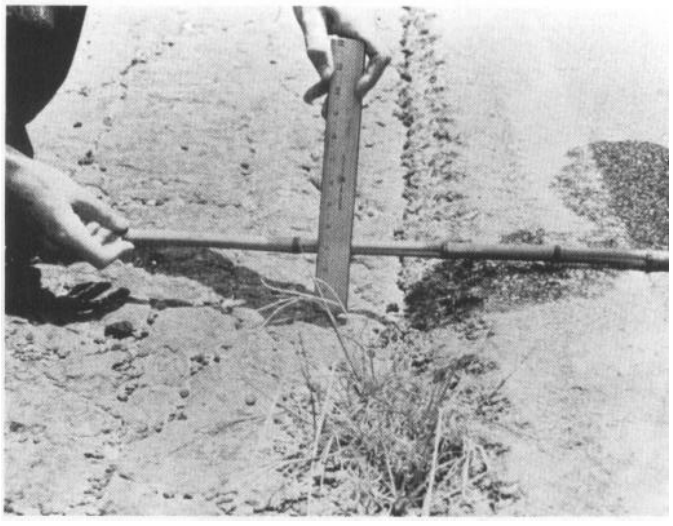

Figure 36. Medium-severity lane/shoulder drop off

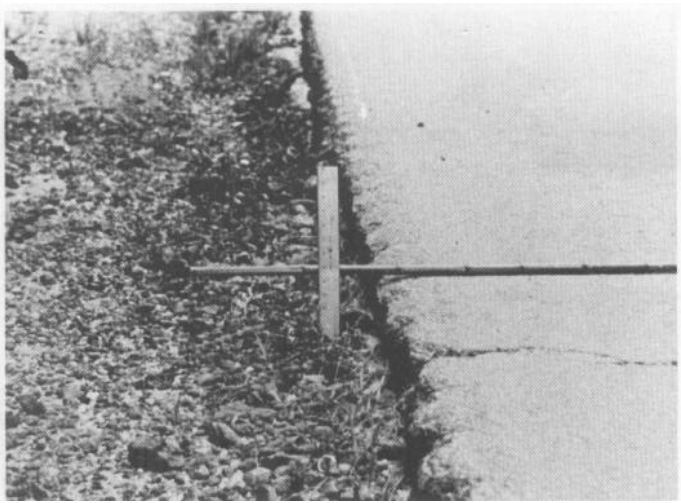

Figure 37. High-severity lane/shoulder drop off

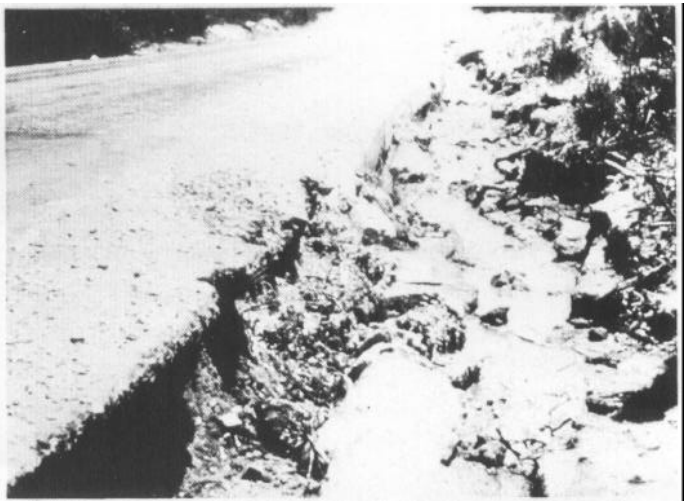

Figure 38. High-severity lane/shoulder drop off

LONGITUDINAL AND TRANSVERSE CRACKING (NON-PCC SLAB JOINT REFLECTIVE)

Description: Longitudinal cracks are parallel to the pavement's centerline or laydown direction. They may be caused by:

1. A poorly constructed paving lane joint.

2. Shrinkage of the AC surface due to low temperatures or hardening of the asphalt and/or daily temperature cycling.

3. A reflective crack caused by cracking beneath the surface course, including cracks in PCC slabs (but not PCC joints).

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

Severity Levels:

L - One of the following conditions exist (see Figure 39):
1. Nonfilled crack width is less than 3/8 in. (10 mm), or
2. Filled crack of any width (filler in satisfactory condition).

M - One of the following conditions exist (Figures 40 and 41):
1. Nonfilled crack width is 3/8 to 3 in. (10 to 76 mm).
2. Nonfilled crack of any width up to 3 in. (76 mm) surrounded by light and random cracking.
3. Filled crack of any width surrounded by light random cracking.

H - One of the following conditions exist (Figure 42):

1. Any crack filled or nonfilled surrounded by medium- or high-severity random cracking.
2. Nonfilled crack over 3 in. (76 mm).
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 the crack, it is also recorded.

Options for Repair:

L - Do nothing; Seal cracks over 1/8 in.

M - Seal cracks.

H - Seal cracks; Partial depth patch.

Figure 39. Low-severity longitudinal and transverse cracking

Figure 40. Medium-severity longitudinal and transverse cracking

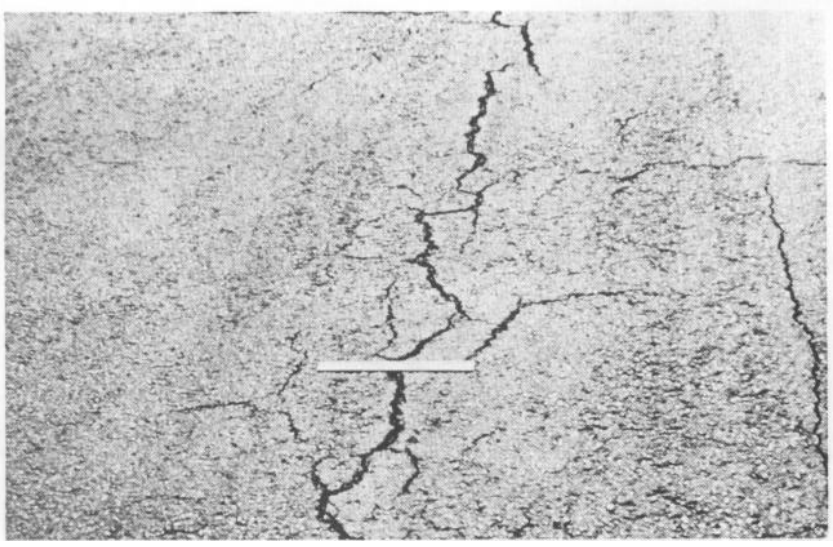

Figure 41. Medium-severity longitudinal and transverse cracking [¾ in (19 mm) crack surrounded by light random cracks].

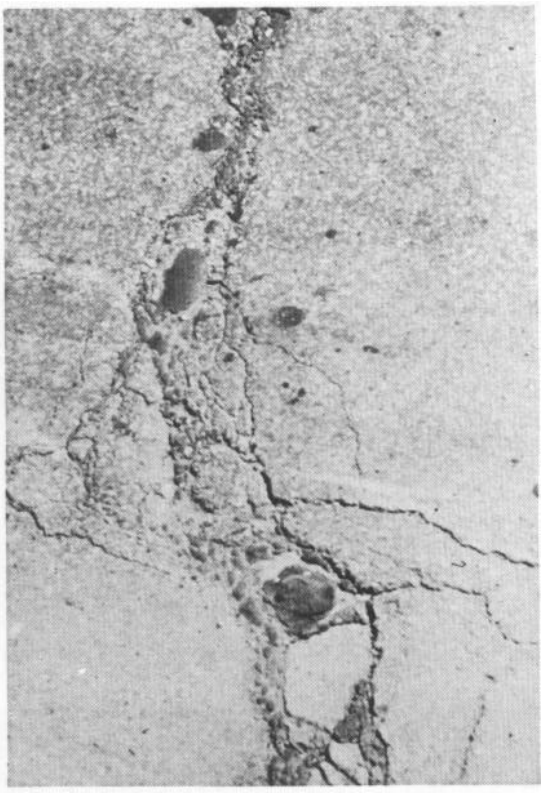

Figure 42. High-severity longitudinal and transverse cracking

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 satisfactory. Ride quality is rated as low severity or better. (Figures 43, 44, and 45)

M - Patch is moderately deteriorated and/or ride quality is rated as medium severity. (Figure 46)

H - Patch is badly deteriorated and/or ride quality is rated as high severity. Patch needs replacement soon. (Figure 47)

How to Measure: Patching is rated 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 square meters) patch may have 10 sq ft (.9 square meters) of medium severity and 15 sq ft (1.35 square meters) of low severity. These areas would be recorded separately. No other distresses (e.g., shoving or cracking) are recorded within a patch (e.g., even if patch material is shoving or cracking, the area is rated only as a 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).

Options for Repair:

L - Do nothing.

M - Do nothing; Replace patch.

H - Replace patch.

Figure 43. Low-severity patching and utility cut patching

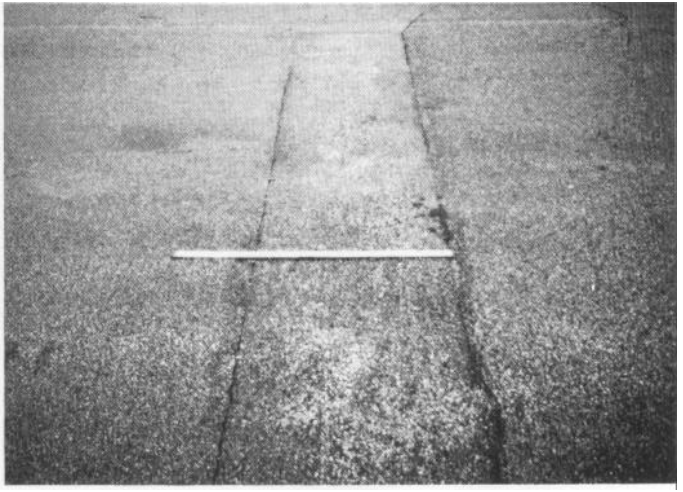

Figure 44. Low-severity patching and utility cut patching

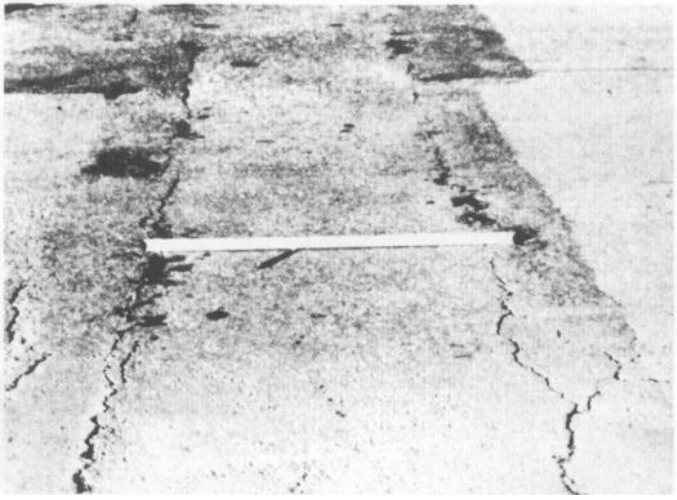

Figure 45. Low-severity patching and utility cut patching

Figure 46. Medium-severity patch

Figure 47. High-severity patching and utility cut patching

POLISHED AGGREGATE

Description: This distress is caused by repeated traffic applications. When the aggregate in the surface becomes smooth to the touch, adhesion with vehicle tires is considerably reduced. When the portion of aggregate extending above the surface is small, the pavement texture does not significantly contribute to reducing vehicle speed. Polished aggregate should be counted when close examination reveals that the aggregate extending above the asphalt is negligible, and the surface aggregate is smooth to the touch. This type of distress is indicated when the number on a skid resistance test is low or has dropped significantly from previous ratings.

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 48).

How to Measure: Polished aggregate is measured in square feet of surface area. If bleeding is counted, polished aggregate should not be counted.

Options for Repair: L, M, H - Do nothing; Surface treatment; Overlay; Mill and overlay.

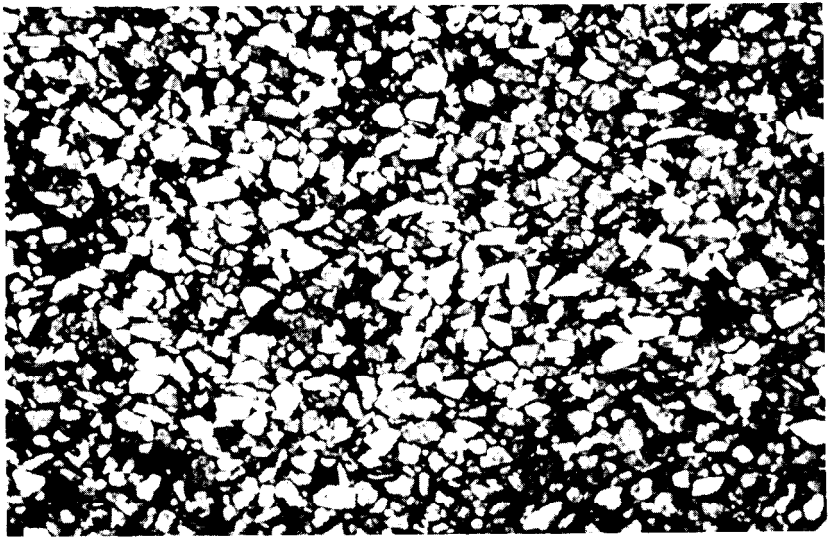

Figure 48. Polished aggregate

POTHOLES

Description: Potholes are small [usually less than 3 ft (.9 m) in diameter], bowl-shaped depressions in the pavement surface. They generally have sharp edges and vertical sides near the top of the hole. Their growth is accelerated by free moisture collection inside the hole. Potholes are produced when traffic abrades small pieces of the pavement surface. The pavement then continues to disintegrate because of poor surface mixtures, weak spots in the base or subgrade, or because it has reached a condition of high-severity alligator cracking. Potholes are generally structurally related distresses and should not be confused with raveling and weathering.

Thus, when holes are created by high-severity alligator cracking, they should be identified as potholes, not as weathering.

Severity Levels: The levels of severity for potholes under 30 in. (762 mm) in diameter are based on both the diameter and the depth of the pothole according to the following table:

Maximum Depth of Pothole	Average Diameter (in.) (mm)		
	4 to 8 in. (102 to 203 mm)	> 8 to < 18 in. (> 203 to < 457 mm)	>18 to < 30 in. (> 457 to < 762 mm)
½ to 1 in. (1.27 to 2.54 cm)	L	L	M
> 1 to 2 in. (2.54 to 5.08 cm)	L	M	H

> 2 in. (5.08 cm)	M	M	H

If the pothole is over 30 in. (76 mm) in diameter, the area should be determined in square feet and divided by 5 sq ft (.47 square meters) to find the equivalent number of holes. If the depth is 1 in. (25 mm) or less, they are considered medium severity. If the depth is over 1 in. (25 mm), they are considered high severity. (Figures 49 through 53)

How to Measure: Potholes are measured by counting the number that are low, medium and high severity and recording them separately.

Options for Repair:

L - Do nothing; Partial or full depth patch.

M - Partial or full depth patch.

H - Full depth patch.

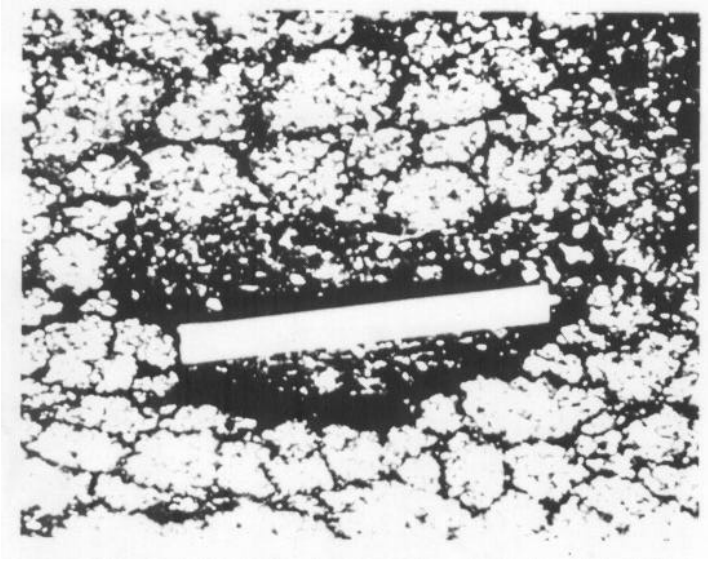

Figure 49. Low-severity pothole

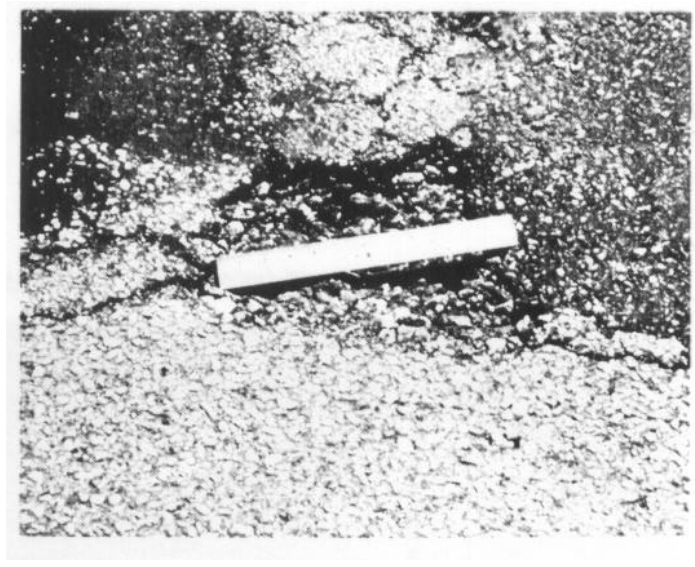

Figure 50. Low-severity pothole

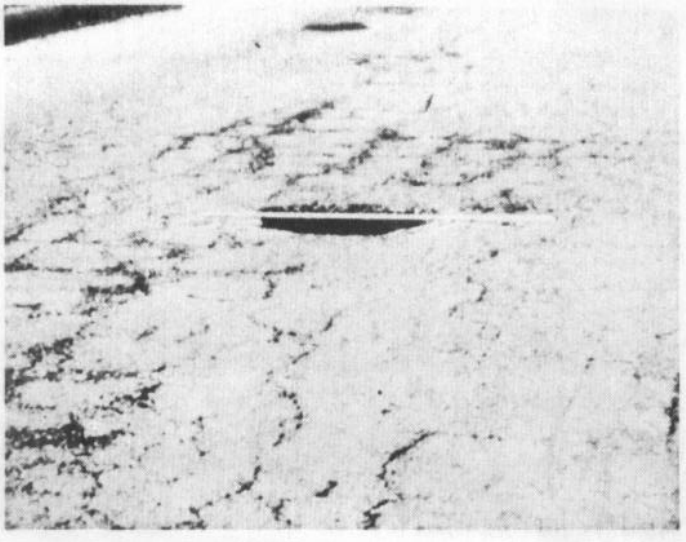

Figure 51. Medium-severity pothole

Figure 52. High-severity pothole

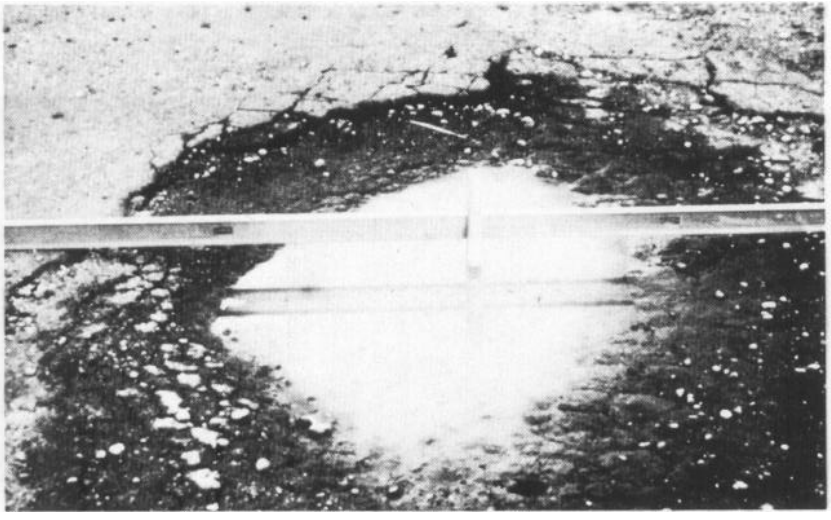

Figure 53. High-severity pothole

RAILROAD CROSSING

Description: Railroad crossing defects are depressions or bumps around and/or between tracks.

Severity Levels:

L - Railroad crossing causes low-severity ride quality. (Figure 54)

M - Railroad crossing causes medium-severity ride quality. (Figure 55)

H - Railroad crossing causes high-severity ride quality. (Figure 56)

How to Measure: The area of the crossing is measured in square feet of surface area. If the crossing does not affect ride quality, it should not be counted. Any large bump created by the tracks should be counted as part of the crossing.

Options for Repair:

L - Do nothing.

M - Shallow or partial depth patch approach; Reconstruct crossing.

H - Shallow or partial depth patch approach; Reconstruct crossing.

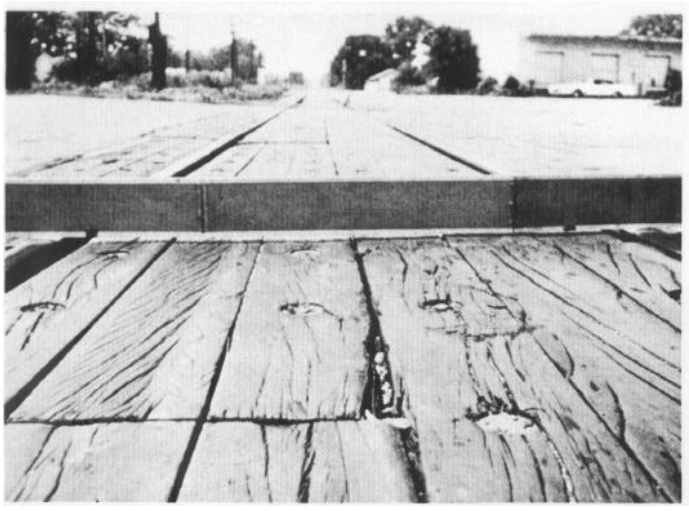

Figure 54. Low-severity railroad crossing

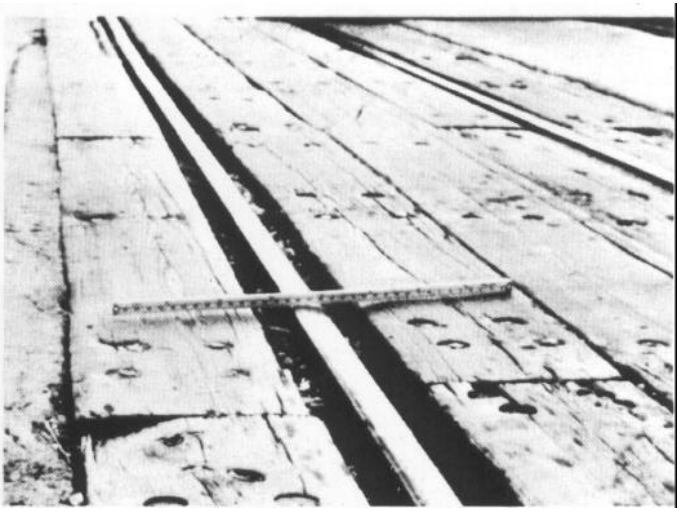

Figure 55. Medium-severity railroad crossing

Figure 56. High-severity railroad crossing

RUTTING

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 paths are filled with water. Rutting stems from a permanent deformation in any of the pavement layers or subgrades, usually caused by consolidated or lateral movement of the materials due to traffic load. Significant rutting can lead to major structural failure of the pavement.

Severity Levels: Mean Rut Depth

L - ¼ to < ½ in. (6 to < 13 mm) (Figures 57 and 58)

M - > ½ to < 1 in. (> 13 to < 25 mm) (Figure 59)

H - > 1 in. (> 25 mm) (Figure 60)

How to Measure: Rutting is measured in square feet of surface area, and its severity is determined by the mean depth of the rut (see above). The mean rut depth is calculated by laying a straightedge across the rut, measuring its depth, then using measurements taken along the length of the rut to compute its mean depth in inches.

Options for Repair:

L - Do nothing; Mill and overlay.

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

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

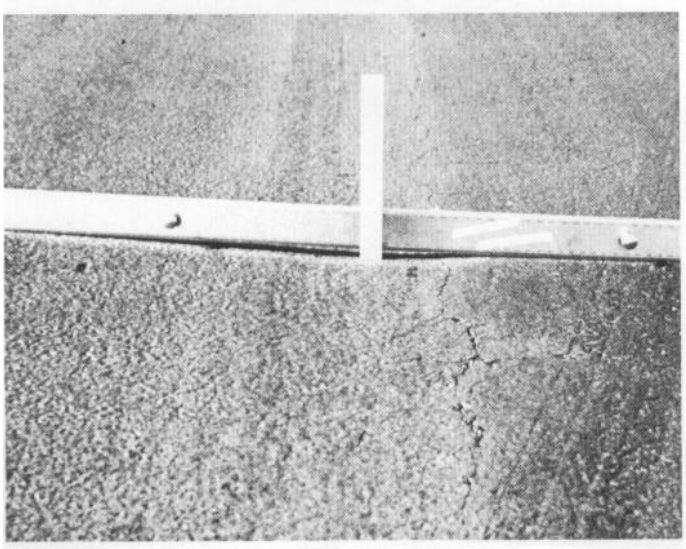

Figure 57. Low-severity rutting

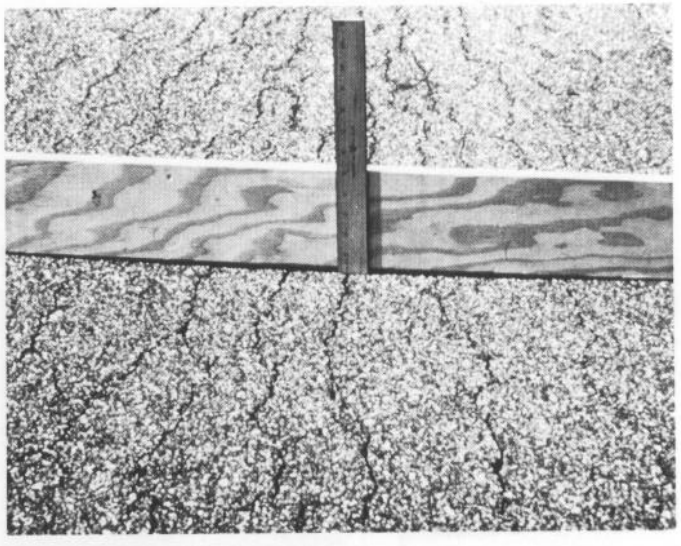

Figure 58. Low-severity rutting

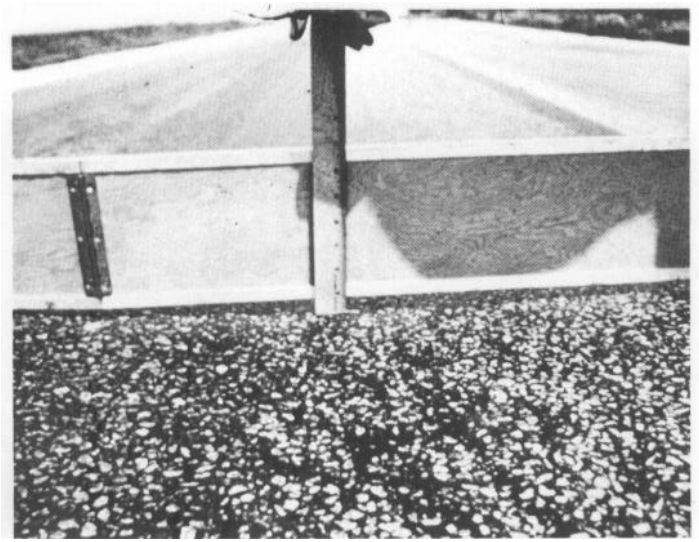

Figure 59. Medium-severity rutting

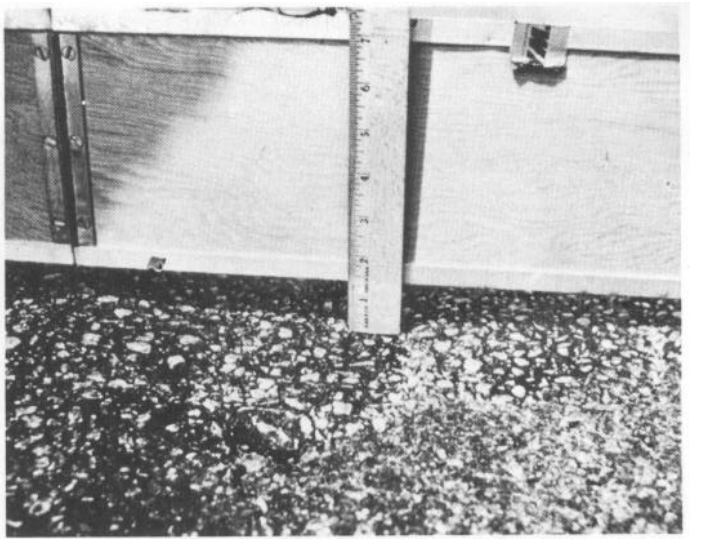

Figure 60. High-severity rutting

SHOVING

Description: Shoving is a permanent, longitudinal displacement of a localized area of the pavement surface caused by traffic loading. When traffic pushes against the pavement, it produces a short, abrupt wave in the pavement surface. This distress normally occurs only in unstable liquid asphalt mix (cutback or emulsion) pavements.

Shoves also occur where asphalt pavements abut PCC pavements; the PCC pavements increase in length and push the asphalt pavement, causing the shoving.

Severity Levels:

L - Shove causes low-severity ride quality. (Figure 61)

M - Shove causes medium-severity ride quality. (Figure 62)

H - Shove causes high-severity ride quality. (Figure 63)

How to Measure: Shoves are measured in square feet of surface area. Shoves occurring in patches are considered in rating the patch, not as a separate distress.

Options for Repair:

L - Do nothing; Mill.

M - Mill; Partial or full depth patch.

H - Mill; Partial or full depth patch.

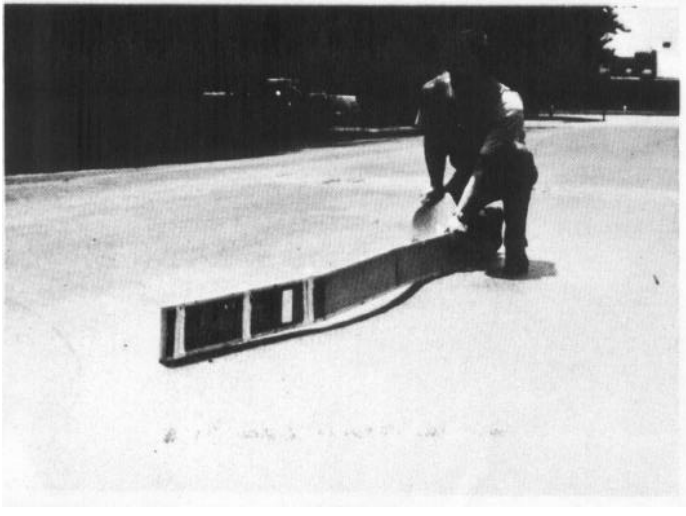

Figure 61. Low-severity shoving

Figure 62. Medium-severity shoving approaching high severity

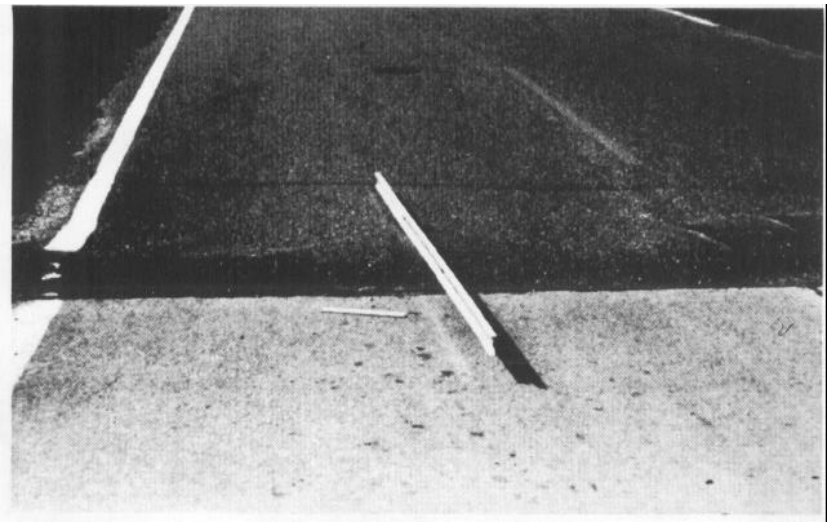

Figure 63. High-severity shoving

SLIPPAGE CRACKING

Description: Slippage cracks are crescent or half-moon shaped cracks. They are produced when braking or turning wheels cause the pavement surface to slide or deform. This distress usually occurs when there is a low-strength surface mix or a poor bond between the surface and the next layer of the pavement structure.

Severity Levels:

L - Average crack width is less than $^{3}/_{8}$ in. (10 mm). (Figure 64)

M - One of the following conditions exist (Figure 65):

1. Average crack width is between $^{3}/_{8}$ and 1½ in. (10 and 38 mm)
2. The area around the crack is broken into tight fitting pieces.

H - One of the following conditions exist (Figure 66):

1. The average crack width is greater than 1½ in. (38 mm)
2. The area around the crack is broken into easily removed pieces.

How to Measure: The area associated with a given slippage crack is measured in square feet and rated according to the highest level severity in the area.

Options for Repair:

L - Do nothing; Partial depth patch.

M - Partial depth patch.

H - Partial depth patch.

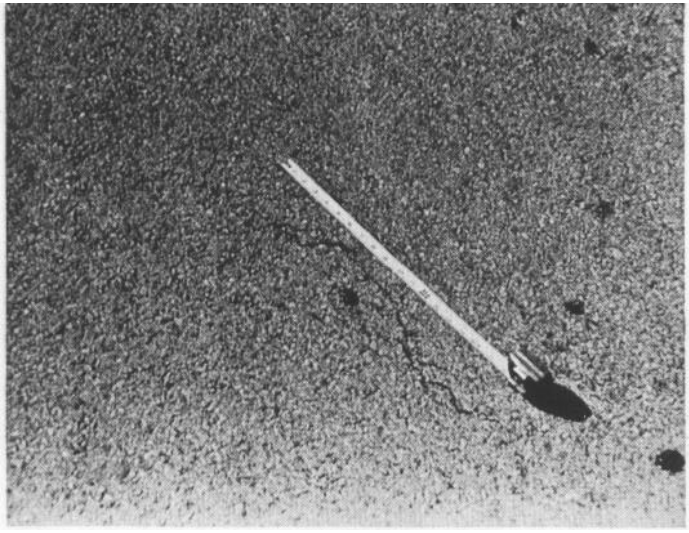

Figure 64. Low-severity slippage cracking

Figure 65. Medium-severity slippage cracking

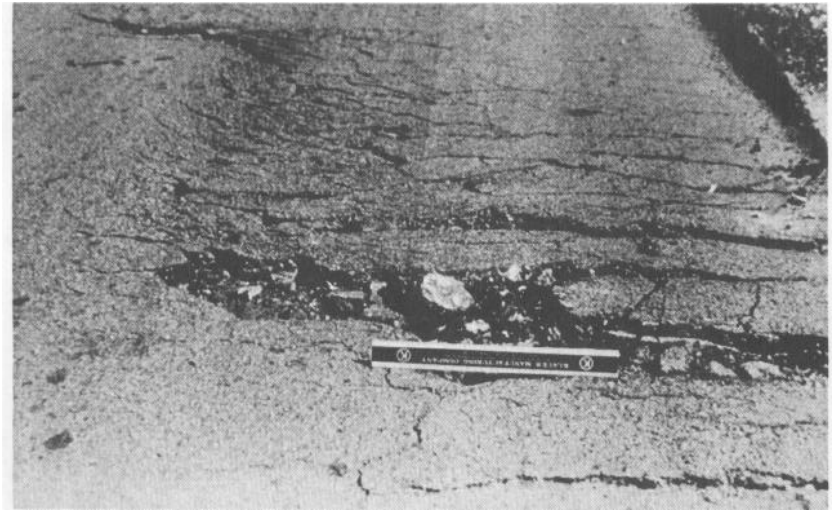

Figure 66. High-severity slippage cracking

SWELL

Description: Swell is characterized by an upward bulge in the pavement's surface-a long, gradual wave of more than 10 ft (3 m) long. Swelling can be accompanied by surface cracking. This distress is usually caused by frost action in the subgrade or by swelling soil.

Severity Levels:

L - Swell causes low-severity ride quality. Low severity swells are not always easy to see, but can be detected by driving at the speed limit over the pavement section. An upward acceleration will occur at the swell if it is present.

M - Swell causes medium-severity ride quality.

H - Swell causes high-severity ride quality.

See Figure 67

How to Measure: The surface area of the swell is measured in square feet.

Options for Repair:

L - Do nothing.

M - Do nothing; Reconstruct.

H - Reconstruct.

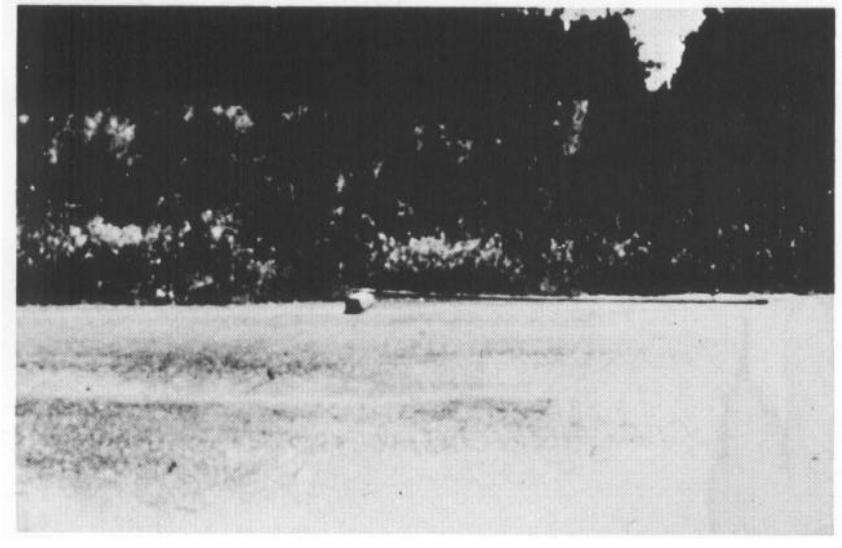

Figure 67. Example swell. Severity level is based on ride quality criteria

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. These distresses indicate 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 spillage is also included under raveling.

Severity Levels:

L - Aggregate or binder has started to wear away. In some areas, the surface is starting to pit (Figures 68 and 69). In 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. The surface texture is moderately rough and pitted (Figures 70 and 71). In case of oil spillage, the surface is soft and can be pentrated with a coin.

H -Aggregate and/or binder has been considerably worn away. The surface texture is very rough and severely pitted. The pitted areas are less than 4 in. (10 mm) in diameter and less than ½ in. (13 mm) deep; pitted areas larger than this arecounted as potholes (Figure 72). In 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.

Options for Repair:

L - Do nothing; Surface seal; Surface treatment.

M* - Surface seal; Surface treatment; Overlay.

H* - Surface treatment; Overlay; Recycle; Reconstruct.

* *If localized, i.e., due to oil spillage, then partial depth patch.*

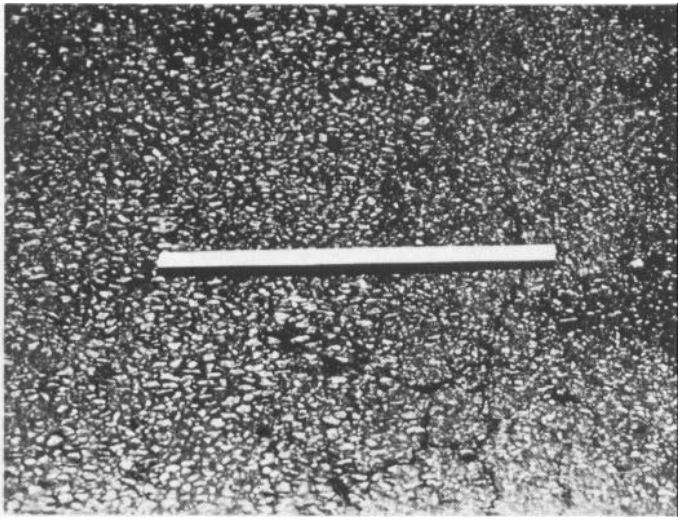

Figure 68. Low-severity weathering and raveling

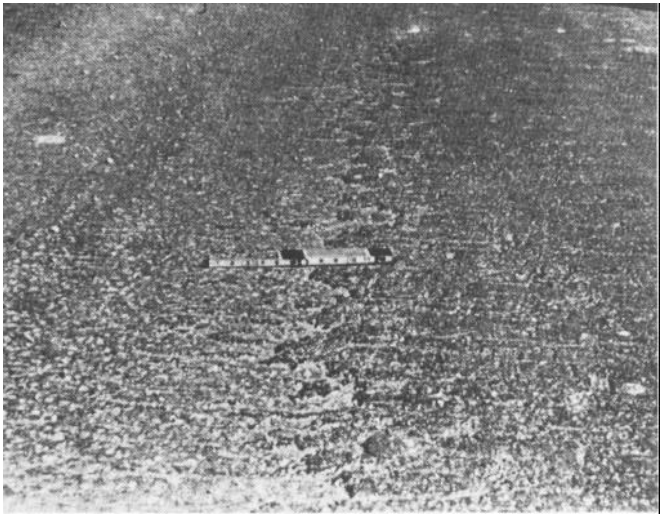

Figure 69. Low-severity weathering and raveling caused by tracked vehicles

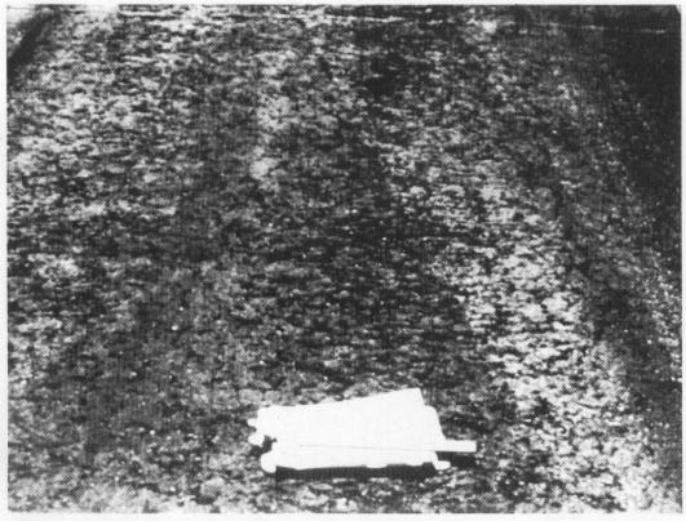

Figure 70. Medium-severity weathering and raveling

Figure 71. Medium-severity weathering and raveling

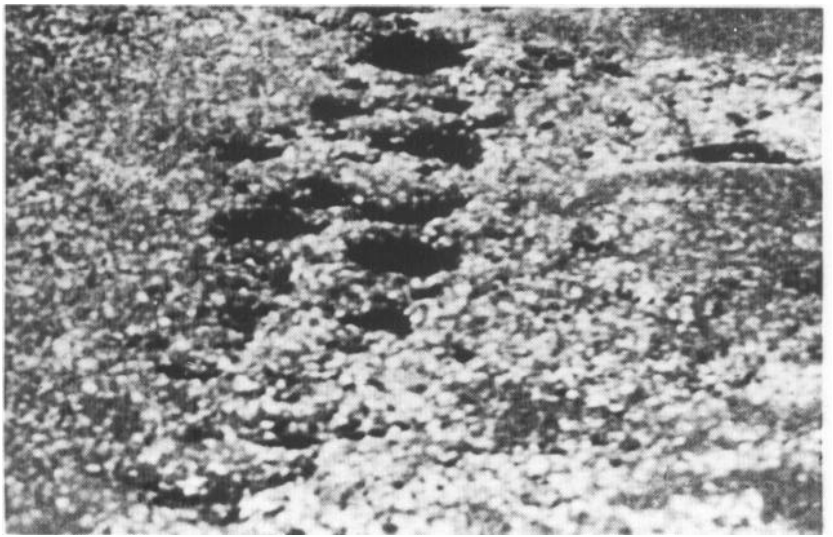

Figure 72. High-severity weathering and raveling