

PAVEMENT DISTRESS SURVEY MANUAL

**PAVEMENT SERVICES UNIT
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**Oregon
Department
of Transportation**

OREGON DEPARTMENT OF TRANSPORTATION

Distress Survey Manual

INTRODUCTION

- This manual in conjunction with the SHRP Distress Identification Manual for the Long-Term Pavement Performance Project (SHRP-P-338) outlines the procedure for conducting distress surveys. The purpose of the distress surveys is to identify and quantify the amount and severity of surface distress in a given segment of pavement. The results of the distress survey are used along with other measured pavement characteristics to establish a condition rating for the roadway segment.
- The Oregon State Highway System is currently composed of three primary surface types; Asphalt Concrete (AC), Jointed Portland Cement Concrete Pavement (JCP), and Continuously Reinforced Portland Cement Concrete Pavement (CRCP). The distress types and procedures for rating each of these pavement types are presented in this manual.
- The main use of this manual is to perform detailed distress rating for National Highway System (NHS) and other State Highways where appropriate to assess pavement conditions of the state highway network. The distress survey is intended primarily to characterize type and extent of pavement distress, but does not attempt to determine the cause of distress and appropriate corrective treatments. Although it may be a useful resource to other pavement related uses this manual is intended primarily for Pavement Management purposes.

SURVEY PROCEDURE

- Two-person crews trained in distress identification procedures will conduct condition surveys. Training will include proper distress identification using standardized sections of the State Highway System. These standardized sections will include examples of each of the three pavement types. For a given pavement type, the standardized sections will include typical examples of each type of distress.
- The condition survey will be accomplished via a "side window" survey from a slow-moving vehicle operating on the adjacent shoulder. If conditions do not permit the safe operation of a vehicle along the shoulder, then the crew will either skip the segment or conduct the survey on foot being careful to not endanger themselves or the motoring public.

- The condition survey may also be accomplished via a Pavement Condition Data Collection Vehicle (service tool equipped with computer, sensor, and video equipment designed to efficiently collect data and video images of the roadway and pavement surface). Data obtained by this vehicle is reviewed later in the office to generate a condition score.
- The highway will be rated in 0.1-mile increments. The distresses will be recorded for each segment rated. The distress will be identified according to the descriptions provided in this manual.
- The following is a brief summary of the distress survey procedure:
 - Begin at the appropriate milepoint marker.
 - Select the appropriate data entry screen or survey form (AC, JCP, or CRCP).
 - Complete the section description information.
 - Survey the 0.1-mile segment.
 - Record information on the computer or survey form.
 - Return to step one and repeat the process.

When recording the survey data, note any unusual conditions in the comment section. Also note, but do not rate, long bridge decks, which fall within the section. Frequently, only partial miles will be rated because of construction activity, a bridge deck, or for safety reasons. In the event one or more 0.1-mile segments are not rated within a given mile, place an "N" in the appropriate field to indicate that the segment was not rated. Also note in the remarks field the reason why the segment was not rated.

DISTRESS SURVEY MANUAL

SECTION 1

ASPHALT CONCRETE (AC) PAVEMENTS

The evaluation of asphalt pavements will be completed by rating the distress in the pavement according to the SHRP descriptions and severity levels as summarized below.

DISTRESS TYPES

Rutting
Fatigue Cracking
Longitudinal Cracking
Transverse Cracking
Block Cracking
Patches
Potholes
Raveling
Bleeding

Summary of AC Pavement Distresses

Rutting	
Zero	0" ≤ Rut < 1/4"
Low	1/4" ≤ Rut < 1/2"
Moderate	1/2" ≤ Rut < 3/4"
High	Rut ≥ 3/4"
Fatigue Crack Severity	
Low	An area of cracks with no or only a few connecting cracks. Cracks are not spalled or sealed. No pumping is evident.
Moderate	An area of interconnected cracks forming a complete pattern. Cracks may be slightly spalled. Cracks may be sealed. No pumping is evident.
High	An area of moderately or severely spalled interconnected cracks forming a complete pattern. Pieces may move when subjected to traffic. Cracks may be sealed. Pumping may be evident.
Longitudinal Cracking Severity	
Low	A crack with a mean width of ≤ 0.25"; or a sealed crack with sealant material in good condition and a width that cannot be determined.
Moderate	Any crack with a mean width > 0.25" and ≤ 0.75"; or any crack with a mean width < 0.75 in and adjacent low severity random cracking.
High	Any crack with a mean width > 0.75"; or any crack with a mean width ≤ 0.75" and adjacent moderate to high severity random cracking.
Transverse and Block Crack Severity	
Low	An unsealed crack with a mean width of ≤ 0.25; <u>or</u> a sealed crack with sealant material in good condition and the width cannot be determined.
Moderate	Any crack with a mean width > 0.25" and ≤ 0.75"; <u>or</u> any crack with a mean width < 0.75 in and adjacent low severity random cracking.
High	Any crack with a mean width > 0.75"; <u>or</u> any crack with a mean width ≤ 0.75" and adjacent moderate to high severity random cracking.
Patching Severity	
Low	A good quality patch with a smooth ride. The patch has, at most, low severity distress of any type including rutting or deformation < 0.25"; pumping is not evident.
Moderate	The patch has moderate severity distress of any type or rutting or deformation from 0.25" to 0.5"; pumping may be evident. Ride quality is good to fair.
High	The patch has high severity distress of any type or rutting or deformation > 0.5"; pumping may be evident. All hand patches or patched potholes are rated as high severity patches.
Pothole Severity	
Low	< 1" deep (Delamination of patch or seal coat)
Moderate	≥ 1" & < 2" deep (Remains within top lift of wearing course.)
High	≥ 2" deep (Extends beyond top lift of wearing course.)
Raveling Severity	
Low	The aggregate has worn away resulting in ≥ 25% to < 50% aggregate loss in a 1' wide longitudinal strip of pavement surface. Loss of chip seal rock should be rated as raveling, but this is the maximum severity for chip sealed surfaces.
Moderate	Surface texture is noticeably rough and/or pitted with ≥ 50% to < 75 % aggregate loss in a 1' wide longitudinal strip of pavement surface. A nearly continuous strip of aggregate loss 3" - 6" wide may be present. Loose particles may be present outside the traffic area.
High	Surface texture is very rough and/or pitted with ≥ 75% aggregate loss in a 1' wide longitudinal strip of pavement surface. Flat bottom potholes may be present where complete loss of aggregate has occurred.
Bleeding	
Y or N	Bleeding is present if multiple (2 or more) areas of 25 ft ² or larger patches are noted.

RUTTING

AC – JCP – CRCP

Rutting is a longitudinal surface depression in the wheel path caused by permanent deformation (AC only) or the wearing away of the pavement surface. Rut depth is measured in both wheel paths by a 5-point laser system mounted on the profilometer. This measurement is performed separate from the manual distress survey.

The rut depth will be categorized as zero, low, moderate, or high according to the following criteria:

Identification

Longitudinal surface depression in wheel path

Severity Level

Zero = $0'' \leq \text{Rut} < 1/4''$

Low = $1/4'' \leq \text{Rut} < 1/2''$

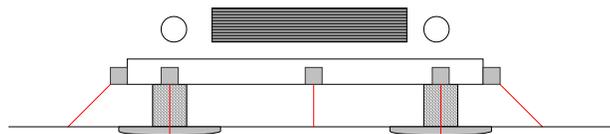
Mod = $1/2'' \leq \text{Rut} < 3/4''$

High $\geq 3/4''$

How to Measure

5-Point Laser System

Ruts are measured with a 5 point laser system mounted on the front bumper of a Class 1 high speed Profilometer. The data is collected every 6-inches and then aggregated for every 10th mile. The average rut depth plus one standard deviation for each wheelpath is evaluated and the greater of the two measurements determines the rut severity.



RUTTING

Low Rutting



Moderate Rutting

High Rutting



FATIGUE CRACKING

Fatigue cracking, also known as alligator cracking, is single crack or a series of interconnected cracks caused by fatigue failure of the asphalt concrete.

Identification

Fatigue cracking occurs in areas subjected to repeated traffic loading (wheel paths) but also maybe present anywhere in the lane due to traffic wander. A series of interconnected cracks characterizes early stages of development. It eventually develops into many-sided, sharp-angled pieces, usually less than 1 foot on the longest side. Characteristically has chicken wire/alligator pattern in later stages.

Longitudinal cracks occurring in the wheel path are rated as fatigue.

Severity Levels

Low - An area of cracks with no or only a few connecting cracks
Cracks are not spalled or sealed
No pumping is evident.

Moderate - An area of interconnected cracks forming a complete pattern
Cracks may be slightly spalled
Cracks may be sealed
No pumping is evident.

High - An area of moderately or severely spalled interconnected cracks forming a complete pattern
Pieces may move when subjected to traffic
Cracks may be sealed
Pumping may be evident

How to Measure

Visually estimate the linear feet of the wheel path affected. Record the **linear feet** at each severity level. Maximum quantity - **1,000** ft per 0.1-mile.

Per new HPMS requirements, also record the area of fatigue cracking in **square feet** at each severity level. A single longitudinal fatigue crack should be considered to have a width of 0.5' in the area calculation.

If different severity levels exist within an area that cannot easily be distinguished, use highest severity level.

LOW SEVERITY FATIGUE CRACKING

Picture #1 - Longitudinal cracks occurring in the wheel path (red arrow).

Picture #2 - The main crack is sealed but there are several small cracks branching off it (red arrow).

Picture #3 - There are 2 cracks in the right wheel path that interconnect in several places (red arrow), but a pattern has not formed.

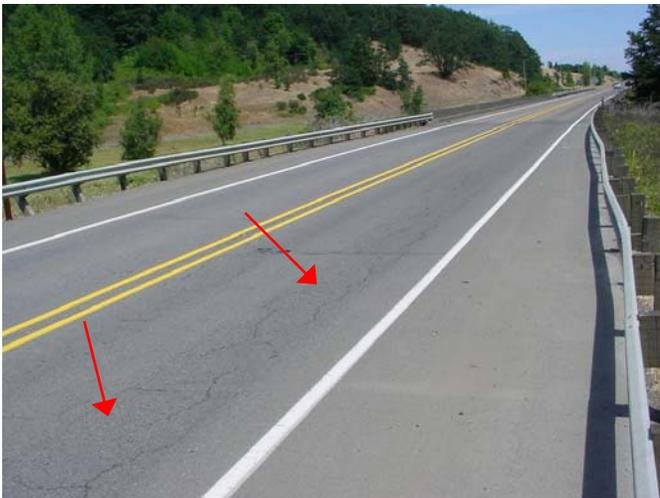
Picture #4 - This picture contains low and moderate severity fatigue cracking. The left wheel path contains the low severity cracking. The cracks are interconnected (red arrows) but haven't formed a pattern as seen in the right wheel path (red circle).



Picture #1



Picture #2



Picture #3



Picture #4

MODERATE SEVERITY FATIGUE CRACKING

Picture #1 - Some of the fatigue cracks have been sealed, but the cracks are forming a pattern (red circle) making this moderate severity fatigue.

Picture #2 - This is predominantly moderate severity fatigue therefore it should be rated as moderate severity although portions of it are borderline high severity due to spalled edges (red arrow).

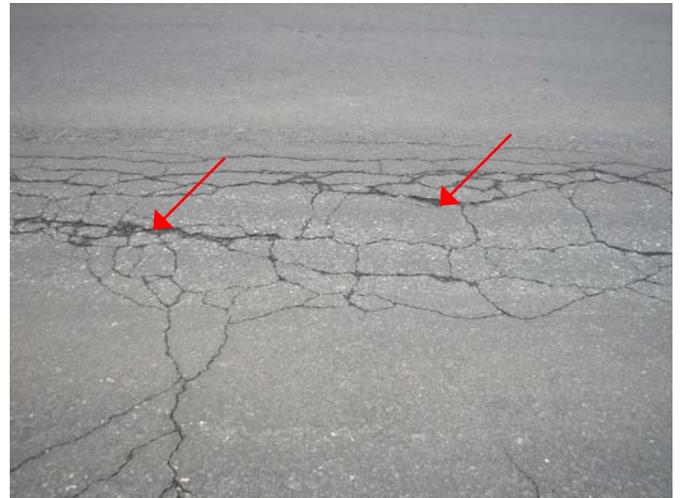
Picture #3 - A majority of these cracks are not spalled.

Picture #4 - This picture is a close up of spalled fatigue crack edges. Some of the cracks are slightly spalled (red arrow).

All of these pictures display a cracking pattern (alligator).



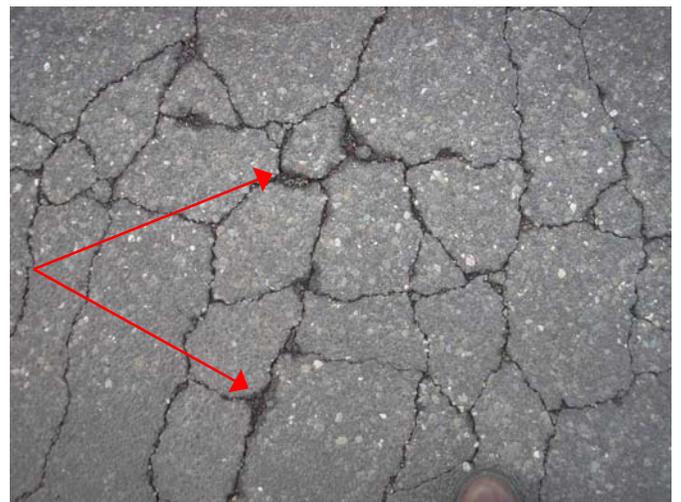
Picture #1



Picture #2



Picture #3



Picture #4

HIGH SEVERITY FATIGUE CRACKING

Picture #1 - Sections of the fatigued area are missing or have been patched (both circled in red). These distresses should also be rated as potholes.

Picture #2 - Sections of the fatigued area are missing (circled in red) and the crack edges are severely spalled (red arrow). These distresses should also be rated as potholes.

Picture #3 - The crack edges are spalled and a depression can be seen in the right wheel path.

Picture #4 - This picture is a close up of spalled fatigue crack edges (red arrow).

All of these pictures display a cracking pattern (alligator).



Picture #1



Picture #2



Picture #3



Picture #4

LONGITUDINAL CRACKING

Longitudinal cracks are cracks that are predominantly parallel to the pavement's centerline. Only longitudinal cracks that are not in a wheel path should be recorded as this form of distress.

Identification

Cracks predominantly parallel to pavement centerline and generally outside the wheel path. Majority of cracks are within 1' of the skip stripe or fog stripe / edge of pavement or within 1' of the middle of the lane. Cracks may meander into the wheel path, but generally stays out of the wheel path.

Longitudinal cracks which occur in the wheel path should be rated as low severity fatigue cracking.

Severity Levels

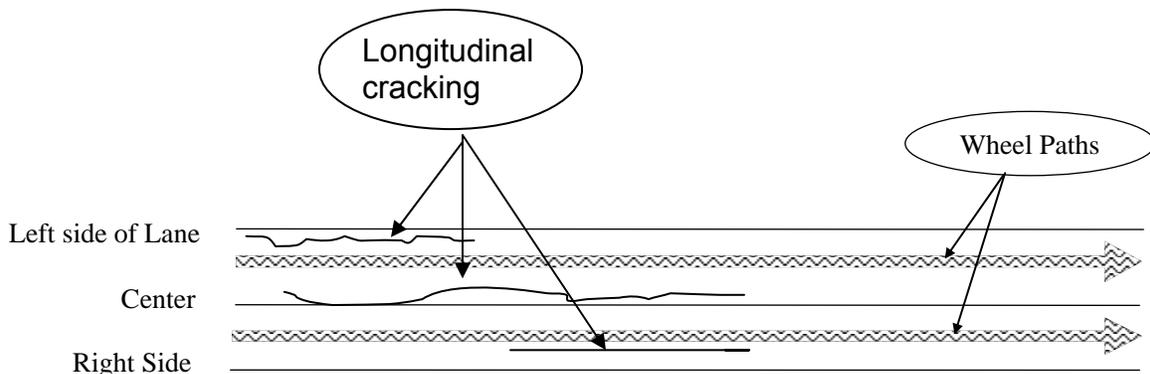
Low - A crack with a mean width of ≤ 0.25 " ; or a sealed crack with sealant material in good condition and a width that cannot be determined.

Moderate - Any crack with a mean width > 0.25 " and ≤ 0.75 " ; or any crack with a mean width < 0.75 in and adjacent low severity random cracking.

High - Any crack with a mean width > 0.75 " ; or any crack with a mean width ≤ 0.75 " and adjacent moderate to high severity random cracking.

How to measure

Record the **linear feet** at each severity level. The maximum length longitudinal cracking is **1,500** linear feet per 0.1-mile section. If questionable whether longitudinal or fatigue cracking, record as fatigue.



LONGITUDINAL CRACKING



Low Severity



Low Severity



Moderate Severity



Low severity with adjacent random cracking becomes Moderate Severity



High Severity



High Severity

TRANSVERSE CRACKING

Transverse cracks are predominantly perpendicular to the pavement centerline, and may extend all or part way across the travel lane. The amount of transverse cracking will be measured by counting the actual number of cracks that occur in the travel lane being rated.

Identification

Transverse cracks predominantly perpendicular to pavement centerline.

Cracks must extend at least half way across the travel lane before being counted.

Severity Levels

Low - An unsealed crack with a mean width of ≤ 0.25 ; or a sealed crack with sealant material in good condition and the width cannot be determined.

Moderate - Any crack with a mean width > 0.25 " and ≤ 0.75 "; or any crack with a mean width < 0.75 in and adjacent low severity random cracking.

High - Any crack with a mean width > 0.75 "; or any crack with a mean width ≤ 0.75 " and adjacent moderate to high severity random cracking.

How to Measure

Record **number** of transverse cracks at each severity level. Maximum number of Transverse Cracks per 0.10-mile is **44**.

Per new HPMS requirements, also record the **length** of transverse cracking in **feet** at each severity level.

Rate entire transverse crack at the highest severity level present (must be present over 10% of crack).

TRANSVERSE CRACKING



Low Severity



Low Severity



Moderate Severity



Moderate Severity



High Severity



High Severity

BLOCK CRACKING

Block cracking is a distress where cracks divide the pavement surface into approximately rectangular pieces. These pieces are typically 1 to 100 square feet. Block cracking, unlike fatigue cracking, will typically occur throughout the pavement width, not just in the wheel paths.

Identification

Block cracking is a pattern of cracks that divide the pavement into approximately rectangular pieces or blocks. Blocks range in size from approximately 1 ft² to 100 ft².

Severity Levels

Low - Cracks with a mean width of ≤ 0.25 ; or sealed cracks with sealant material in good condition and the width cannot be determined.

Moderate - Cracks with a mean width > 0.25 " and ≤ 0.75 "; or any crack with a mean width < 0.75 in and adjacent low severity random cracking.

High - Cracks with a mean width > 0.75 "; or any crack with a mean width ≤ 0.75 " and adjacent moderate to high severity random cracking.

How to Measure

Record the **square feet** of affected area at each severity level. The maximum area of Block cracking is **6,000** ft² per 0.10-mile.

Note: An occurrence should be at least 50 feet long before rating as block cracking.

BLOCK CRACKING



Low Severity



Low Severity



Moderate Severity



Moderate Severity



High Severity



High Severity

PATCH

A patch is an area where the original pavement surface is removed and replaced, or additional material is applied to the pavement surface after original construction. The severity of distresses present in the patch and the ride quality of the patch determine the severity level.

Identification

Portion of pavement surface, greater than 1-ft² that has been removed and replaced or additional material applied to the pavement after original construction.

Severity Levels

Low – A good quality patch with a smooth ride. The patch has, at most, low severity distress of any type including rutting or deformation < 0.25”; pumping is not evident.

Moderate - The patch has moderate severity distress of any type or rutting or deformation from 0.25” to 0.5”; pumping may be evident. Ride quality is good to fair.

High - The patch has high severity distress of any type or rutting or deformation > 0.5”; pumping may be evident. All hand patches or patched potholes are rated as high severity patches.

How to Measure

Record the **square feet** of affected area at each severity level. The maximum area of Patching is **6,000** ft² per 0.10-mile.

Note 1: Any distresses noted within the patch boundary must be included in the severity rating of the patch. Rutting (settlement) may be at the perimeter or interior of the patch.

Note 2: Do not include utility patches. Only include patches caused by distress.

Note 3: A large patch with well defined areas of different severity levels should be measured and rated separately. If variation is present but not in well defined areas, measure and rate the entire patch at highest severity present.

LOW SEVERITY PATCHING

Picture #1 - This is a good quality smooth wheel path patch with no distress.

Picture #2 - This is a good quality smooth blade patch with no distress.

Picture #3 - This is a good quality smooth wheel path patch with no distresses in the left wheel path and low severity wheel path cracking on the right (red arrow). Both patches would be rated as low severity. The wheel path cracking quantity is also rated in addition to the patching distress.

Picture #4 - This is a good quality smooth wheel path patch with low severity wheel path cracking (red arrow). The wheel path cracking quantity is also rated in addition to the patching distress.



Picture #1



Picture #2



Picture #3



Picture #4

MODERATE SEVERITY PATCHING

Picture #1 - This is a wheel path patch with moderate severity fatigue (red arrow). If this patch had no or low severity distress it would be rated as a low severity patch. Further in the lane is a newer low severity blade patch (blue arrow)

Picture #2 - This is a blade patch with moderate severity fatigue (red arrow).

Picture #3 - This is a blade patch with moderate severity fatigue (red arrow).

Picture #4 - This is a wheel path patch with fair quality ride.



Picture #1



Picture #2



Picture #3



Picture #4

HIGH SEVERITY PATCHING

Picture #1 - This is an inlayed wheel path patch with high severity fatigue (red arrow).

Picture #2- All of the wheel paths in this picture have been patched. The patch edges are shown with red arrows. The high severity fatigue drives these patches severity to high.

Picture #3 - This is a hand patch (all hand patches are considered high severity).

Picture #4 - The patch on the left (red arrow) has $> 0.5''$ deformation (red circle) and has a jagged edge. This patch on the right (blue arrow) is a low severity patch



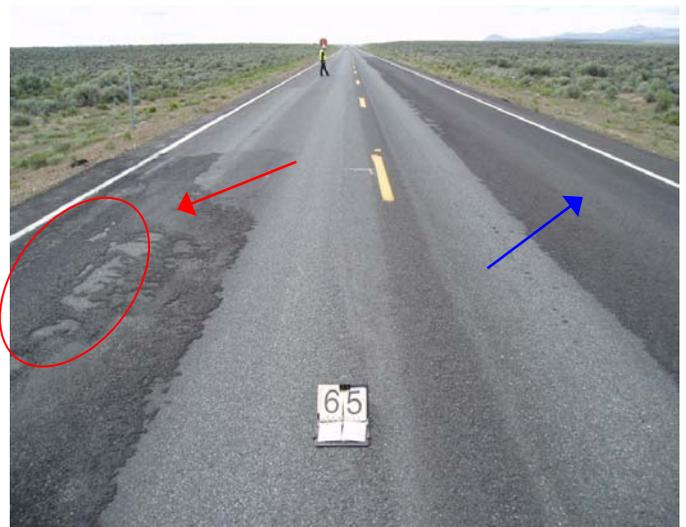
Picture #1



Picture #2



Picture #3



Picture #4

POTHOLE

A pothole is a shallow or deep hole in the pavement surface resulting from loss of pavement surfacing material. Prior to 2010, potholes and patches were rated together. Starting with the 2010 rating, they shall be rated separately.

Identification

Bowl-shaped holes of various sizes in the pavement surface. Minimum plan dimension is **6"**.

Severity Levels

Low - < 1" deep (Typically delamination of patch or seal coat)

Moderate - $\geq 1"$ & < 2" deep (Remains within top lift of asphalt wearing course)

High - $\geq 2"$ deep (Extends beyond top lift of asphalt wearing course)

How to Measure

Record the **number** of potholes at each severity level, up to a maximum of 44 per 0.10 of a mile.

A long pothole or string of potholes greater than 12' in length shall be counted as separate potholes. For example, a 40' continuous string of potholes would be counted as 4 potholes.

POTHOLE



Low Severity



Low Severity



Moderate Severity



Moderate Severity



High Severity



High Severity

RAVELING

Raveling is the wearing away of the pavement surface caused by the dislodging of aggregate particles. It is a progressive disintegration from the surface downward, usually as the result of traffic action. The severity of raveling is based on the estimated percentage of aggregate loss in a 1' wide longitudinal strip of pavement surface as described below. The quantity of raveling will be estimated based on the linear feet of raveling occurring in the inside wheel path, outside wheel path, and between the wheel paths.

Identification

Raveling can be identified by a roughened or pitted texture on the pavement surface. Mechanical abrasion from tire chains, studs, snowplows, or dragging equipment which significantly roughens up the texture should be rated as raveling. Studded tire rutting which does not roughen up the texture significantly should not be rated as raveling. Raveling tends to be most often found in the wheel paths, but can be elsewhere on the pavement surface.

Severity Level

For all surface types, raveling is not rated if less than 25% of the surface in a given 1' wide strip is affected. NOTE Chip Seals are normally rough textured - only rate as low severity raveling if there is $\geq 25\%$ aggregate loss present in a 1' wide strip.

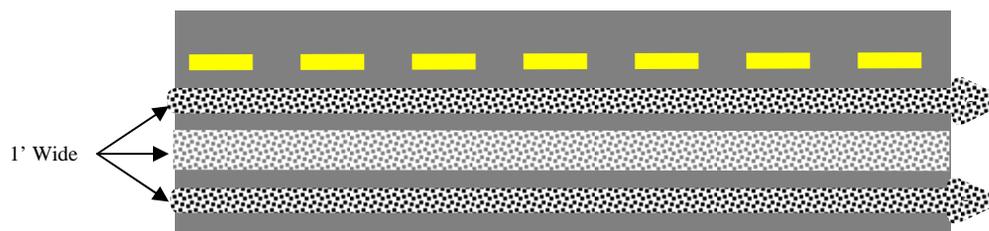
Low - The aggregate has worn away resulting in $\geq 25\%$ to $< 50\%$ aggregate loss in a 1' wide longitudinal strip of pavement surface. Loss of chip seal rock should be rated as raveling, but this is the maximum severity for chip sealed surfaces.

Moderate - Surface texture is noticeably rough and/or pitted with $\geq 50\%$ to $< 75\%$ aggregate loss in a 1' wide longitudinal strip of pavement surface. A nearly continuous strip of aggregate loss 3" - 6" wide may be present. Loose particles may be present outside the traffic area.

High - Surface texture is very rough and/or pitted with $\geq 75\%$ aggregate loss in a 1' wide longitudinal strip of pavement surface. Flat bottom potholes may be present where complete loss of aggregate has occurred.

How to Measure

Record **linear feet** of each severity level for each path - inside, outside, and between wheel paths. Maximum of **500 ft** per path and **1,500 ft** per 0.1 mile. If raveling covers entire area count as if there were 3 adjacent paths.



RAVELING



No raveling (open graded surface)



No raveling (open graded surface)



Low in wheel paths (open graded surface)



Low - same as left (close up)



Moderate in wheel paths (open graded surf.)



Moderate - same as left (close up)

RAVELING



Moderate in left wheel path, low in right



Moderate in left wheel path, low between wheel paths



High



High



High (close up)



High (with potholes)

BLEEDING

Bleeding is indicated by the excess bituminous material on the pavement surface, which creates a shiny, glass-like reflective surface. Bleeding is not rated by severity level, but should be recorded when it is severe enough to cause a reduction in skid resistance. A segment is considered to have measurable bleeding if it has multiple areas ≥ 25 square feet of bleeding. Bleeding will simply be recorded as either existing or not existing for each 0.1-mile segment.

Identification

Excess bituminous binder on pavement surface, and may create a shiny, glass-like, reflective surface that may be tacky to the touch. Usually found in the wheel paths.

Note: Prevention maintenance treatments (slurry seals, chip seals, fog seals, etc.) sometimes exhibit bleeding characteristics. These occurrences should be noted, but not rates as bleeding

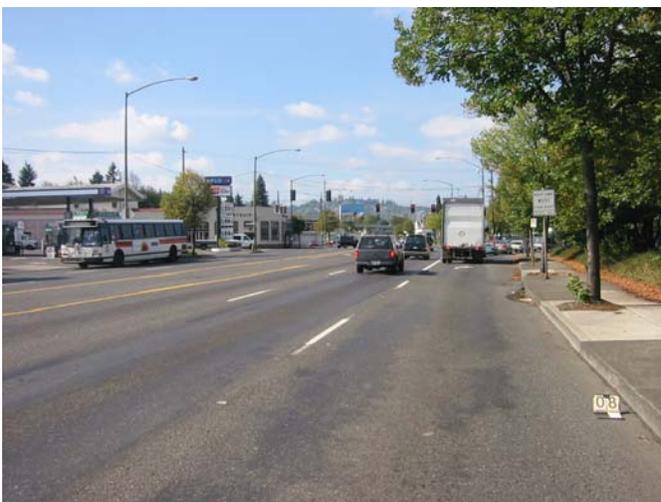
Severity Levels

Bleeding is present if multiple (2 or more) areas of **25 ft²** or larger.

How to Measure

Recorded as either existing or not existing (Yes/No)

BLEEDING



DISTRESS SURVEY MANUAL

SECTION 2

JOINTED CONCRETE PAVEMENTS (JCP)

The evaluation of jointed concrete pavements will be completed by rating the distress in the pavement according to the SHRP descriptions and severity levels as summarized below.

DISTRESS TYPES

Rutting (See AC Pavement Section)

Corner Crack

Corner Break

Longitudinal Cracking

Transverse Cracking

Shattered Slab

Patch Condition

Joint Condition

Faulting (measure per AASHTO R36-04 – not in this manual)

Per the new 2010 HPMS requirements, the percentage of slabs with fatigue cracking must be recorded. For this requirement, record the **total number of all** slabs in the 0.1 mile segment. Also record the **number of fatigue cracked slabs** in the segment. A fatigue cracked slab is one with one or more of the following distresses:

- Corner Crack
- Corner Break
- Shattered Slab

A slab with more than one of the distresses listed above is counted as only 1 slab. Use the highest severity of any of the distresses present to determine the overall severity of the cracked slab.

Summary of JCP Pavement Distresses

Rutting	
Zero	$0" \leq \text{Rut} < 1/4"$
Low	$1/4" \leq \text{Rut} < 1/2"$
Moderate	$1/2" \leq \text{Rut} < 3/4"$
High	$\text{Rut} \geq 3/4"$
Corner Crack	
Low	Crack widths $< 0.125"$, no spalling, and no measurable faulting; or well sealed and with a width that cannot be determined.
Moderate	Crack widths $\geq 0.125"$ and $< 0.5"$; or with spalling $< 3"$; or faulting up to $0.5"$.
High	Crack widths $\geq 0.5"$; or with spalling $\geq 3"$; or faulting $\geq 0.5"$.
Corner Break	
Low	Crack is not spalled for more than 10 percent of the length of the crack; there is no measurable faulting; and the corner piece is not broken into two or more pieces and has no loss of material and no patching.
Moderate	Crack is spalled at low severity ($< 3"$) for more than 10 percent of its total length; or faulting of crack or joint is $< 0.5"$; and the corner piece is not broken into two or more pieces.
High	Crack is spalled at moderate ($\geq 3"$ and $< 6"$) to high severity ($\geq 6"$ and $< 10"$) for more than 10 percent of its total length; or faulting of the crack or joint is $\geq 0.5"$; or the corner piece is broken into two or more pieces or contains patch material.
Longitudinal Cracking	
Low	Crack widths $< 0.125"$, no spalling, and no measurable faulting; or well sealed and with a width that cannot be determined.
Moderate	Crack widths $\geq 0.125"$ and $< 0.5"$; or with spalling $< 3"$; or faulting up to $0.5"$.
High	Crack widths $\geq 0.5"$; or with spalling $\geq 3"$; or faulting $\geq 0.5"$.
Transverse Cracking	
Low	Crack width < 0.125 inches, and no spalling, and no measurable faulting; or well-sealed and width cannot be determined.
Moderate	Crack widths ≥ 0.125 inches and < 0.25 inches; or with spalling < 3 inches; or faulting up to 0.25 inches.
High	Crack widths ≥ 0.25 inches; or with spalling ≥ 3 inches; or faulting ≥ 0.25 inches.
Shattered Slab	
Low	Slab is broken into 3 pieces. The cracks describing the broken sections are not spalled or are spalled for $< 10\%$ of the length of the crack; no measurable faulting.
Moderate	Slab is broken into 4 pieces; <u>or</u> the cracks describing the broken sections are spalled at low severity ($< 3"$) for $> 10\%$ of its total length; <u>or</u> faulting is $< 0.5"$.
High	Slab is broken into 5 or more pieces; <u>or</u> the cracks describing the broken sections are spalled $\geq 3"$ for $> 10\%$ of its total length; <u>or</u> faulting is $\geq 0.5"$.
Patch Condition	
Low	Patch has at most low severity distress of any type; and no measurable faulting or settlement; pumping is not evident.
Moderate	Patch has moderate severity distress of any type; or faulting or settlement to 0.25 inches; pumping is not evident.
High	Patch has a high severity distress of any type; or faulting or settlement ≥ 0.25 inches; pumping may be evident. Also includes patches that are not made with concrete materials.
Joint Condition	
Low	Joint is in good condition and seal is in good condition.
Moderate	Joint is slightly spalled with seal in good condition or joint is in good condition with seal in poor condition.
High	Joint is badly spalled or joint is slightly spalled with seal in poor condition.

CORNER CRACKING

Corner cracks are cracks of any length that intersect at least one transverse joint and are predominantly parallel to the pavement centerline. Corner crack severity is based on crack width, spalling or faulting.

Identification

A crack, predominantly parallel to the pavement centerline, which intersects at least one transverse joint and radiates into the panel. These cracks must be located laterally in the wheel path. For this purpose, the wheel path is from 1' inside the lane or shoulder joint to 1' from the middle of the lane.

Corner cracks that intersect transverse cracks will be rated as corner breaks and not as corner cracks.

Severity Levels

Low – Crack widths $< 0.125''$, no spalling, and no measurable faulting; or well sealed and with a width that cannot be determined.

Moderate – Crack widths $\geq 0.125''$ and $< 0.5''$; or with spalling $< 3''$; or faulting up to $0.5''$.

High – Crack widths $\geq 0.5''$; or with spalling $\geq 3''$; or faulting $\geq 0.5''$.

How to Measure

Record the **number of corner cracks** at each severity level (Total **32** max per 0.1 mile)

The length of corner cracks should also be measured and recorded as longitudinal cracks.

A longitudinal crack that intersects both transverse joints should be rated and recorded as 2 corner cracks, plus a longitudinal crack.

Cracks that occur between the wheel paths should be rated and recorded as longitudinal cracking only, not corner cracking.

CORNER CRACKING



Low - Corner crack is tight and has no spalling or faulting.



Moderate - Corner crack has spalling less than 3" wide.



Moderate - Corner crack has spalling less than 3" wide.



Moderate - Corner crack width is over 1/8" but less than 1/2" wide.



Moderate - Corner crack has spalling less than 3" wide.



Moderate - Corner crack has spalling less than 3" wide.

CORNER BREAK

A corner break is the separation of a corner portion of concrete from the rest of the PCC slab. Corner breaks occur when a corner crack is intersected by a transverse crack or when a diagonal crack extends across the corner of a slab. Corner break severity is based on spalling, faulting, or number of broken pieces, not crack width.

Identification

A crack which separates the slab and intersects the adjacent transverse and longitudinal joints, describing an approximate 45 degree angle with the direction of traffic. Not included are cracks that are within one foot of the edge and less than 1 foot long.

Severity Levels

Low – Crack is not spalled for more than 10 percent of the length of the crack; there is no measurable faulting; and the corner piece is not broken into two or more pieces and has no loss of material and no patching.

Moderate – Crack is spalled at low severity ($< 3''$) for more than 10 percent of its total length; or faulting of crack or joint is $< 0.5''$; and the corner piece is not broken into two or more pieces.

High – Crack is spalled at moderate ($\geq 3''$ and $< 6''$) to high severity ($\geq 6''$ and $< 10''$) for more than 10 percent of its total length; or faulting of the crack or joint is $\geq 0.5''$; or the corner piece is broken into two or more pieces or contains patch material.

How to Measure

Record the **number of corner breaks** at each severity level (Total **32** max)

CORNER BREAK



Low - Corner Break



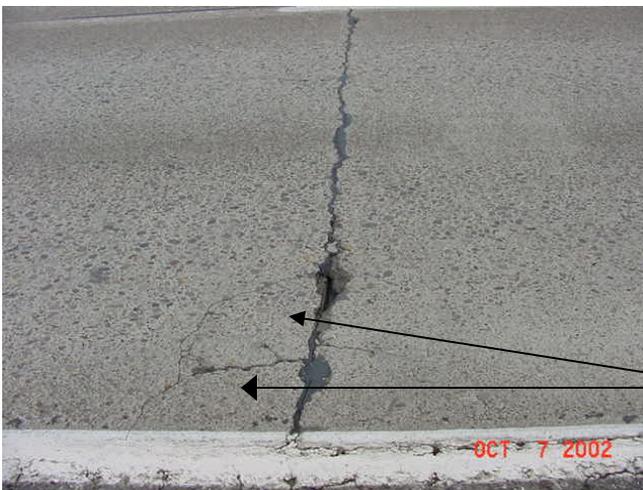
Moderate - Crack has low severity (<3" wide) spalling for > 10% of length.



High - Faulted over 1/2".



High - Corner break broken into two or more pieces.



Not a corner break because less than 1' from transverse joint.

LONGITUDINAL CRACKS

Longitudinal cracks are cracks that are predominantly parallel to the pavement centerline. Longitudinal cracks may occur laterally anywhere within the rated lane. The crack severity is based on width, spalling, and faulting.

Identification

Cracks that are predominately parallel to the pavement centerline.

Longitudinal cracks that intersect transverse cracks will be rated as corner breaks and not as longitudinal cracks.

Severity Levels

Low – Crack widths < 0.125 " , no spalling, and no measurable faulting; or well sealed and with a width that cannot be determined.

Moderate – Crack widths ≥ 0.125 " and < 0.5 "; or with spalling < 3 "; or faulting up to 0.5 ".

High – Crack widths ≥ 0.5 "; or with spalling ≥ 3 "; or faulting ≥ 0.5 ".

How to Measure

Record the **linear feet** in each severity level (**1500** ft Maximum per 0.1 mile segment).

A longitudinal crack that intersects a transverse joint should also be rated and recorded as a corner crack for each transverse joint intersected.

Cracks that occur outside the wheel paths should be rated and recorded as longitudinal cracking only, not corner cracking.

LONGITUDINAL CRACKS



Low Severity



Up Close picture of the crack



Moderate Severity



Up Close picture of the crack



High Severity



Up Close picture of the crack

TRANSVERSE CRACK

Transverse cracks are cracks that are predominantly perpendicular to the pavement centerline. These cracks extend all or part way across the travel lane. Transverse crack severity is based on crack width, spalling and faulting. The amount of transverse cracking will be measured by counting the actual number of cracks that occur in the travel lane being rated.

Identification

Cracks that are perpendicular to the pavement centerline.

Severity Levels

Low – Crack width < 0.125 inches, and no spalling, and no measurable faulting; or well-sealed and width cannot be determined.

Moderate – Crack widths \geq 0.125 inches and < 0.25 inches; or with spalling < 3 inches; or faulting up to 0.25 inches.

High – Crack widths \geq 0.25 inches; or with spalling \geq 3 inches; or faulting \geq 0.25 inches.

How to Measure

Record the **number** of cracks at each severity (Total **44** maximum). Rate the entire transverse crack at the highest severity level present for at least 10% of the total length of the crack. Cracks should extend at least half way across the travel lane before being counted.

TRANSVERSE CRACK



Low - Transverse crack width < 0.125"
No faulting or spalling.

Moderate - Transverse crack has
spalling.



High - Transverse crack width is over 1/4"

SHATTERED SLAB

A shattered slab is a concrete slab that is broken into three or more pieces. Slabs that are divided solely by transverse cracks are not included. Corner breaks are also not included. The severity of a shattered slab is determined by the number of pieces the slab is broken into combined with the severity of spalling and faulting exhibited. The quantity of shattered slabs will be measured by counting the number that occurs in each 0.1-mile segment.

Identification

A concrete slab that is broken into three or more pieces. Do not include corner breaks when counting broken slab sections. Also do not include slab sections that are divided by one or more transverse cracks.

Severity Levels

Low – Slab is broken into 3 pieces. The cracks describing the broken sections are not spalled or are spalled for <10 % of the length of the crack; no measurable faulting.

Moderate – Slab is broken into 4 pieces; or the cracks describing the broken sections are spalled at low severity (< 3”) for >10% of its total length; or faulting is < 0.5”.

High – Slab is broken into 5 or more pieces; or the cracks describing the broken sections are spalled ≥ 3 ” for >10 % of its total length; or faulting is ≥ 0.5 ”.

How to Measure

Record the **number** of shattered slabs at each severity level (Total **32** max).

SHATTERED SLAB



Low - Slab broken into three pieces and no spalling exists.

Moderate - Slab broken into four sections and no spalling or faulting exists.



High - broken into five or more pieces.



Not a shattered slab. Slab broken into three sections by transverse cracks only. This is three T-cracks.

PATCH CONDITION

A patch is an area where the original pavement has been removed and replaced, or additional material applied to the pavement after original construction. *If patch material is non-concrete, the patch will be rated as high severity.* The patch severity is based on distresses present in the patch or faulting. The amount of patching will be measured by estimating the square feet of the rated lane that is patched.

Identification

A portion or all of the original concrete slab that has been removed and replaced, or additional material applied to the pavement after original construction.

Severity Levels

Low – Patch has at most low severity distress of any type; and no measurable faulting or settlement; pumping is not evident.

Moderate – Patch has moderate severity distress of any type; or faulting or settlement to 0.25 inches; pumping is not evident.

High – Patch has a high severity distress of any type; or faulting or settlement \geq 0.25 inches; pumping may be evident. Also includes patches that are not made with concrete materials.

How to Measure

Record the **square feet** at each severity level (**6,000** square feet maximum).

PATCH CONDITION

Low- Patch is in good condition



Moderate- Patch is displaying faulting < 0.25"



High- AC Patch is counted as a high severity patch.



High- Patch is displaying high severity distress.

JOINT CONDITION

Rating

Rating is based on a combination of the joint and joint seal condition. The condition of the transverse, lane, and shoulder joints will be rated separately based on the average condition of the joints in each segment, as follows:

Severity Level

Low - Joint is in good condition and seal is in good condition.

Mod - Joint is slightly spalled with seal in good condition or joint is in good condition with seal in poor condition.

High - Joint is badly spalled or joint is slightly spalled with seal in poor condition.

JOINT CONDITION



Low - transverse joint. Joint is not spalled and seal is in good condition.



Moderate- Seal is missing.



Moderate- Seal is missing.



High - Joint is badly spalled.

DISTRESS SURVEY MANUAL

SECTION 3

CONTINUOUSLY REINFORCED CONCRETE PAVEMENT (CRCP)

The evaluation of continuously reinforced concrete pavements will be completed by rating the distress in the pavement according to the SHRP descriptions and severity levels as summarized below.

DISTRESS TYPES

Rutting (See AC Pavement Section)
Longitudinal Cracking
Transverse Cracking
Punchouts
Patches
Joint Condition

Summary of CRCP Pavement Distresses

Rutting	
Zero	0" ≤ Rut < 1/4"
Low	1/4" ≤ Rut < 1/2"
Moderate	1/2" ≤ Rut < 3/4"
High	Rut ≥ 3/4"
Longitudinal Cracking	
Low	Non-wheel path longitudinal cracks with a width < 0.125", no spalling, and no measurable faulting; <u>or</u> well sealed and with a width that cannot be determined. Low wheel path longitudinal cracks are bumped to moderate.
Moderate	Crack widths ≥ 0.125" and < 0.5"; <u>or</u> with spalling < 3"; or faulting up to 0.5". Also includes low severity wheel path longitudinal cracks . Moderate wheel path longitudinal cracks are bumped to high.
High	Crack widths ≥ 0.5"; <u>or</u> with spalling ≥ 3"; or faulting ≥ 0.5". Also includes moderate severity wheel path longitudinal cracks.
Transverse Cracking	
Low	Cracks that are not spalled or are spalled < 10% of the crack length.
Moderate	Cracks that are spalled along ≥ 10% and < 50% of the crack length.
High	Cracks that are spalled along ≥ 50% of the crack length.
Punchouts	
Low	Longitudinal or transverse crack are spalling < 3" or faulting < 0.25". At least two cracks defining the block must be spalled. Does not include "Y" cracks.
Moderate	Spalling ≥ 3" and < 6" or faulting ≥ 0.25 inches. Includes "Y" cracks that exhibit spalling, breakup and faulting in the branch portion of the "Y" along >10% (1' minimum) and <50% of crack length.
High	Spalling ≥ 6" or concrete within the punchout is punched down by ≥ 0.5" or is loose and moves under traffic. Includes "Y" cracks that exhibit high severity spalling, breakup and faulting in the branches of the "Y" along >50% of the crack length.
Patches	
Low	Patch has at most low severity distress of any type; and no measurable faulting or settlement; pumping is not evident.
Moderate	Patch has moderate severity distress of any type; or faulting or settlement up to 0.25 inches; pumping is not evident.
High	Patch has a high severity distress of any type; or faulting or settlement ≥ 0.25 inches at the perimeter of the patch; pumping may be evident.
Joint Condition	
Low	Joint is in good condition and seal is in good condition.
Moderate	Joint is slightly spalled with seal in good condition or joint is in good condition with seal in poor condition.
High	Joint is badly spalled or joint is slightly spalled with seal in poor condition.

LONGITUDINAL CRACKING

Longitudinal cracks are cracks that are predominantly parallel to the pavement centerline. The crack severity is based on width, spalling, and faulting, and is adjusted for location laterally within the lane.

Identification

Cracks that are predominately parallel to the pavement centerline. For CRCP, the severity level is "bumped" up to the next level if the crack is located in the wheel path, in accordance with the definition below.

Wheel Path Longitudinal Cracks - Majority of crack is located laterally *in the wheel path*. For this purpose, the wheel path is from 1' inside the lane or shoulder joint to 1' from the middle of the lane. Shape is typically linear and parallel to lane, although may be diagonal or crescent shaped. All wheel path related cracks are rated as either moderate or high severity

Non-Wheel Path Longitudinal Cracks - Majority of crack is located *out of wheel path* as defined above. The crack may meander into wheel path but generally stays out of the wheel path.

Severity Levels

Low – Non-wheel path longitudinal cracks with a width $< 0.125"$, no spalling, and no measurable faulting; or well sealed and with a width that cannot be determined.

Low wheel path longitudinal cracks are bumped to moderate.

Moderate – Crack widths $\geq 0.125"$ and $< 0.5"$; or with spalling $< 3"$; or faulting up to $0.5"$. Also includes low severity wheel path longitudinal cracks.

Moderate wheel path longitudinal cracks are bumped to high.

High – Crack widths $\geq 0.5"$; or with spalling $\geq 3"$; or faulting $\geq 0.5"$. Also includes moderate severity wheel path longitudinal cracks.

How to Measure

Record the **linear feet** in each severity level. (1,500 feet maximum)

WHEEL PATH LONGITUDINAL CRACKING



Moderate - Low sealed crack bumped to moderate.



Moderate – Low crack bumped to moderate



High - Moderate crack bumped to high.



High - based on width.



High - based on width and spalling.

NON-WHEEL PATH LONGITUDINAL CRACKING



Low - Low based on sealant.

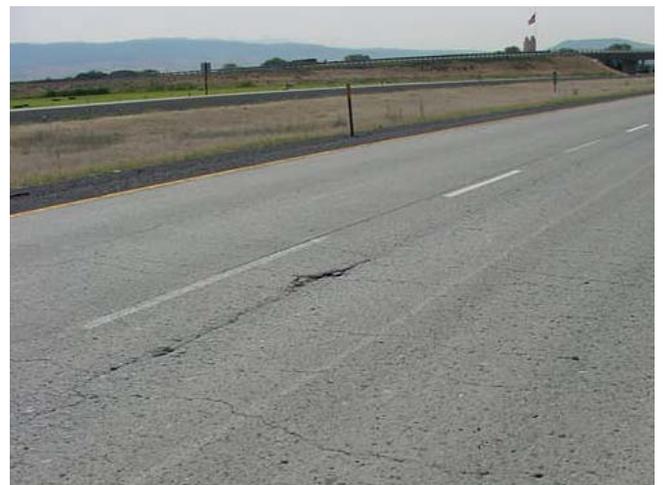


Low- Crack is low based on width.

Moderate - Crack is moderate based on width.



High - High based on width and spalling.



TRANSVERSE CRACK

Transverse cracking of continuously reinforced concrete pavement is normal and is not considered a form of distress. However, if the cracks open up, major deterioration may result. Transverse crack severity is rated based on the average crack condition in the 0.1-mile segment. Also, at each milepoint marker, the average crack spacing is determined in a 100-foot section by dividing 100 by the number of cracks counted in the section.

Identification

Cracks that are perpendicular to the pavement centerline

Severity Levels

Low – Cracks that are not spalled or are spalled < 10% of the crack length.

Moderate – Cracks that are spalled along $\geq 10\%$ and < 50% of the crack length.

High – Cracks that are spalled along $\geq 50\%$ of the crack length.

How to Measure

Measure **once per mile at the mile point marker** by counting the number of cracks within a 100-foot section. Record as a crack spacing (100/number of cracks). Severity is based upon average crack condition. All transverse cracks that intersect an imaginary longitudinal line at midlane, and propagate from the pavement edges, shall be counted as individual cracks. Cracks that do not cross midlane are not counted.

EXAMPLE # 1

The DMI indicates the raters are at MP 240. The raters count the number and severity of the cracks for 100 feet. After traveling the 100 feet the raters have gathered the following information:

17 Low severity cracks, of which 5 are "Y" cracks

20 Moderate severity cracks, of which 8 are "Y" cracks

3 High severity cracks, of which 1 is a "Y" crack.

There are a total of 40 cracks ($17 + 20 + 3 = 40$). Recall that "Y" cracks are recorded as a single crack. The crack spacing is calculated as $100/40 = 3$ (Nearest whole number). The average severity is moderate. Three is entered under the moderate spacing column for transverse crack severity

EXAMPLE #2

The DMI indicates the raters are at MP 241. The following information is recorded in the 100-foot measurement interval.

1 Low severity cracks

4 Moderate severity cracks

15 High severity cracks

The crack spacing is $100/20 = 5$. The severity is high

TRANSVERSE CRACK



Low - Spalling drives severity. This crack has little to no spalling.



Low - Little spalling.



Three low cracks in a row.



Moderate



Moderate next to a low.



Close up of moderate next to a low.

High severity "T - Cracks" in CRCP are rare

PUNCHOUT

A punchout is the separation of a block of concrete from the rest of the CRCP formed by two closely spaced transverse cracks, a short longitudinal crack, and the edge of the pavement or longitudinal joint. As the cracks deteriorate, the steel ruptures and the block of concrete punches downward into the base and subbase. Punchouts will be rated as low, moderate, or high based on spalling or faulting. The quantity of punchouts will be measured by counting the number that occurs in each segment. If a punchout has been patched with asphalt, it should be rated as a high-severity punchout and not a patch, as the patch is only a temporary repair.

Description

A localized separation of a block of concrete from the rest of the PCC slab. Also includes "Y" cracks that exhibit spalling, breakup, and faulting. Longitudinal crack defining the block may be any length. Adjacent transverse cracks may be more than 2' apart.

Branch portion of "Y" crack must be less than 1/2 lane.

Severity Levels

Low – Longitudinal or transverse crack are spalling < 3" or faulting < 0.25". At least two cracks defining the block must be spalled. Does not include "Y" cracks.

Moderate – Spalling $\geq 3"$ and < 6" or faulting ≥ 0.25 inches. Includes "Y" cracks that exhibit spalling, breakup and faulting in the branch portion of the "Y" along >10% (1' minimum) and <50% of crack length.

High – Spalling $\geq 6"$ or concrete within the punchout is punched down by $\geq 0.5"$ or is loose and moves under traffic. Includes "Y" cracks that exhibit high severity spalling, breakup and faulting in the branches of the "Y" along >50% of the crack length.

How to Measure

Record the **number** of punchouts at each severity level (Total **5** maximum). A group of punchouts on a single longitudinal crack is counted as only one punchout (rate highest severity of group). The cracks which outline the punchout are also recorded under longitudinal and transverse cracking when appropriate.

PUNCHOUT



Low - Spalling on T-crack and L-crack.



Low - Spalling on T-crack and L-crack. If faulted over 0.25", then rate as moderate



Two low punchouts near centerline. Rate as one low since localized in one area.



Not a punchout. Spalling on L-crack only



Moderate - Spalling between 3" and 6".



High - More than 0.5" faulting.

See next page for more punchout pictures

PUNCHOUT



High - All AC patches are rated as high punchouts



High



One high punchout. This is localized within a small area.



Y-crack. Do NOT record as a punchout since branches are not exhibiting spalling. Only the trunk is spalling.



Not a Y-crack based on 1/2 lane rule. Crack severity of Y is moderate. Count as one moderate T-crack.



Moderate Severity punchout - Y-crack with >10% spalling in the branches.

PATCH CONDITION

A patch is an area where the original pavement has been removed and replaced with non-asphalt type of material. *An asphalt patch should be rated as a high-severity punchout instead of a patch.* The patch severity is based on distress in the patch, faulting or pumping. The amount of patching will be measured by estimating the square feet of the rated lane that is patched.

Description

A portion or the entire original concrete slab that has been removed and replaced with a permanent (concrete) type of material, or additional material applied to the pavement after original construction. An asphalt patch should be rated as a high-severity punchout instead of a patch.

Severity Levels

Low – Patch has at most low severity distress of any type; and no measurable faulting or settlement; pumping is not evident.

Moderate – Patch has moderate severity distress of any type; or faulting or settlement up to 0.25 inches; pumping is not evident.

High – Patch has a high severity distress of any type; or faulting or settlement ≥ 0.25 inches at the perimeter of the patch; pumping may be evident.

How to Measure

Record the **square feet** at each severity level (**6,000** square feet maximum).

PATCH CONDITION



Low - severity patch. Note tight T-cracks



Low - Punchout has been replaced with a concrete patch. Record as patch, not as a punchout.



Moderate - Cracks are generally tight and are not exhibiting spalling, however, they are in the wheel path so they bump to moderate.



Moderate - Longitudinal cracks are moderate severity non-wheel path. Record entire patch as moderate.



High - Longitudinal cracks are wheel path moderate to high severity. Record patch with high severity L-crack as high.

JOINT CONDITION

Rating

Rating is based on a combination of the joint and joint seal condition. The condition of the lane joint and shoulder joint will be rated separately based on the average condition of the joints in each segment, as follows:

Severity Levels

Low - Joint is in good condition and seal is in good condition.

Mod - Joint is slightly spalled with seal in good condition or joint is in good condition with seal in poor condition.

High - Joint is badly spalled or joint is slightly spalled with seal in poor condition.

JOINT CONDITION



Low transverse joint. Joint is not spalled and seal is in good condition.



Moderate. Seal is missing.



Moderate. Seal is missing.



High. Joint is badly spalled.