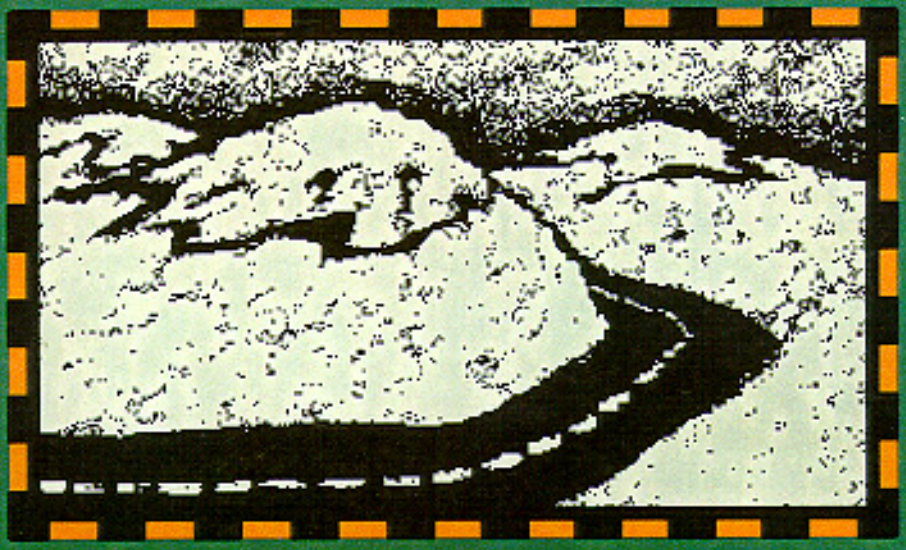
Pavement Surface Condition
RATING MANUAL



Northwest Pavement Management Systems Users Group

Sponsored by:
Northwest Technology Transfer Center
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PAVEMENT SURFACE CONDITION RATING MANUAL

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INTRODUCTION

Regularly scheduled pavement condition inspection is one of the most important steps in implementing a comprehensive Pavement Management System (PMS). Such a system involves dividing the pavement network into logical segments, recording descriptive segment inventory data, and collecting pavement performance information relating to these segments. These processes provide the critical information needed for analysis to determine maintenance and rehabilitation requirements, project priorities, and conduct long-term planning.

The purpose in performing manual (or automated) pavement condition surveys is to document the progressive deterioration of each of the segments of paved roadway. For these data to be useful in a predictive way, consistency in locating, defining, observing, and recording the surface defects is critical.

While many types of data might be collected, the Washington State Department of Transportation (WSDOT) concentrates on defects that indicate progressive deterioration, particularly those that are associated with the pavement's strength or ability to support and carry traffic loads.

In general, each defect is classified and rated according to type, severity, and extent. In most cases three levels of severity are defined, and the extent is measured, or estimated, as a percentage of the length of the surveyed segment. A matrix of severities and ranges of extent was developed by WSDOT for each type of defect. The rater is then able to select the one combination of severity and extent range for each defect that most represents the condition of the segment.

WSDOT has performed this type of manual visual surveys, and accumulated the resulting data, since 1969. The usefulness of the information, and the validity of the techniques used, have been proved.

Ideally, the extent of the severity of each type of defect would be accurately measured, recorded, and used for developing the Pavement Condition Rating. However, in order for a manual, visual survey to progress along an extensive network of roadways, the number of types and severities of defects that are independently collected and recorded, as well as the accuracy of the measurement of their extents, must be limited. Automated survey techniques may allow more precise collection of data at a reasonable cost in time and funds.

To assist local agencies within Washington state in developing and operating an effective PMS, a Core Program was defined on the basis of the concepts and practices of the Washington State Pavement Management System (WSPMS). These concepts include the basic theory of fatigue based performance curves, the definitions of specific defect types, their severities and units of measure, and the computational techniques that WSDOT uses.

To achieve the same success and reliability, obtain comparable results, and make use of past and future state research and development, the Core Program must be used as defined. Deviation from the details as defined will yield results that may not be meaningful when used in subsequent processes or comparisons.

OBJECTIVE OF THIS MANUAL

The objective of this manual is to provide guidelines and definitions for identifying pavement distress types and defining the levels of severity and extent (area, length, count) associated with each distress.

This manual is intended to be a training aid for pavement raters and a field reference during the rating process. In performing pavement inspections, you, the pavement condition rater, should be able to identify each distress type and its level of severity and extent consistent with the descriptions contained within this manual.

HOW TO USE THIS MANUAL

This manual provides the name, description, severity levels, and quantification process for each distress type that an agency evaluates in its pavement management program. The distresses are categorized by pavement type (flexible or rigid) and are listed as either Core Program defects or optional defects. The definition of each distress type is followed by a description of its levels of severity, units of extent quantification, measurement procedure, and an example. When necessary, additional comments and guidelines for evaluation may be included.

Study this manual carefully before performing your first inspection and keep a copy close at hand during inspections to serve as a reference.

COMMON TERMS

To perform the inspection procedure, you must understand some commonly used terms.

PMS Pavement management system.

Network The roadway network is the complete system of roadways that make up the PMS database. It can be the complete roadway system or a subset, such as the arterials only.

Project A project is the unit used to evaluate or group pavement elements. Projects are generally thought of as portions of roadway that could reasonably become funded improvement projects; however, they can be grouped together for various reasons. They generally consist of similar geometric data, such as pavement width, structure, and pavement type, or can be related to other needs, such as traffic volumes or planning needs.

Segment A segment is generally a single block, 1/10th mile, or other relatively short, homogeneous unit of roadway. Several segments may be included in a single project. They may vary in length for reasons such as pavement structure, behavior, and surface condition. They may also vary to meet the objectives of the agency implementing the PMS. Smaller segment definitions provide greater flexibility in the growth and expansion of the pavement management system.

These are generally the fundamental elements of the roadway network and thus the PMS database

structure. All ratings are performed over or within each segment. All data within the PMS are linked or referenced to a given segment, and they are located in the segment or roadway network by the distance or mile post along a given street or road.

Samples Generally the WSDOT rating procedures involve summarizing and averaging the severities and extents of each defect of an entire segment. However, smaller multiple samples can be used for rating. This technique results in more than one rating value per segment and, if done using statistically correct sampling techniques, can help to improve the performance of the PMS software.

Approaches to choosing samples for manual ratings differ. One way is to select them to represent the overall condition of the segment. Other approaches may use biased sampling, for example choosing the samples in the stopping lanes at intersections. The choice is based on how the agency wishes to drive or control its PMS network. For example, if the controlling factor is that the worst sections of a given project require repair, then this should trigger the system to specify an action.

Biased sampling should only be used for internal operations because it does not conform to the Core Program definitions and practices.

PCR The Pavement Condition Rating is a value from 0 to 100 computed for each segment or project ,where 100 indicates no defects. Other values are developed by deducting the value of cumulative distresses. The Core Program PCR is a fatigue based condition index. The Local Option PCR is a combined index.

Core Program The PMS Core Program (as adopted December 28, 1987, by the Northwest Pavement Management System Users Group) is the minimum amount of information and minimal data collection process required to provide uniformity between jurisdictions for comparison.

The complete description of the Core Program is available in agreement form, but it is too lengthy

to include here. However, a few of the important elements of that document are as follows:

- Interpretive Processes (PCR and performance curve computation)
- Pavement rating training in accordance with WSDOT training
- Condition ratings conform to state standards

Distress or Defects Visual pavement surface distress or pavement defects can be quantified and related to the life cycle of a given type of pavement or roadway under given traffic and weather conditions. Each distress is generally associated with a specific pavement property, such as aging, wearing, fatigue, or materials. These pavement surface defects can be distinguished and quantified visually by human or automated techniques, in contrast to invisible defects that may relate to base materials, drainage, or other conditions.

Severity The definition of severity for a given defect varies with each distress and is generally a measure of how badly or to what intensity a given defect has deteriorated. Examples are crack widths, crack deterioration or spalling, and loss of materials. See also "Rating Considerations."

Extent Extent is the measure of area, length, or count associated with a given distress. It is how much and how far a given defect has progressed. See also "Rating Considerations."

Deduct The deduct value is a number from 0 to 100 that is assigned to the combination of defects observed in a pavement segment. An alternative method assigns a deduct value to each distress type and its various levels of extent and severity. The deduct value(s) in a given pavement segment are summed together and subtracted from 100 to compute the final Pavement Condition Rating (PCR) for the segment.

Wheel Path There are two wheel paths per traffic lane. If the lane is divided laterally into two equal parts, each half may be broadly considered one wheel path. Therefore, a two-lane roadway has four wheel paths, which make up the full traveled surface area of a typical street, road, or highway.

Predominant The predominant distress severity is the distress condition that is most prevalent, or the typical severity. In general, if approximately equal portions of more than one severity exist, the higher severity should be used.

If each severity of the defect is quantified and recorded separately, use of the predominant severity is unnecessary.

Spalling and Raveling Spalling and raveling are commonly used terms in connection with several principal defects. More general detailed descriptions are as follows:

Spalling is the deterioration of the sharp edge formed at the pavement surface along each side of a crack or joint. With severe spalling, pieces of the pavement break away, causing the visual size or width of the crack on the pavement surface to be irregular and greater than the crack width below the surface. Large spalls may extend to full depth.

Raveling is the loss of material from the pavement. This may involve only small amounts of fine aggregate and / or binder; or it may involve larger pieces of the pavement at the edge of cracks or joints.

PAVEMENT TYPES

FLEXIBLE PAVEMENTS

A flexible pavement has little or moderate bending resistance. It maintains intimate contact with and distributes loads to the subgrade. It depends on aggregate interlock, particle friction, and cohesion for stability.

ACP Asphalt concrete pavement (ACP) is a mixture of liquid asphalt and aggregate. It is placed with a mechanical spreader and rollers, giving the finished product a smooth, dense surface with varying sizes of aggregate.

BST Bituminous surface treatment (BST) includes various composite layered pavement treatments that may be applied over existing ACP or BST roadways, or are used to build up new roadway surfaces. They generally consist of uniformly sized gravel spread over a liquid asphalt layer, which solidifies when it cures. This process creates a thin structure with a very rough surface. Chip seals are the most common form of BST. Slurry seals (also a BST) consist of a premixed thin layer spread over the roadway surface and creates a smooth, flat surface.

RIGID PAVEMENTS

A rigid pavement has a greater bending resistance than does a flexible pavements and distributes loads to the subgrade because of its inherent ability to resist bending.

PCCP Portland Cement Concrete Pavement (PCCP) is a rigid pavement that is usually placed on a bed of gravel or other free draining material.

COMPOSITE PAVEMENTS

Composite pavements are generally any of several combinations of rigid and/or flexible layers of mixed pavement types. At least one agency in Washington state identifies the most common composite pavement specifically as asphalt concrete over portland cement concrete. Composite pavements are rated according to the top, visible layer. The PMS database and software may allow for special handling of composite pavements if the type and thickness of lower layers are known.

INSPECTION PROCEDURES AND GUIDELINES

These inspection procedures offer a method of determining pavement condition that involves observing and recording the presence of specific types and severities of defects or distresses in the pavement surface.

The elements of pavement condition rating are as follows:

1) the type of defect
2) the severity of the defect
3) the extent to which the road surface is affected by the defect

There are several types of defects and several possible severities and extents for each defect. These are described and illustrated for flexible and rigid pavements in the following pages of this manual. The generic definitions of type, severity, and extent are given for Core Program defects and some optional defects. The WSDOT rating procedures and suggested estimating ranges are also included.

Note: The PAVER procedures for rating PCCP are preferred by some agencies as an alternative method for rating PCCP streets. Materials for implementing these procedures are available from the APWA and other sources. How data collected with PAVER techniques will affect subsequent Core Program processes and results is uncertain, but *the resulting value (PCR) will not be equivalent to WSDOT PCR values*.

RATING CONSIDERATIONS

Listed below are important factors to consider when you collect pavement condition data.

- Each agency must decide whether to record the predominant **severity** of each defect type or to record the **extent** of each severity of each defect type. The agency must also decide whether to estimate/measure and record these extents using finite values or standardized ranges of values.

  If the predominate severity procedure is used for each type of defect observed, you should record only one severity, the predominant severity. Always record the higher rated severity if approximately equal proportions of more than one severity exist. The purpose is to establish a severity that represents the typical condition of the roadway segment. The extent you record is always the overall extent associated with all levels of severity for a given distress type. This extent may be a range of values or it may be a finite value. Your individual agency may wish to note (in the comments section of the form) the occurrence of any level of severity that is significantly higher than what you have recorded in the rating.

  If you are recording the extent associated with each severity of each distress type, then instead of recording the total extent and the predominant severity, you will record the extent of each severity of each type of defect. You should probably record a finite value (the actual percentage or count) of the extent for each of the severity categories, as the use of ranges will probably result in too large an extent for the total of the severities. This is an excellent alternative to WSDOT's conventional procedure if an agency desires greater accuracy and detail or will use automated rating procedures. Values can be computed from these more detailed data, as well as from the conventional data for statewide comparison. The complexity of this highly detailed survey may not be practical for large roadway networks when done by human observation.

- Roads can be rated on foot or by automobile. In urban areas, rating is frequently done on foot. The best driving speeds for observing the defects range from 5 to 10 miles per hour. A single lane is generally used, but if time and funds allow, an agency can measure more than one lane.

Note: Different values will likely be obtained in walking versus driving and the agency needs to be aware of possible problems in comparing results obtained by using more than one technique.

- The relative sun angle and direction of viewing the roadway surface can greatly affect your visual observation. Be sure to occasionally view the pavement from more than one direction during the survey to assure the true nature of the pavement surface is being observed.

- The time of year and predominant weather (moisture and temperature) conditions over a given time period can also affect the severity and visibility of certain distresses. If at all possible, rate the roadway network at a similar time of the year and only while the pavement is dry.

- When rating a roadway, you must observe the entire area of the traveled roadway segment or sample and determine the defect severities and extents over this full pavement surface area.

- When rating composite pavements (such as asphalt over rigid pavement), classify cracks that may correspond with the concrete joints as distresses and rate these, as well as other cracks, as the type of crack they represent (transverse or longitudinal).

- When rating the width of cracks, use the average width, not the extremes. Cracks often vary in width and the intent is to rate the overall severity of the crack.

- Condition ratings apply only to the traveled surface of a road. Do not include the conditions of shoulders or other adjacent areas. Shoulder condition, drainage information, or other items may be accounted for and collected separately from or with the pavement rating data.

- Areas within the curb returns are considered a part of the intersection for rating purposes. Intersections are generally rated with a higher functional class street or in a given direction. Intersections may also be separately rated and recorded. Each agency needs to develop its own policy.

- If opposite sides of the roadway or individual lanes (automated measurements) are rated separately, use separate forms and enter the data into the database as separate multi-lane segments.

- When any type of defect is not observed, write an “N” in the first space on the field form for that defect. The “N” indicates clearly that a defect was not present and reduces the potential for confusion when the data are entered into the database.

GENERAL NOTES

Other items that you should observe and correct or add to the rating form if they are not present are listed below. The extent to which this information is collected/edited may depend on your PMS manager and should be made clear to you before you conduct a survey.

- If the survey is conducted on foot, the members of the rating team should walk the segment (or sample) on opposite sides of the street to note distresses.
- At the end of each segment/sample, the team members should compare notes.
- Discuss all distresses observed and log them onto the segment or sample unit distress rating forms for later entry into the computer.
- Verify the historical data provided, for example, segment limits and pavement surface type, width, and lengths.
- Previous years' rating data should be provided so that you can avoid making a poor choice if the severity or extent is a borderline judgment call. You may also detect and verify major changes or erroneous data from previous years.
- If new projects need to be created, write a note to the PMS manager for review and creation.
- The agency may ask you to create new segments or samples if old ones are inaccurate or you find definite pavement condition breaks between existing segment boundaries. Beginning and ending points must coincide with original end points where applicable.
- Measure pavement lengths to the center of the intersections. The pavement management system software should account for the intersections automatically when computing lengths and areas.
- Bring to the PMS manager's attention the location of any potholes, utility trenches, street cuts, curbs, or sidewalks that need repair.
- Note any problems.

FLEXIBLE PAVEMENT DISTRESSES

Severity and Extent Summary

1. Rutting and Wear

Severity

The average rut depth in the wheel path for the segment or sample.

Low	1/4 in. to 1/2 in.
Medium	1/2 in. to 3/4 in.
High	over 3/4 in.

Extent

Assumed to be the full length of the surveyed segment.

2. Alligator Cracking

Severity

Low	Hair Line (< 1/4 inch)
Medium	Spalling
High	Spalling and pumping

Extent

Percentage of the length of both wheel paths.

Suggested ranges for estimating:

1% - 9%	of both wheel paths
10% - 24%	of both wheel paths
25% - 49%	of both wheel paths
50% or more	of both wheel paths

Old WSDOT ranges for estimating - prior to 1991:

1% - 24%	of both wheel paths
25% - 49%	of both wheel paths
50% - 74%	of both wheel paths
50% or more	of both wheel paths

3. Longitudinal Cracking

Severity

Low	< 1/4 in. wide
Medium	> 1/4 in. wide
High	Spalled

Extent

Percentage of the length of the surveyed segment.

Suggested ranges for estimating:
1% - 99% of the length of the segment
100% - 199% of the length of the segment
200% or more of the length of the segment

4. Transverse Cracking

Severity

Low	< 1/4 in. wide
Medium	> 1/4 in. wide
High	Spalled

Extent

Frequency, count per 100 feet.

Suggested ranges for estimating:
1 - 4 cracks per 100 ft.
5 - 9 cracks per 100 ft.
10 or more cracks per 100 ft.

5. Raveling

Severity

Low	Slight
Medium	Moderate
High	Severe

Extent (estimated):
Localized
Wheel Paths
Entire Lane

6. Flushing

Severity

Low	Slight
Medium	Moderate
High	Severe

Extent (estimated):
Localized
Wheel Paths
Entire Lane

7. Patching

Severity

Low	Chip seal patch
Medium	Blade patch (cold or hot mix)
High	Dig-out, full depth patch (or repair)

Extent

Percentage of the length of both wheel paths.

Suggested ranges for estimating:

1% - 9%	of both wheel paths
10% - 24%	of both wheel paths
25% or more	of both wheel paths

8. Corrugation and Waves

Severity

The maximum deviation from a 10-foot straight edge

Low	1/8-in. to 2-in. change per 10 ft.
Medium	2-in. to 4-in. change per 10 ft.
High	Over 4-in. change per 10 ft.

Extent

The percentage of the affected surface area.

Suggested ranges for estimating:

1% - 9%	of the area of the segment
10% - 24%	of the area of the segment
25% or more	of the area of the segment

9. Sags and Humps

Severity

The maximum deviation from a 10-foot straight edge.

Low	1/8-in. to 2-in. change per 10 ft.
Medium	2-in. to 4-in. change per 10 ft.
High	Over 4-in. change per 10 ft.

Extent

The percentage of the affected surface area.

Suggested ranges for estimating:

1% - 9%	of the area of the segment
10% - 24%	of the area of the segment
25% or more	of the area of the segment

10. Block Cracking

Severity

Block Size:

Low	12-ft. x 12-ft. blocks	(9 x 9 and larger)
Medium	6-ft. x 6-ft. blocks	(5 x 5 to 8 x 8)
High	3-ft. x 3-ft. blocks	(2 x 2 to 4 x 4)

Crack Size:

Low	< 1/4 in. wide
Medium	> 1/4 in. wide
High	Spalled

Extent

Assumed to be the full length of the segment.

11. Pavement Edge Condition

Edge Raveling Extent (Severity is undefined):

1% - 9%	of the length of the segment
10% - 24%	of the length of the segment
25% or more	of the length of the segment

Edge Patching Extent (Severity is undefined):

1% - 9%	of the length of the segment
10% - 24%	of the length of the segment
25% or more	of the length of the segment

Edge Lane Less Than 10 Feet Extent (Severity is undefined):

1% - 9%	of the length of the segment
10% - 24%	of the length of the segment
25% or more	of the length of the segment

12. Crack Seal Condition

Severity

Low	Hairline cracks in the sealant allow only minimal water passage.
Medium	The crack sealant is open and will allow significant water passage.
High	The crack sealant is very open or non-existent.

Extent

1% - 9%	of the total length of cracks or joints
10% - 24%	of the total length of cracks or joints
25% or more	of the total length of cracks or joints

1. Rutting and Wear

(Core Program Defect)

Rutting is a surface depression within the wheel path and is a result of permanent deformation of the pavement or subgrade. When the upper pavement layers are severely rutted, the pavement along the edges of the rutted area may lift up. Usually, the depression occurs more gradually across the wheel path, reaching a maximum depth in the center of the wheel path. Ruts are most obvious after rainfall when they are full of water.

Wear is surface depression in the wheel path resulting from tire abrasion.

In both cases, the severity is measured by the depth of the rut or wear depression. Rate the overall severity by using the average observed severity level within the segment. If a localized area is severe, add a note to the comments field. Also, note any potential safety issues in evaluating this distress.

Severity

The average rut depth in the wheel path for the segment or sample. Automated systems may accurately record mean, maximum, minimum, standard deviation, and maybe other useful data.

Rutting and wear

Recommended ranges for estimated severity:

Low	1/4 in. to 1/2 in.
Medium	1/2 in. to 3/4 in.
High	over 3/4 in.

Extent

The extent of rutting is assumed to be the full length of the segment.

Measurement

Lay a 4-foot or longer straight edge across the wheel path and measure the depth or distance between the straight edge and the pavement at the center of the wheel rut. Take measurements in as many locations as is practical and average them.

Example

- Segment: One tenth (1/10) mile
- Three representative measurements of 3/16 inch, 1/2 inch, and 0 inches
- Rated:Low (1/4 to 1/2)

2. Alligator Cracking

(Core Program Defect)

Alligator cracking is associated with loads and is usually limited to areas of repeated traffic loading. Most load related cracking of this type begins as a single longitudinal, discontinuous crack within the wheel path that progresses with time and loads to a more branched pattern that begins to interconnect. The stage at which several discontinuous longitudinal cracks begin to interconnect is defined by WSDOT as alligator cracking. Eventually the cracks interconnect sufficiently to form many pieces, resembling the pattern of alligator hide.

On narrow, two-lane roads, alligator cracking may form along the center line rather than in the customary wheel paths.

Almost always, the pattern of the cracking (the longer dimension of the connected cracks) is parallel to the roadway or direction of vehicle travel. However, alligator cracking occasionally occurs in a pattern transverse to the roadway because of poor trench compaction, settlement, or frost action.

Record each narrow occurrence of transverse alligator cracking as a single incidence of high (spalled) severity transverse cracking. More extensive occurrences should be accumulated with the alligator distress.

Pot holes and other occurrences of destroyed or missing pavement are accumulated as high severity alligator cracking and may also be noted in the comments area of the field form.

Alligator cracking.

Severity

Low Branched, longitudinal, discontinuous thin cracks are beginning to interconnect and form the typical alligator pattern. There is no spalling along the cracks. A single, continuous crack may appear, usually along the wheel path, with frequent, intermittent smaller cracks running at angles to the primary crack.

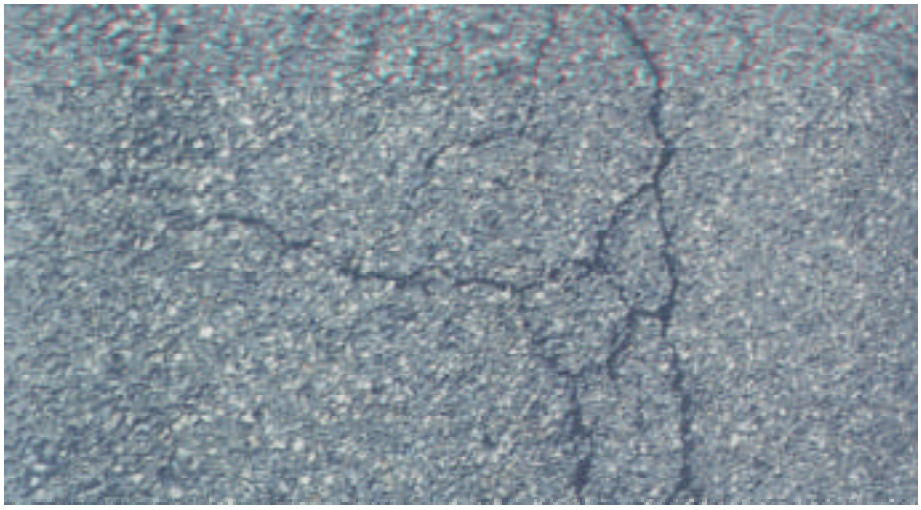
Medium Cracking is completely interconnected and has fully developed an alligator pattern. Spalling appears at the edges of cracks. The pieces formed by the cracking may be predominantly large (12 in. or more in the longest dimension). The cracks may be greater than 1/4 in. wide, but the pavement pieces are still in place.

High The pattern of cracking is well developed, with predominantly small pieces (less than 12 in. in the longest length). Spalling is very apparent at the crack. Individual pieces may be loosened and may rock under traffic. Pieces may be missing. Pumping of fines up through the cracks may be evident.

Extent

The extent of alligator cracking is related to the length of the wheel paths. A 100-foot segment has 200 feet of wheel paths. Accurate measurement and recording as a percentage of wheel path length is preferable.

Low severity alligator cracking.



Medium severity alligator cracking.

Recommended ranges for estimated extent:

1% - 9%	of both wheel paths
10% - 24%	of both wheel paths
25% - 49%	of both wheel paths
50% - 100%	of both wheel paths

Note: The original WSDOT percentage category of 1 to 24 percent has been split into two extent categories (1-9 and 10-24) to better fit current pavement design needs and the need for higher resolution in the early stage extent values of this measurement. This new break point was selected to allow direct comparison between older and newer data. An agency is not required to switch from the original extent categories; however, use of the new system is advisable, especially for new or first time users.

High severity alligator cracking.

Measurement

Accumulate the lengths along the surveyed lane of each severity of the alligator cracking as it occurs in both wheel paths. Divide the accumulated lengths by twice the length of the segment (two wheel paths per lane). Multiply by 100 to get a percentage and round to a whole number.

Example

- Segment: 1/10 mile = 528 feet (1,056 feet of wheel paths)
- <u>Left wheel path</u> <u>Right wheel path</u> <u>Total</u>
  Low = 125 feet Low = 100 feet 225 (21%)
  Med = 50 feet Med = 75 feet 125 (12%)
  High = none High = 25 feet 25 (2%)
- Rated as 21% low severity and 12% medium severity and 2% high severity;
  OR
  Rated as 25%-50% low severity (using the predominant severity and ranges of extent)

3. Longitudinal Cracking

(Core Program Defect)

Longitudinal cracks run roughly parallel to the roadway center line. Longitudinal cracks associated with the beginning of alligator cracking are generally discontinuous, broken, and occur in the wheel path. However, any longitudinal crack that is clearly within the traveled lane should be rated. Joint reflective cracking from overlaid PCCP slabs and other rigid pavements within the lane is rated.

Note: Do not include cracks that reside only within six inches of a lane edge. These cracks are assumed to be caused by, or related to, a paving construction joint. If your survey includes an item for joint or crack seal condition, you should include the seal condition of these lane edge construction joints in that survey item.

Severity

Low The cracks have very little or no spalling along the edges and are less than 1/4 inch wide. If the cracks are sealed and the width of the crack before sealing is invisible, they should be classified as Low Severity.

Medium The cracks have little or no spalling, but they are greater than 1/4 inch wide. There may be a few randomly spaced low severity connecting cracks near the main crack or at the corners of intersecting cracks.

Longitudinal cracking.

High Cracks are spalled and there may be several randomly spaced cracks near the main crack or at the corners of intersecting cracks. Pieces are visibly missing along the crack, or the two sides of the crack do not match. At some point, this longitudinal cracking becomes alligator cracking.

Extent

The extent of longitudinal cracking is recorded as a percentage of the length of the surveyed segment. Accurate measurement and recording are preferred.

Recommended ranges for estimated extent:
1% - 99% of length of segment
100% - 199% of length of segment
200% or more of length of segment

Measurement

Accumulate the lengths along the surveyed lane of each severity of the longitudinal cracking as it occurs. Divide the accumulated lengths by the length of the segment. Multiply by 100 to get a percentage and round to a whole number.

Example

- Segment: 1/10 mile = 528 feet
- Low = 75 feet14%
  Med = 50 feet 9%
  High = 100 feet 19%
- Rated as 14% low severity and 9% medium severity and 19% high severity;
  OR
  Rated as 25%-50% high severity (using the predominant severity and ranges of extent)

Low severity longitudinal cracking.

Medium severity longitudinal cracking.

High severity longitudinal cracking.

4. Transverse Cracking

(Core Program Defect)

Tranverse cracks run roughly perpendicular to the roadway center line. They may be due to surface shrinkage casued by low temperatures, hardening of the asphalt, or cracks in the underlying pavement layers such as PCCP slabs. They may extend partially or fully across the roadway. Count only the transverse cracks that cut across most of at least one full wheel path in the rated lane (2 feet minimum crack length).

Count each occurrence of narrow transverse alligator cracking as a single, high severity transverse crack. Of course, any associated conventional alligator cracking should also be recorded separately.

The PMS software may be able to use different deduct values or curves to deal with composite pavements. Therefore, any reflective cracks should be rated as longitudinal or transverse cracks, and the appropriate pavement type should be noted on the form.

Severity

Low The cracks have very little or no spalling along the edges and are less than 1/4 inch wide. If the cracks are sealed and the width of the crack before sealing is invisible, they should be classified as Low Severity.

Transverse cracking.

Medium The cracks have little or no spalling but they are greater than 1/4 inch wide. There may be a few randomly spaced low severity connecting cracks near the main crack or at the corners of intersecting cracks.

High Cracks are spalled and there may be several randomly spaced cracks near the main crack or at the corners of intersecting cracks. Pieces are visibly missing along the crack, or the two sides of the crack do not match. At some point, this longitudinal cracking becomes alligator cracking.

Extent

The extent of transverse cracking is quantified as a frequency of occurrence, expressed as a count per 100 feet of lane length. Accurate counting and recording are preferred.

Recommended ranges for estimated extent:

1 - 4	cracks per 100 feet
5 - 9	cracks per 100 feet
10 or more	cracks per 100 feet

Measurement

Accumulate the count along the surveyed lane of each severity of transverse crack as it occurs. Divide the accumulated counts by the length of the segment. Multiply by 100 to get the frequency and round to a whole number.

Example

- Segment: 1/10 mile = 528 feet
- Low = 10 each 2 per 100 feet
  Med = 15 each 3 per 100 feet
  High = 5 each 1 per 100 feet
- Rated as 2/100 low severity, 3/100 medium severity, and 1/100 high severity;
  OR
  Rated as 5 - 9 cracks per 100 feet medium severity (using the predominant severity and ranges of extent)

Low severity transverse cracking.

Medium severity transverse cracking.

High severity transverse cracking.

5. Raveling

(Core Program Defect)

Raveling and weathering are pavement surface deterioration that occurs when aggregate particles are dislodged (raveling) or oxidation causes loss of the asphalt binder (weathering). An ACP loses its smooth surface and begins to appear very open and rough like very coarse sand paper. It may begin to look like a chip seal surface.

The severity is rated by the degree of aggregate loss (for raveling) or binder loss (for weathering). Rate the overall severity within the segment as the highest observed level.

This distress is measured or observed differently, depending on whether the road surface is BST or ACP. In BST, raveling is caused by loss of the aggregate, and the binder is exposed. This often looks like bleeding (flushing) and is rated as flushing. A good general practice is to not rate raveling for chip sealed pavements, as they tend to look raveled because of the inherent nature of the chip seal surface.

Severity

Low The aggregate or binder has started to wear away but has not progressed significantly. The pavement only appears slightly aged and slightly rough.

Raveling.

Medium The aggregate or binder has worn away and the surface texture is moderately rough and pitted. Loose particles may be present, and fine aggregate is partially missing from the surface.

High The aggregate and/or binder have worn away significantly, and the surface texture is deeply pitted and very rough. Fine aggregate is essentially missing from the surface, and pitting extends to a depth approaching one half the coarse aggregate size.

Extent

The extent of raveling is estimated and expressed relative to the surface area of the surveyed lane.

Recommended ranges for estimated extent:

Localized patchy areas, usually in the wheel paths

Wheel Path majority of wheel tracks are affected, but little or none elsewhere in the lane

Entire Lane most of the lane is affected

Measurement

Estimate the typical severity and estimate the representative extent.

Low severity raveling.

Medium severity raveling.

High severity raveling.

Example

- Segment: 1/10 mile = 528 feet
- Slight raveling is present in most of both wheel paths, no apparent raveling exists in the center of the lane.
- Rated as slight raveling, wheel paths.

Note: See **Note** under "Flushing."

High severity raveling.

6. Flushing

(Core Program Defect)

Flushing (or bleeding) is indicated by an excess of bituminous material on the pavement surface, which presents a shiny, glass-like reflective surface that may become sticky in hot temperatures. Bleeding should always be recorded when it is severe enough to reduce skid resistance.

At the lower severity levels, the extents "localized" and "wheel path" may be difficult to differentiate; however, as the severity increases, "wheel path" becomes more well defined. Wheel path refers to the tire tracking area and may be used to represent the condition of only one wheel track if it is heavily involved.

Severity

Low Minor amounts of the aggregate have been covered by excess asphalt, but the condition has not progressed significantly.

Medium Significant quantities of the surface aggregate have been covered with asphalt. However, much of the coarse surface aggregate is exposed, even in areas that show flushing.

Flushing.

High Most of the aggregate is covered by asphalt in the affected area. The area appears wet and is sticky in hot weather.

Extent

The extent of flushing is estimated and expressed relative to the surface area of the surveyed lane.

Recommended ranges for estimated extent:
Localized patchy areas, usually in the wheel paths

Wheel Path majority of wheel tracks are affected, but little or none elsewhere in the lane

Entire Lane most of the lane is affected

Note: Raveling and flushing are generally mutually exclusive defects. WSDOT has used the same coding and storage fields for recording the rating, so it is necessary to specify "R" for raveling or "F" for flushing in the column provided. Measure only one distress, raveling or flushing. Choose the predominant one to rate. If raveling and flushing are nearly equal, your agency needs to specify a preference of one over the other. WSDOT selects flushing, as it may present a friction (skid) hazard. When one is greater than the other, identify the greater.

Measurement

Estimate the typical severity and estimate the representative extent.

Example

- Segment: 1/10 mile = 528 feet
- Severe flushing was present in places, but most of both wheel paths showed little if any flushing. No flushing existed in the center of the lane.
- Rated as severe flushing, localized.

Low severity flushing.

Medium severity flushing.

High severity flushing.

7. Patching

(Core Program Defect)

In general, patches are smaller than typical rehabilitation in size and scope. They are less than full roadway width and/or are less than project length. Some agencies may have patches as long as the work defined by another agency as a rehabilitation. WSDOT defines a lane with new surfacing as a patch if it is less than about half a mile in length. Definition of minimum rehabilitation versus maximum patch length is a matter of agency policy.

Temporary patches, as well as localized permanent repairs (dig-out repair) are included in this distress category. The patches or repairs that are obviously the result of utility work are the exception and are not included as part of the patching values.

While appropriately done repairs are an asset rather than a liability to the life of a segment of pavement, the fact that they were required (other than for utility work) generally indicates some failure in the pavement structure.

If any patch (including a utility patch) shows surface defects, such as alligator cracking, accumulate those defects also and include them in the overall segment rating.

Severity

Patching severity is defined in three categories. These are most easily recognized by the method of construction.

Blade patch.

Low Chip seal repair
The lowest severity is BST patching, or chip seal patching. BST patches are constructed by spraying hot asphalt onto the roadway (usually with a spray bar from a truck) and then spreading and rolling crushed stone onto the surface. BST is identified by its nearly straight edges, rough texture, and surface contours that mimic the surface below. It is assumed to cover low severity cracking or raveling.

Medium Blade repair (cold or hot mix)
Blade patching is the medium severity patching. It has edges shaped to the contours of the surrounding pavement and is of variable thickness, with feathered edges. This type of patching is assumed to cover (or replace) medium to severe alligator cracking, pot holes, rutting, or other significant pavement defects. Cold patches are this type.

High Dig-out, full depth patch
Dig-out, or full depth patching, is the most severe of the patches. A patch (or repair) of this type is constructed by neatly cutting out a full depth portion of the pavement, removing all disturbed materials, and refilling the void with an appropriate pavement section. This appropriately reconstructed section should be as strong as the original pavement section, perhaps even stronger. This type of patch is assumed to replace severe alligator cracking.

Extent

The extent of patching is related to the length of wheel paths. Accurate measurement expressed as a percentage of wheel path length is preferable. Each half of the lane is considered one wheel path. This form of measurement is identical to that of alligator cracking because the general assumption is that patching replaces alligator cracking.

Recommended ranges for estimated extent:

1% - 9%	of both wheel paths
10% - 24%	of both wheel paths
25% or more	of both wheel paths

Note: Patching was included in the WSPMS because without a deduction for patching, a roadway that is virtually made

Chip seal repair.

Blade repair (cold or hot mix).

Dig-out, full depth patch.

of patches would appear to be a "perfect" segment or project. This would result in the segment or project never being included in a prioritized list of pavements needing rehabilitation.

If an agency has separate maintenance districts, or crews assigned to specific areas, the more efficient crew / district can be penalized by the pavement management system for doing a better job. If its roadways rate higher as a result of better maintenance operations, those roadways might not receive repair and rehabilitation funds as a result.

The way in which the PMS uses these distress severities can vary, and the desired effect can be accommodated by using different deduct values to reflect the needs of the agency. If patching and / or repairs are not deemed a serious issue within your agency, then reduce or remove the optional local deducts associated with the patching severities. If it is important, assign deducts to reflect the needs or use the Core Program values. In either case, the survey should record the patching occurrences.

Measurement

Accumulate the lengths along the surveyed lane of each severity (type) of patching as it occurs in both wheel paths. Divide the accumulated lengths by twice the length of the segment (two wheel paths per lane). Multiply by 100 to get a percentage and round to a whole number.

Example

- Segment: 1 / 10 mile = 528 feet (1,056 feet of wheel paths)
-

Left wheel path	Right wheel path	Total
BST = 50 feet	BST = none	50 (5%)
Blade = 10 feet	Blade = 25 feet	35 (3%)
ACP = none	ACP = 3 feet	3 (0%)

- Rated as 5% BST, 3% Blade, and no ACP (dig-out);
  OR
  Rated as 1%-9% BST (using the predominant severity and ranges of extent)

8. Corrugation and Waves

(Optional Defect)

This distress category covers a general form of surface distress that is not limited to the wheel path, although they may occur in the wheel path. The distress may occur in isolated areas, such as at intersections, or it may occur over a large part of the roadway surface.

Corrugations and waves are regularly occurring transverse undulations in the pavement surface. Corrugations occur as closely spaced ripples, while waves are undulations whose distance from peak to valley is more than 3 feet.

Severity

The severity of corrugations is defined as the maximum vertical deviation from a 10-foot straight edge placed on the pavement parallel to the center line of the roadway.

Low	1/8 in. to 2 in. per 10 ft.
Medium	2 in. to 4 in. per 10 ft.
High	Over 4 in. per 10 ft.

Corrugation.

Extent

The extent is expressed as a percentage of the lane area affected.

1% - 9%	of the area of the segment
10% - 24%	of the area of the segment
25% or more	of the area of the segment

Measurement

Determine the severity by measuring the maximum difference in elevation that occurs within a 10-foot straight-edge length centered over the area of the displacement. Rate the overall distress by using the highest observed level.

Example

- Segment: 1/10 mile = 528 feet
- Several measurements were taken and they generally showed about 3-inch depths. The corrugated area was about 75 feet long near the end of the segment.
- Rated as 14% medium corrugation; OR 10%-24% medium (using the ranges of extent).

9. Sags and Humps

(Optional Defect)

This distress category also covers forms of surface distress that are not limited to the wheel path, although they generally include the wheel paths. The distress usually occurs in isolated areas of the roadway surface.

Sags and humps are localized depressions or elevated areas of the pavement that result from settlement, pavement shoving, displacement due to subgrade swelling, or displacement due to tree roots.

Severity

The severity of sags or humps, like corrugation, is defined as the maximum vertical deviation from a 10-foot straight edge placed on the pavement parallel to the center line of the roadway.

Low	1/8 in. to 2 in. per 10 ft.
Medium	2 in. to 4 in. per 10 ft.
High	Over 4 in. per 10 ft.

Sags.

Extent

The extent of corrugations is expressed as a percentage of the lane area affected.

1% - 9%	of the area of the segment
10% - 24%	of the area of the segment
25% or more	of the area of the segment

Measurement

Determine the severity by measuring the maximum difference in elevation that occurs within a 10-foot straight-edge length centered over the area of the displacement. Rate the overall distress by using the highest observed level.

Example

- Segment: 1/10 mile = 528 feet
- A sag measuring 2-1/2 inches deep and about 25 feet long occurred within the segment.
- Rated as 5% medium sag/hump;
  OR
  1%-9% medium (using the ranges of extent).

10. Block Cracking

(Optional Defect)

Block cracks divide the pavement surface into nearly rectangular pieces with cracks that intersect at about 90 degrees. This type of distress differs from alligator cracking in that alligator cracks form smaller, irregular shaped pieces with sharp angles. Also, alligator cracks are caused by repeated traffic loadings and are, therefore, generally located in traffic areas (i.e., the wheel paths).

Block cracking is caused principally by shrinkage of the asphalt concrete and daily temperature cycling. It is not load-associated, although load can increase the severity of individual cracks. The occurrence of block cracking usually indicates that the asphalt has hardened significantly through aging. Block cracking normally occurs over a large portion of the pavement area, including non-traffic areas. However, various fatigue related defects may occur in the same segment.

Severity

The severity of block cracking is defined by the average size of the blocks and the average width of the cracks that separate them.

Block Size:		
Low	12 ft. x 12 ft. blocks	(9 x 9 and larger)
Medium	6 ft. x 6 ft. blocks	(5 x 5 to 8 x 8)
High	3 ft. x 3 ft. blocks	(2 x 2 to 4 x 4)

Block cracking.

Crack Size:

Low	Less than 1/4 inch
Medium	Over 1/4 inch
High	Spalled

Extent

The extent of block cracking is assumed to be the full surveyed segment. If the block cracking does not extend throughout the segment, then rate the segment using longitudinal and transverse cracking.

Measurement

Estimate the typical size of the blocks and select the appropriate standard block size. Estimate the typical crack size and select the appropriate standard crack width.

Example

- Segment: 1/10 mile = 528 feet
- Blocks of varying size, but averaging about 10 feet by 10 feet square, were observed throughout the segment. The cracks separating the blocks were typically wide and spalled.
- Rated as low block size (12x12) and high crack size (spalled).

Note: This distress may be used as defined in the place of longitudinal and transverse cracking to simplify the field process when an entire segment displays block cracking. Use it only if your software can convert the data to comparable quantities of longitudinal and transverse cracking. If the conversion is not made, the considerable deduct for the equivalent Core Program cracking will not be recognized, and continuity of the PMS will be lost.

11. Pavement Edge Condition

(Optional Defect)

Edge raveling occurs when the pavement edge breaks away from roadways without curbs or paved shoulders. However, edge conditions can still occur with paved shoulders. Edge patching is the repair of this condition. The "lane less than 10 feet" distress indicates that the edge raveling has progressed to the point where the pavement width from the center line to the outer edge of roadway has been reduced to less than 10 feet.

Extent

Edge Raveling Extent
1% - 9% of the length of the segment
10% - 24% of the length of the segment
25% or more of the length of the segment

Edge Patching Extent
1% - 9% of the length of the segment
10% - 24% of the length of the segment
25% or more of the length of the segment

Edge Lane Less Than 10 Feet Extent (edge raveling extent):
1% - 9% of the length of the segment
10% - 24% of the length of the segment
25% or more of the length of the segment

Measurement

Accumulate the lengths along the surveyed lane of each type edge defect as it occurs. Divide the accumulated lengths by the length of the segment. Multiply by 100 to get a percentage and round to a whole number.

Example

- Segment: 1/10 mile = 528 feet
- Edge Raveling = 75 feet 14%
  Edge Patching = 50 feet 9%
  Lane less that 10 feet = 100 feet 19%
- Rated as 14% edge raveling, 9% edge patching, and 19% lane Less then 10 feet;
  OR
  Rated (using extent ranges) as 10%-24% edge raveling, 1%-9% edge patching, and 10%-24% lane less than 10 feet.

Edge raveling.

Edge patching.

12. Crack Seal Condition

(Optional Defect)

Rate the condition of any existing crack (or joint) sealant. There may be separate information fields available for recording the amount (total length) of seal and the year it was installed.

Severity

Low	Hairline cracks in the sealant allow only a minimal amount of water to pass.
Medium	The sealant is severely cracked and may allow significant quantities of water to pass.
High	The sealant is wide open (or non-existent) and will allow water to pass freely.

Extent

The extent of crack sealing is quantified as the percentage of the total length of the cracks (or joints) in the segment that exhibit the seal condition.

1% - 9%	of the total length of cracks or joints
10% - 24%	of the total length of cracks or joints
25% or more	of the total length of cracks or joints

Measurement

Count (or estimate) and accumulate the length of cracks and joints that exhibit each severity of seal condition. Count (or estimate) the total length of cracks and joints in the segment. Divide each of the accumulated lengths of condition by the total length of the cracks and joints; multiply by 100; and round to a whole number.

Example

- Segment: 1/10 mile = 528 feet
- 4 full-width transverse cracks, medium 4x12 = 48 Med.
  2 half-width transverse cracks, high 2x6 = 12 High
  1 full-length longitudinal joint, fully sealed = 528 none
  Total 588
- Rated as 8% medium, 2% high, and 0 low;
  OR
  Rated as 10%-24% medium severity crack seal (using the predominant severity and ranges of extent).

Low severity crack seal.

Medium severity crack seal.

High severity crack seal.

PORTLAND CEMENT CONCRETE DISTRESSES

Severity and Extent Summary

1. Cracking

Severity

Low	1 crack per panel
Medium	2 or 3 cracks per panel
High	4 or more cracks per panel

Extent

1% to 9%	of the panels are cracked
10% to 24%	of the panels are cracked
25% or more	of the panels are cracked

2. Joint and Crack Spalling

Severity

Low	1/8-in. to 1-in. spalls
Medium	1-in. to 3-in. spalls
High	Greater than 3-in. spalls

Extent

1% to 9%	of the joints and cracks are spalling
10% to 24%	of the joints and cracks are spalling
25% or more	of the joints and cracks are spalling

3. Pumping and Blowing

Severity

Low	Slight shoulder depression, no staining
Medium	Significant depression, slight staining
High	Severe depression, significant staining

Extent

1% to 9%	of the joints and cracks show evidence of pumping.
10% - 24%	of the joints and cracks show evidence of pumping.
25% or more	of the joints and cracks show evidence of pumping.

4. Faulting and Settlement

Severity

Low	1/8-in. to 1/4-in. faulting or settlement at joints or cracks.
Medium	1/4-in. to 1/2-in. faulting or settlement at joints or cracks.
High	Over 1/2-in. faulting or settlement at joints or cracks.

Extent

1% to 9%	of all panels are faulting or settling.
10% to 24%	of all panels are faulting or settling.
25% or more	of all panels are faulting or settling.

5. Patching

Severity

Low	1% to 9%	of the panel area is patched.
Medium	10% to 24%	of the panel area is patched.
High	25% or more	of the panel area is patched.

Extent

1% to 9%	of all panels in a travel lane are patched.
10% to 24%	of all panels in a travel lane are patched.
25% or more	of all panels in a travel lane are patched.

6. Raveling or Scaling

Severity

Slight	The aggregate or binder has started to wear away but has not progressed significantly. The pavement only appears slightly aged and slightly rough.
Moderate	The aggregate or binder has worn away and the surface texture is moderately rough and pitted. Loose particles may be present, and fine aggregate is partially missing from the surface.
Severe	The aggregate and/or binder have worn away significantly, and the surface texture is deeply pitted and very rough. Fine aggregate is essentially missing from the surface, and pitting extends to a depth approaching one half the coarse aggregate size.

Extent

1% to 9%	of pavement surface in the segment
10% to 24%	of pavement surface in the segment
25% or more	of pavement surface in the segment

7. Blowups

Severity/Extent

Number of occurrences per segment

8. Wear

Severity

The average rut depth in the wheel path for the segment or sample. Automated systems may accurately record mean, maximum, minimum, standard deviation, and other useful data.

Recommended ranges for estimated severity

Low	1/4 in. to 1/2 in.
Medium	1/2 in. to 3/4 in.
High	over 3/4 in.

Extent

The extent of wear is assumed to be the full length of the segment.

1. Cracking

(Core Program Defect)

The cracking defects are irregular breaks that may form transversely, longitudinally, or diagonally within a (PCCP) panel. Construction joints, which are straight and obviously formed or cut, are not considered cracks.

Severity

The severity of the cracking is quantified by the number of cracks in a panel.

Low	1 crack per panel
Medium	2 or 3 cracks per panel
High	4 or more cracks per panel

Extent

The extent of the cracking is quantified by the percentage of panels in the segment that exhibit the cracking.

1% - 9%	of the panels are cracked
10% - 24%	of the panels are cracked
25% or more	of the panels are cracked

Measurement

Accumulate the count of the panels, along the surveyed segment, that exhibit each severity of cracking. Divide the accumulated counts by the number of panels in the segment. Multiply by 100 to get a percentage and round to a whole number.

Example

- Segment: 1/10 mile = 528 feet (assume 40 panels in this example)
- Low (1 crack) 3 panels (8%)
  Medium (2-3 cracks) 5 panels (13%)
  High (4 or more) none (0%)
- Rated as 8% low, 13% medium, and 0 high severity cracking
  OR
  Rated as 10%-24% medium severity cracking (using the predominant severity and ranges of extent)

Low severity PCC cracking.

Medium severity PCC cracking.

High severity PCC cracking.

2. Joint and Crack Spalling

(Core Program Defect)

Spalling occurs when fragments break off or chip off along the edges of the pavement joints or cracks. These spalls may be large wedges or flakes, or they may be only lost pieces of aggregate.

Severity

The severity of the joint and cracking spalling is quantified by the typical size of the spalls in the joints and cracks that are spalled.

Low	1/8-in. to 1-in. spalls
Medium	1-in. to 3-in. spalls
High	Greater than 3-in. spalls

Extent

The extent of the joint and crack spalling is quantified as the percentage of spalled joints/cracks out of the total joints/cracks in the segment.

1% - 9%	of the joints and cracks are spalling.
10% - 24%	of the joints and cracks are spalling.
25% or more	of the joints and cracks are spalling.

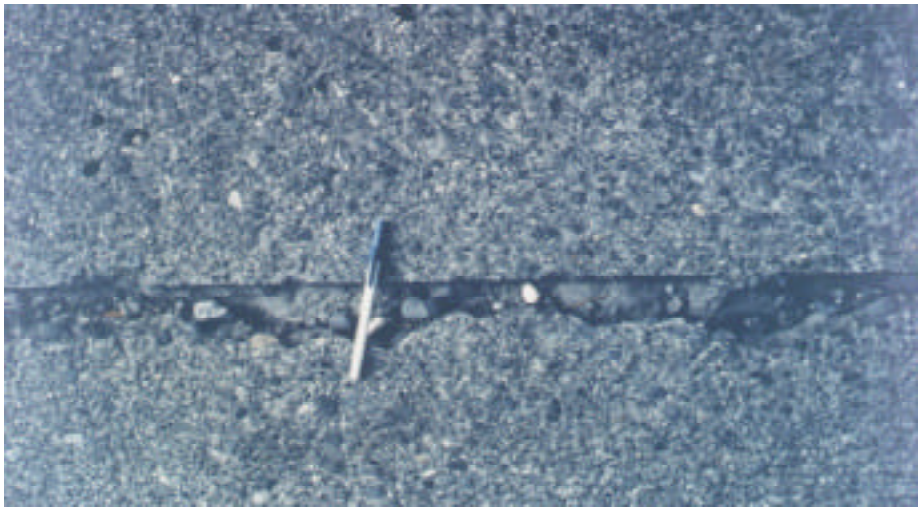
Measurement

Accumulate the count of the joints and cracks, along the surveyed segment, that exhibit each severity of spalling. Divide the accumulated counts by the number of joints and cracks in the segment. Multiply by 100 to get a percentage and round to a whole number.

Example

- Segment: 1/10 mile = 528 feet (assume 40 joints and 10 cracks in this example)
- Low (1/8-1 in.) 10 joints/cracks (20%)
  Medium (1-3 in.) none (0%)
  High (over 3 in.) 2 (4%)
- Rated as 20% low, 0% medium, and 4% high severity spalling;
  OR
  Rated as 10%-24% low severity spalling (using the predominant severity and ranges of extent)

Low severity joint spalling.



Medium severity joint spalling.

High severity joint spalling.

3. Pumping and Blowing

(Core Program Defect)

Pumping and blowing refer to the ejection of water from underneath the pavement. Cyclic wheel loadings eject water through or along the transverse or longitudinal joints and cracks, or at panel edges. The ejected water also carries fine soil particles, thus eroding the pavement foundation. Pumping is recognized by the visible fine soil left on the dried surface of the roadway and/or shoulder areas. Because pavement rating is not done during wet weather, pumping activity would not generally be observed directly.

Severity

The severity of pumping is quantified by the type and amount of the evidence observed at each joint or transverse crack. Either depression of the shoulder at the joint/crack or stains on the shoulder pavement showing fine subgrade soil particles are evidence of pumping.

Low	Slight shoulder depression evident, little or no staining.
Medium	Moderate shoulder depression with obvious staining.
High	Severe shoulder depression and/or significant staining.

Plumping and blowing with depression and staining.

Extent

The extent is quantified by the percentage of joints or cracks in the segment that exhibit evidence of pumping.

1% - 9% of the joints / cracks show evidence of pumping
10% - 24% of the joints / cracks show evidence of pumping
25% or more of the joints / cracks show evidence of pumping

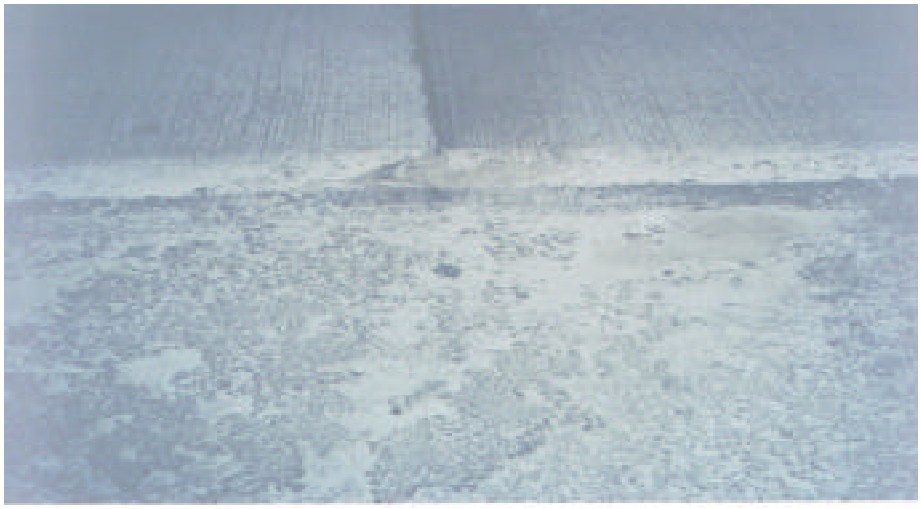
Measurement

Accumulate the count of the joints and cracks, along the surveyed segment, that exhibit each severity of pumping. Divide the accumulated count by the number of joints and cracks in the segment. Multiply by 100 to get a percentage and round to a whole number.

Example

- Segment 1 / 10 mile = 528 feet (assume 40 joints and 10 cracks in this example)
- Low severity 8 joints / cracks (16%)
  Medium severity 1 joint (2%)
  High severity none (0%)
- Rated as 16% low, 2% medium, and 0% high severity pumping;
  OR
  Rated as 10%-24% low severity pumping (using the predominant severity and ranges of extent)

Pumping and blowing with staining and patch.



Pumping and blowing with significant staining.

4. Faulting and Settlement

(Core Program Defect)

Faulting and/or settlement occurs when abutting pavements separate vertically at joints or cracks through settling or uplifting. The result is a "step" difference between the adjoining pavement surfaces. Settlement is defined as differences in height between pavements across a longitudinal joint or crack. Generally, faulting will be found as a downward "step" across a transverse joint or crack in the direction of travel.

Severity

The severity of faulting or settlement is quantified by the vertical distance between panels or pavement surfaces.

Low	1/8-in. to 1/4-in. faulting or settlement at joints or cracks.
Medium	1/4-in. to 1/2-in. faulting or settlement at joints or cracks.
High	Over 1/2-in. faulting or settlement at joints or cracks.

Faulting.

Extent

The extent is quantified by the percentage of joints or cracks in the segment that exhibit evidence of faulting.

1% - 9%	of all panels are faulting or settling.
10% - 24%	of all panels are faulting or settling.
25% or more	of the panels are faulting or settling.

Measurement

Accumulate the count of the joints and cracks, along the surveyed segment, that exhibit each severity of faulting or settling. Divide the accumulated counts by the number of joints and cracks in the segment. Multiply by 100 to get a percentage and round to a whole number.

Example

- Segment: 1/10 mile = 528 feet (assume 40 joints and 10 cracks in this example)
- Low (1/8 - 1/4 in.) 4 joints/cracks (8%)
  Medium (1/4 - 1/2 in.) 5 (10%)
  High (over 1/2 in.) none (0%)
- Rated as 8% low, 10% medium, and 0% high severity faulting;
  OR
  Rated as 10%-24% medium severity faulting (using the predominant severity and ranges of extent)

5. Patching

(Core Program Defect)

Patching is the temporary or semi-permanent replacement of all, or part, of a (PCCP) slab with a flexible or rigid pavement material. A new, full size, replacement slab is NOT a patch.

Severity

The severity of patching is quantified by a representative percentage of area of patch within a typical patched panel.

Low	1% to 9% of the panel area is patched
Medium	10% to 24% of the panel area is patched
High	25% or more of the panel is patched

Extent

The extent of patching is quantified by the percentage of panels in a segment that have patches.

1% - 9%	of the panels are patched
10% - 24%	of the panels are patched
25% or more	of the panels are patched

Measurement

Accumulate the count of the panels, along the surveyed segment, that exhibit patching. Divide the accumulated count by the number of panels in the segment. Multiply by 100 to get a percentage and round to a whole number. In addition, estimate the predominant severity or the patching throughout the segment.

Example

- Segment: 1/10 mile = 528 feet (assume 40 panels in this example)
- Most patched panels exhibited patches that were about 1/4 of the panel area. Twelve panels were patched.
- Rated as 30% high severity patching;
  OR
  As 25% or more high severity patching (using the ranges of extent)

PCC patching.

PCC patching.

6. Raveling or Scaling

Pavement scaling is the progressive disintegration of the pavement from the surface downward, or from the edges inward, by the dislodgment of aggregate particles. In severe cases, the surface is very rough and irregular.

Severity

The severity of raveling or scaling is determined from personal judgment on the basis of the following descriptions:

Slight The aggregate or binder has started to wear away but has not progressed significantly. The pavement only appears slightly aged and slightly rough.

Moderate The aggregate or binder has worn away and the surface texture is moderately rough and pitted. Loose particles may be present, and fine aggregate is partially missing from the surface.

Severe The aggregate and/or binder have worn away significantly, and the surface texture is deeply pitted and very rough. Fine aggregate is essentially missing from the surface, and pitting extends to a depth approaching one half the coarse aggregate size.

Extent

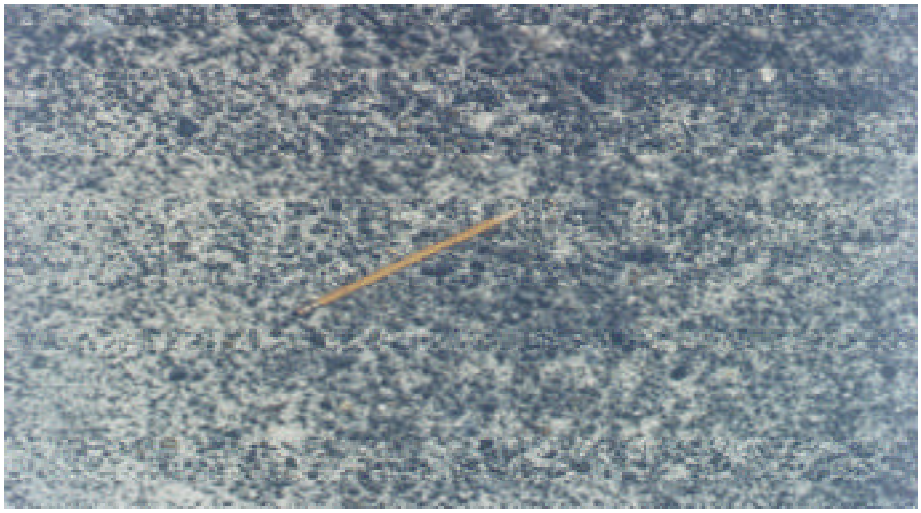
The extent of raveling or scaling is the percentage of the surface area of the pavement that is raveled or scaled.

1% - 9%	of the pavement surface in the segment
10% - 24%	of the pavement surface in the segment
25% or more	of the pavement surface in the segment

Measurement

Estimate the overall extent of the raveling/scaling as a percentage of the surface area of the surveyed segment, and estimate the predominant severity of the raveling/scaling throughout the segment.

Slight raveling.



Moderate raveling.

Severe raveling.

Example

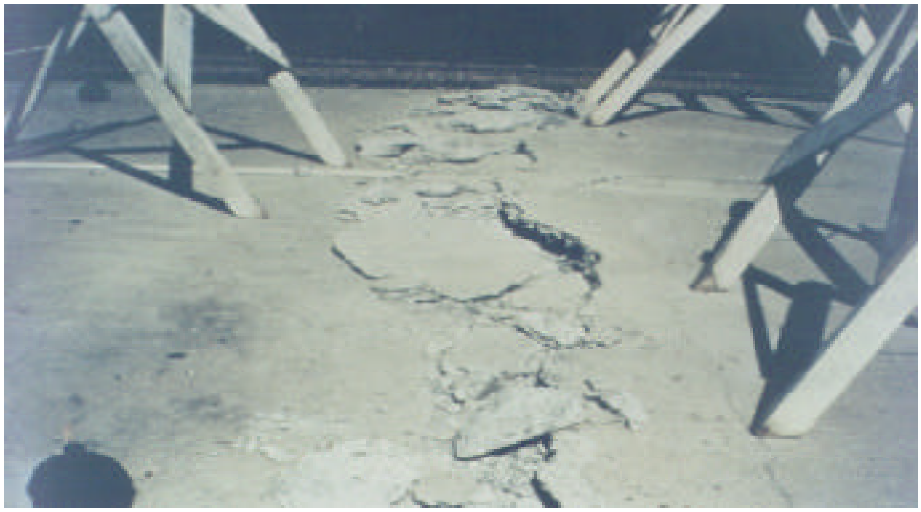
- Segment: 1/10 mile = 528 feet (assume 40 panels in this example)
- Most panels exhibited slight scaling. However, five panels were severely scaled.
- Rated as 25% or more low severity raveling or scaling.

7. Blowups

Blowups are the shattering or upward buckling of pavement panels at transverse cracks or joints. The occurrence is caused by the expansion of a PCCP when all available room for expansion has been previously taken and the PCCP is tightly confined. This is a classic example of irresistible force meeting an immovable object. The defect is seldom, if ever, observed in action, but the evidence may be observed and documented. The rater will likely find a patch where the blowup happened. Usually the patch will indicate that parts of two or more partial slabs have been removed in adjacent lanes across the whole roadway. Raters must assure themselves that the patching was not for utility work or some other such activity. The patch is also included in the patching category.

Severity/Extent/Measurement

The number of occurrences in the segment are counted and recorded.



Result of a blowup.

8. Wear

(Core Program Defect)

Wear is a surface depression in the wheel path resulting from tire abrasion (usually studded tires).

Severity

The severity is the average wear (rut) depth in the wheel path for the segment or sample. Automated systems may accurately record mean, maximum, minimum, standard deviation, and other useful data.

Recommended ranges for estimated severity:

Low	1/4 in. to 1/2 in.
Medium	1/2 in. to 3/4 in.
High	Over 3/4 in.

Extent:

The extent of wear is assumed to be the full length of the segment.

Measurement

Lay a 4-foot or longer straight edge across the wheel path and measure the depth or distance between the straight edge and

PCC wear.

the pavement at the center of the wheel rut. Take measurements in as many locations as is practical and average them.

Example

- Segment: One-tenth (1/10) mile
- Five representative measurements (one at 3/16 inch, three at 5/8 inch, and one at 0 inch) were taken.
- Rated:medium (1/2 to 3/4)

PAVEMENT CONDITION RATING AIDS

Mile to Feet Conversions

Segment =	1 Mile	or	1/10 Mile	or	1/100 Mile
Full Segment Length	5280 ft.		528 ft.		53 ft.
50% Segment Length	2640 ft.		264 ft.		26 ft.
25% Segment Length	1320 ft.		132 ft.		13 ft.
10% Segment Length	528 ft.		53 ft.		5 ft.
1% Segment Length	53 ft.		5 ft.		1/2 ft.

Segment =	1 Mile	or	1/10 Mile	or	1/100 Mile
Full Wheel Paths	10560 ft.	1056 ft.			106 ft.
50% Wheel Paths	5280 ft.		528 ft.		53 ft.
25% Wheel Paths	2640 ft.		264 ft.		26 ft.
10% Wheel Paths	1056 ft.		106 ft.		11 ft.
1% Wheel Paths	106 ft.		11 ft.		1 ft.

PCCP Panels per Segment

Segment =	1 Mile	or	1/10 Mile	or	1/100 Mile
Pre - 1969 *	352 panels		35 panels		3 panels
1969 and later **	460 panels		46 panels		4 panels

Pre - 1969 Uniform 15 ft. Spacing
**** 1969 and later Variable Spacing (9, 10, 14, then 13 ft.)**

ACP and BST Estimating

Alligator Cracking or Patching Ranges (% of Wheel Track Length)

Segment =	1 Mile	or	1/10 Mile	or	1/100 Mile
1% - 9%	106-1055 ft.		11-105 ft.		1-10 ft.
10% - 24%	1056-2639 ft.		106-263 ft.		11-25 ft.
25% - 49%	2640-5279 ft.		264-527 ft.		26-52 ft.
50% or more	5280-10560 ft.		528-1056 ft.		53-106 ft.

Longitudinal Cracking Ranges (% of Segment Length)

Segment =	1 Mile	or	1/10 Mile	or	1/100 Mile
1% - 99%	53-5279 ft.		5-527 ft.		1-52 ft.
100%-199%	5280-10559 ft.		528-1055 ft.		53-105 ft.
200% or more	10560 ft. (+)		1056 ft. (+)		106 ft. (+)

Transverse Cracking Ranges (Count per 100 feet of Segment Length)

Segment =	1 Mile	or	1/10 Mile	or	1/100 Mile
1-4 per 100 ft.	53-263		6-26		1-2
5-9 per 100 ft.	264-527		27-52		3-5
10 or more/100 ft.	528 or more		53 or more		6 or more

PCCP Estimating

Panel Count Ranges per Segment (pre-1969 construction)

Segment =	1 Mile	or	1/10 Mile	or	1/100 Mile
1% - 9%	4-35 panels		1-3 panels		N.A.
10% - 24%	36-87 panels		4-8 panels		N.A.
25% or more	88 or more		9 or more		1 or more

Panel Count Ranges per Segment (1969 or later construction)

Segment =	1 Mile	or	1/10 Mile	or	1/100 Mile
1% - 9%	4-45 panels		1-4 panels		N.A.
10% - 24%	46-114 panels		5-11 panels		N.A.
25% or more	115 or more		12 or more		1 or more