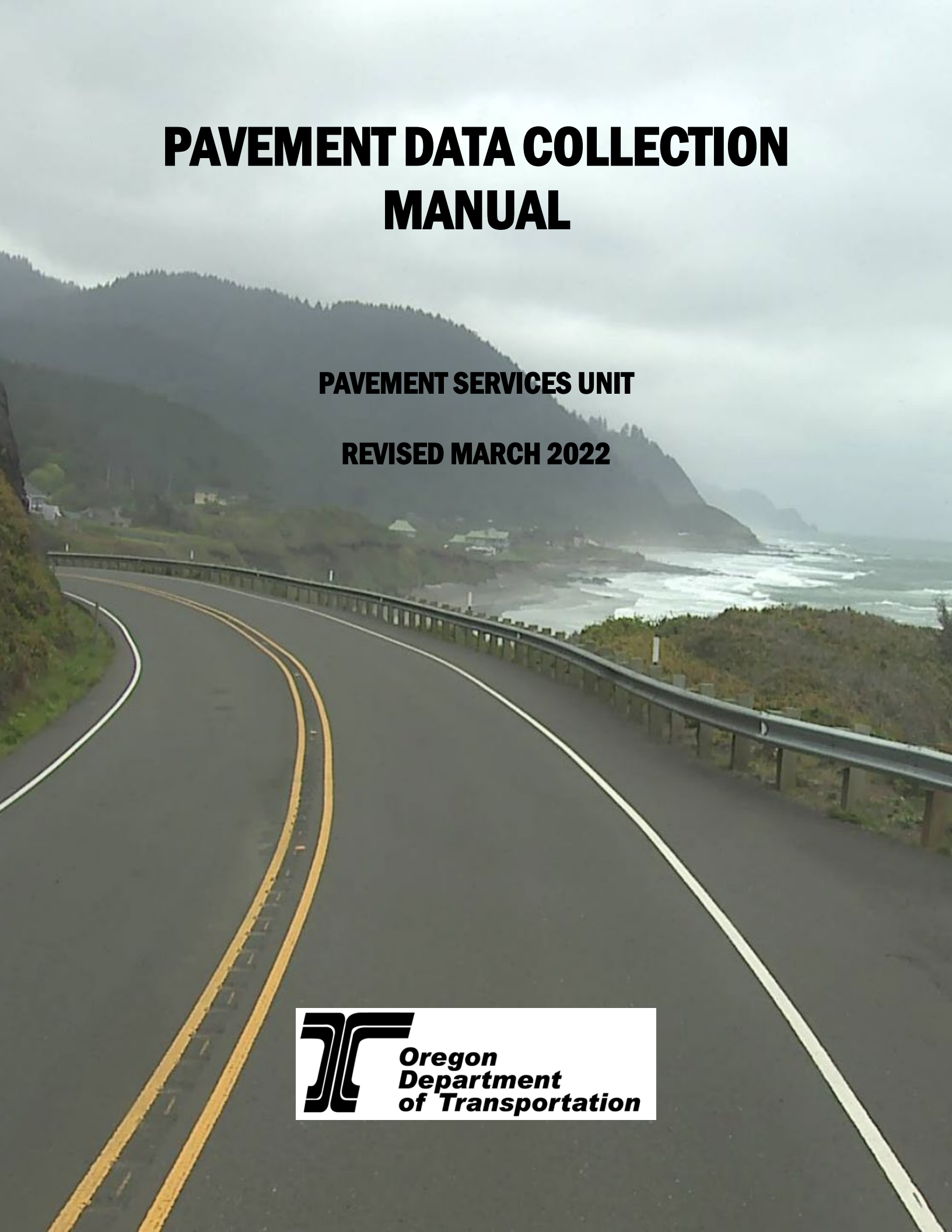
PAVEMENT DATA COLLECTION MANUAL



PAVEMENT SERVICES UNIT

REVISED MARCH 2022

Oregon Department of Transportation

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PAVEMENT DATA COLLECTION MANUAL

INTRODUCTION

This manual, in conjunction with the Highway Performance Monitoring System (HPMS) Field Manual[1] and the Distress Identification Manual for the Long-Term Pavement Performance Program (LTPP)[2] outlines procedures for conducting pavement data collection surveys. The purpose of the data collection survey is to measure surface profiles and identify and quantify surface distresses in a given segment of pavement for both ODOT Pavement Management and FHWA Performance Reporting purposes.

The Oregon State Highway System is currently composed of three primary surface types; Asphalt Concrete Pavement (ACP), Jointed Concrete Pavement (JCP), and Continuously Reinforced Concrete Pavement (CRCP). Procedures for surveying surface profiles and distresses for each of these primary pavement types are presented in this manual. Where applicable, this manual notes additional identification and measurement procedures for pavement data elements, such as cracking types, which are used in determining HPMS pavement metrics.

The main use of this manual is to perform network-level surface profile and distress rating for Interstate, National Highway System (NHS), and other State Highways, where appropriate, to assess pavement conditions. The distress survey is intended primarily to characterize type and extent of pavement distress, but not 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, including determination of pavement data metrics required for reporting in HPMS and FHWA National Performance Management Measures.

SUMMARY OF RECENT CHANGES

ODOT has collected pavement distress information on the State Highway System since the early 1990's. Initially, a manual rating process was used. The distress protocol has been updated over time as needed to keep up with developing technologies in semi-automated and automated pavement data collection using truck mounted cameras and sensors. The distress types that ODOT collects have changed very little since the early days, however the methods used for collecting and interpreting the data have changed. ODOT regularly assesses the data collection process and makes continuous improvements to its survey methods and procedures. The 1990's version of the manual went through a major update in 2010 as ODOT moved from manual survey methods to more automated data collection methodologies. A significant revision to the former "ODOT Distress Survey Manual" was made in 2018, including a name

[1] HPMS Field Manual (December 2016) and Errata (February 2018)
[2] Distress Identification Manual for the LTPP Program (Fifth Revised Edition, FHWA-HRT-13-092)

change to the "ODOT Pavement Data Collection Manual" to reflect the addition of IRI profile data and faulting. These changes were needed to comply with new federal requirements for pavement data collection and reporting. The 2019 manual added clarifications for several distress types from the 2018 version. This manual makes further improvements. It is not practical to document every change that was made from previous versions of the manual; however the following lists describe the most significant updates that have been incorporated into this manual since the 2010 version.

MARCH 2022

- Rutting – Removes reference to 5-point rut depth method
- Asphalt Concrete Pavement (ACP) Distresses:
    - Adds a 4th severity level for sealed cracks - Fatigue Cracking, Longitudinal Cracking, and Transverse Cracking.

OCTOBER 2021

- Updates to Survey Methods and Procedures Section:
    - Adds statement that distresses that cannot be reliably extracted by automated methods must be rated by manual methods.
    - Clarifies requirements for training and manual rating certification per the Pavement Data Quality Management Plan.
    - Clarifies distress ratings in vicinity of bridges.

- Updates to Surface Profile Section:
    - Rutting - Removes reference to Low, Moderate, and High rut depth levels.

- Asphalt Concrete Pavement (ACP) Distresses:
    - Patches – Updates language and pictures regarding patch severity.
    - Raveling – Updates language regarding chip seal. Raveling should only be rated if there is complete loss of chip seal and additional loss of aggregate in original wearing course underneath the chip seal.
    - Bleeding – Minor revisions to language to bring in line with current practice.

- Jointed Concrete Pavement (JCP) Distresses:
    - Longitudinal Cracking – Adds statement that fine longitudinal cracks that are not visible in the Right of Way image should not be rated. Re-emphasizes that measured length should be longitudinal length where cracking present, not crack length.
    - Patching – Minor editing to improve clarity.
    - Joint Condition – Removes this distress from the rating procedure.

- Continuously Reinforced Concrete Pavement (CRCP) Distresses:
    - Longitudinal Cracking – Adds statement that fine longitudinal cracks that are not visible in the Right of Way image should not be rated. Re-emphasizes that measured length should be longitudinal length where cracking present, not crack length.
    - Patching – Minor editing to improve clarity.
    - Joint Condition – Removes this distress from the rating procedure.

APRIL 2019

- Updates to Survey Methods and Procedures Section:
    - Added reference to AASHTO R 86-18 (Collecting Images of Pavement Surfaces for Distress Detection).
    - Clarified that no distress is to be measured on bridge surfaces and no bridge distress is to be reported for 0.10-mile pavement data.

- Updated AASHTO Standard Practices that were formerly Provisional Standards:
    - AASHTO R 85-18 (Quantifying Cracks in Asphalt Pavement Surfaces from Collected Pavement Images Utilizing Automated Methods) was formerly AASHTO PP 67-16 (2017).
    - AASHTO R 87-18 (Determining Pavement Deformation Parameters and Cross Slope from Collected Transverse Profiles) was formerly AASHTO PP 69-14 (2017).
    - AASHTO R 88-18 (Collecting the Transverse Pavement Profile) was formerly AASHTO PP 70-14 (2017).

- Asphalt Concrete Pavement (ACP) Distresses:
    - Fatigue Cracking – Clarified that fatigue cracking in wheel path and non-wheel path lane zones are measured separately for HPMS and ODOT reporting.
    - Patches – Added example images of pavement features that are not rated as patches.
    - Raveling – Clarified that raveling is not rated on patches.

- Jointed Concrete Pavement (JCP) Distresses:
    - Corner Breaks – Changed the maximum number of corner breaks from 36 to the total number of slabs per 0.10-mile segment.
    - Longitudinal Cracking – Clarified that the length measured is the length of affected wheel path and non-wheel path lane zones, not the length of all individual cracks; added example images of what should not be rated as longitudinal cracks.
    - Shattered Slabs – Clarified the shattered slab definition and when to count a slab as both shattered and transverse cracking; changed the maximum number of shattered slabs from 36 to the total number of slabs per 0.10-mile segment.
    - Joint Condition – Added additional images of joint conditions.

- Continuously Reinforced Concrete Pavement (CRCP) Distresses:
    - Longitudinal Cracking – Clarified that the length measured is the length of affected wheel path and non-wheel path lane zones, not the length of all individual cracks; added example images of what should not be rated as longitudinal cracks.

APRIL 2018

- Document Name – Changed from "ODOT Distress Survey Manual" to "ODOT Pavement Data Collection Manual" to reflect the addition of IRI profile data and Faulting into this manual.

- Updates to Survey Methods and Procedures Section:
    - Clarified that condition surveys are primarily to be accomplished using Data Collection Vehicles (DCV's) rather than a manual survey method.
    - Clarified that manual surveys may be needed for training, certification, or quality assurance purposes, and are to be performed from DCV images or in the field where DCV images do not provide sufficient detail.
    - Added the requirement that manual raters must be certified by ODOT, as required by the ODOT Pavement Data Quality Management Plan[3].
    - Added and updated language regarding collection direction, lane, lighting and weather conditions, and event marking.
    - Clarified that all pavement adjacent to bridge structures should be rated.

- Added Surface Profile Section:
    - Moved Rutting protocol from the previous manual into this section and updated language to reflect latest AASHTO protocols as a primary method and 5-point laser system as a backup alternative.
    - Added protocols for IRI and Faulting in accordance with AASHTO and HPMS requirements.

- Asphalt Concrete Pavement (ACP) Distresses:
    - Fatigue Cracking – As before, this continues to be based on LTPP protocol with wheel path longitudinal cracks included; added AASHTO and HPMS definitions for wheel path zones which will be used in federal Cracking Percent metrics.
    - Longitudinal Cracking – Minor changes; based on LTPP protocol for non-wheel path longitudinal cracks only.
    - Transverse Cracking – Minor changes; based on LTPP protocol; removed requirement for recording transverse crack length.
    - Block Cracking – Removed from distress protocol since it is not compatible with automated collection methods and redundant to transverse and longitudinal crack measurements.

[3] ODOT Data Quality Management Plan for Pavement Condition (October 2018)

  - Patches – ODOT modified version of LTPP protocol to incorporate deterioration of the patch and ride quality; language was updated to clarify the distinction between patching and improvements; and added language clarifying that cracking distress inside patches are also to be rated under cracking distress.
  - Potholes – Minor changes; based on the LTPP protocol.
  - Raveling – Minor changes to simplify severity descriptions; ODOT specific protocol.
  - Bleeding – No changes; ODOT specific protocol.

- Jointed Concrete Pavement (JCP) Distresses:
  - Corner Cracks – Removed from distress protocol since it is redundant to longitudinal crack measurements.
  - Corner Breaks – Minor changes; based on the LTPP protocol.
  - Longitudinal Cracking – Added categories for wheel path and non-wheel path to be rated and measured separately; definition and severity levels based on the LTPP protocol.
  - Transverse Cracking – Changed the method of measurement to number of cracked slabs rather than number of cracks; added count of total number of slabs in the 0.10-mile segment for federal Cracking Percent metrics; definition and severity levels based on the LTPP protocol.
  - Shattered Slabs – Updated language regarding number of pieces and severity level to be consistent with PAVER protocol; not an LTPP distress type.
  - Patches – ODOT modified version of LTPP protocol to incorporate deterioration of the patch; updated patch severity language regarding non-concrete materials and shape of patch.
  - Joint Condition – Minor changes; ODOT specific protocol.

- Continuously Reinforced Concrete Pavement (CRCP) Distresses:
  - Longitudinal Cracking – Added categories for wheel path and non-wheel path to be rated and measured separately; definition and severity levels based on the LTPP protocol.
  - Transverse Cracking – removed from distress protocol because it was too subjective and not repeatable.
  - Punchouts – ODOT modified version of LTPP protocol to incorporate “Y” cracks; updated the language to clarify that completely patched punchouts are to be rated as patches, regardless of patch material; changed the maximum number of punchouts per 0.10-mile segment from 5 to 36.
  - Patches – ODOT modified version of LTPP protocol to incorporate deterioration of the patch; updated patch severity language regarding non-concrete materials and shape of patch.
  - Joint Condition – Minor changes; ODOT specific protocol.

SURVEY METHODS AND PROCEDURES

Pavement data collection is to be primarily accomplished via a Pavement Condition Data Collection Vehicle (DCV). A DCV is a truck equipped with computer, sensor, and video equipment designed to efficiently collect data and video images of the roadway and pavement surface. Specialized sensors are used to automatically measure longitudinal and transverse surface profiles. Longitudinal profiles are used to determine smoothness (e.g. IRI) and transverse profiles are used to determine rut depth. Pavement longitudinal profiles are to be collected according to AASHTO R57-14, transverse profiles are to be collected according to AASHTO R88-18, and pavement images are to be collected according to AASHTO R 86-18. Both automated and semi-automated methods are used to identify and quantify distresses from pavement images. Data obtained with the vehicle is reviewed later in the office to generate segmented data reports and condition ratings.

Data collection should be accomplished for the full extent of the highway and continuously collected in a manner that will allow for reporting in nominally uniform section lengths of 0.10-mile segments, or smaller where designated by ODOT. The DCV should be used to collect pavement data in the direction(s) of travel and lane(s) specified. The following guidelines are to be followed for long-term uniformity:

- Collect in the normal collection lane[4] unless otherwise specified.
- Collect Interstate highways in both directions unless otherwise specified.
- For divided highways, collect both directions only where specified.
- For undivided highways, collect the add-mileage direction (generally north to south and west to east).
- Collect additional lanes on multi-lane divided highways where specified.

Passing lanes, weaving and auxiliary lanes, and turning lanes should not be collected unless specifically requested. Truck climbing lanes that are part of the mainline highway should be treated as a normal driving lane and should be collected where they occur. Unless otherwise noted, ramps and approaches not part of mainline state highways should not be collected. Data should continue to be collected when lane deviations occur. Lane deviations for work zones and construction detours are acceptable and expected. Lane deviations for passing other vehicles should be limited to the extent practical.

Work should be scheduled to minimize impacts of traffic congestion. Seasonal and daily sun angle should be considered during routing to ensure acceptable image quality. Data should not be collected when the visibility of cracking and other distress forms are obstructed by road conditions. Data collection should not take place if there is precipitation falling, if the roadway

[4] For data collection purposes, the normal collection lane is the right most travel lane referencing the median – including truck climbing lanes but not including weaving or auxiliary lanes between interchanges. This is designated as Lane "T" and should be collected unless otherwise designated. Where a specific lane number is designated, start at the median and progress outward.

is wet, or if there is visible precipitation such as snow, ice, hail, standing water, etc., on the roadway.

All 0.10-mile segments should be collected except for segments where roadway closures, safety hazards, or other legitimate reason makes data collection infeasible. When this occurs and the problem is of a temporary nature, data collection should be rescheduled. If rescheduling is not feasible, the appropriate exclude field(s) of the shell database should be flagged and the reason field populated to explain why.

During data collection or in post-processing, the beginning and ending points of "events" or features that may cause abnormal readings should be marked. The events listed below should be marked:

- The beginning and ending points of every bridge and railroad crossing.
- The beginning and ending points of anytime the test lane is vacated, e.g. where passing other vehicles or in a work zone.
- The beginning and ending points of each occurrence where the speed of the DCV drops below minimum inertial profiler recommended speeds or starts/stops to allow for filtering out erroneous IRI data.

The information above should be used to populate an event field in the shell database to note when the 0.10-mile segment includes a bridge, is out of lane, or is in a construction detour zone. The bridge begin and end locations are also important for ensuring that distress on pavement can be separated from bridges.

Distress collection should be consistent with IRI inventory direction and lane. Distresses should be identified and measured according to the instructions provided in this manual and recorded for each segment rated. Although IRI and rut data should be continuously collected and reported across all structures, distress in the vicinity of bridge decks is handled differently. Bridge deck surfaces may optionally be rated, however only distress on pavement surfaces next to bridges should be included in the 0.10-mile segment distress quantities. When segments contain both pavement and bridges, reported distress quantities should exclude distress on bridges. For segments where the entire length is a bridge, if distress was optionally rated on the bridge the distress quantities may be reported, otherwise the appropriate exclude field of the shell database should be flagged and the reason field populated to explain why.

The expected pavement wearing surface type will be pre-populated in the shell database for each 0.10-mile segment. The raters should validate the pavement type and flag discrepancies for resolution by ODOT prior to final distress rating. Pavement type discrepancies not related to bridge structures such as weigh in motion panels, intersection approaches or roundabouts are examples which should be flagged.

The following is a brief summary of the survey procedure:

1. Begin at the appropriate milepoint marker for the 0.10-mile segment.
2. Identify the apparent pavement type (ACP, JCP, or CRCP).
3. Is there <u>any</u> part of a bridge in the segment?
    a. If yes, go to step 7
    b. If no bridges, continue to step 4

<u>Situation for no bridge in 0.10-mile segment:</u>

4. Does apparent pavement type match original pavement type for entire segment?
    a. If yes, survey segment and report distress quantities for original pavement type.
    b. If no, not full length original pavement type, go to step 5.
5. Is the entire segment a different pavement type than originally provided?
    a. If yes, flag for Agency resolution identifying apparent pavement type; survey segment and report distress quantities using apparent pavement type.
    b. If no, not full length different pavement, go to step 6.
6. Compute length of each pavement type within segment, then follow either option A or B below:
    a. Option A – survey segment and report distress quantities for original pavement type only not including distress on other pavement type(s), <u>or</u>
    b. Option B – flag for Agency resolution; identify apparent pavement type with dominant length; survey segment and report distress quantities corresponding to pavement type with dominant length.

<u>Situation for bridge in 0.10-mile segment:</u>

7. Full bridge situation: Does the bridge span the full segment?
    a. If yes, flag as “Full Bridge” in remarks field of shell database, then follow either option i or ii below:
        i. Option i – identify “apparent” pavement type; survey bridge segment and report distress quantities using apparent pavement type. *(This is the only exception to excluding distress on a bridge surface in segment quantity reporting),* or
        ii. Option ii – flag the appropriate exclude field of the shell database and populate the reason field to explain why.
    b. If no, not a full span bridge, go to step 8.

8. Part bridge situation: Does pavement type *adjacent to bridge* match original pavement type?
    a. If yes, flag as “Part Bridge” in remarks field of shell database; survey pavement within segment and report distress quantities *for pavement only*. Do not report distress on bridge.

b. If no, pavement type adjacent to bridge is different than original pavement, flag as “Part Bridge” in remarks field of shell database; also flag for Agency resolution identifying apparent pavement type; survey pavement within segment using apparent pavement type distresses and report distress quantities *for pavement only*. Do not report distress on bridge deck.

Distresses that cannot reliably be extracted using automated methods must be reduced by manual or semi-automated methods. Examples of distress types that may require manual or semi-automated methods include but are not limited to sealed cracks, patching, raveling, bleeding, potholes, punchouts, and concrete distress.

Manual distress surveys may be conducted for training, certification, or quality assurance purposes. Manual surveys will be performed from DCV images whenever possible to reduce worker exposure to vehicular traffic. When DCV images do not provide sufficient detail, manual survey methods may be employed via a “side window” survey from a slow-moving vehicle operating on the adjacent shoulder. Two-person crews are required for this situation. 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.

Manual raters should be trained and familiar with ODOT and HPMS data collection procedures. Supervisory personnel responsible for distress ratings should be certified by ODOT, as required by the ODOT Pavement Data Quality Management Plan. Training of personnel should include proper distress identification using example images for each of the three pavement types. For a given pavement type, the example images should include typical examples of each type of distress and at various severity levels. Documentation of the training, including dates and times of training, training session agenda, topics covered, and list of attendees should be maintained.

SECTION 1

SURFACE PROFILE

The evaluation of surface profiles for asphalt concrete, jointed concrete, and continuously reinforced concrete pavements is completed by identifying and measuring the pavement according to the descriptions summarized on the following pages.

TYPES

IRI (Longitudinal Profile)
Rutting (Transverse Profile)
Faulting – JCP Only (Longitudinal Profile)

IRI – INTERNATIONAL ROUGHNESS INDEX

The International Roughness Index (IRI) is a statistic derived from a measured longitudinal profile to quantify pavement roughness. It is used worldwide for evaluating and managing road systems. It is an HPMS required data element on all pavement surface types (ACP, JCP, and CRCP) on Interstate, NHS, and principal arterials.

Identification

Roughness is identified by surface irregularities in a longitudinal profile that affect a vehicle's ride. IRI is interpreted as the ratio of a standard vehicle's accumulated suspension motions to the distance traveled, or the average absolute slope of the longitudinal profile, as described in ASTM E1926-08.

How to Measure

To measure roughness, use a DCV system that meets the requirements of AASHTO M 328-14 and is certified according to AASHTO R 56-14. At least one accelerometer is vertically aligned with each height sensor. The method to collect data should be in accordance to network-level procedures outlined in AASHTO R 57-14. ODOT requires the use of a line laser type height sensor, which has a large footprint to reduce the effects of rough macro-texture on profile repeatability and accuracy. Sensor measurements will be taken at intervals of 1.0 inch or less unless otherwise specified. Calculate and report quarter-car **IRI for the left and right wheel paths** and the **average** (Mean Roughness Index) for every 0.10-mile segment, in accordance with AASHTO R 43-13. Report data all three values to the nearest **1 inch per mile**. All wavelengths exceeding 300 feet should be removed with long-wavelength filters.

RUTTING

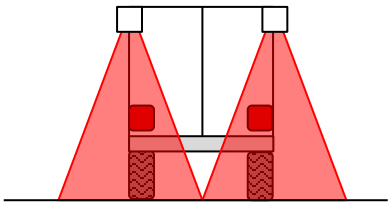
Rutting is a longitudinal surface depression in the wheel path caused by permanent deformation (ACP only) or the wearing away of the pavement surface (JCP and CRCP). Rut depth is determined by measuring the transverse profile across the width of a lane and calculating the depths in both wheel paths. Measurements are collected and reported for segments consistent with those reported for IRI. Rutting is reported in HPMS for ACP only.

Identification

A rut is a longitudinal surface depression in a wheel path derived from measurements of a profile transverse to the path of travel on a highway lane.

How to Measure

Transverse profiles should be collected according to AASHTO R 88-18 to allow for determination of rut depth. As of 2018, for Interstate and non-Interstate NHS routes, the preferred equipment for measuring rut depths in each wheel path is a DCV equipped with a 3-D imaging system called a Laser Crack Measurement System (LCMS). This system should collect transverse data points at increments of 0.4 inch or less across a minimum width of 13 feet. The longitudinal (reporting) interval between transverse profiles should not be more than 12 inches. Calculation of rut depth should follow the method described in section 6.7 of AASHTO R 87-18 with results averaged and reported for each wheel path. For each 0.10-mile segment, report **average**, **standard deviation**, and **maximum rut depths** for the **left and right wheel paths** to the nearest **0.01 inch**.



3-D Imaging System
(rear view)

FAULTING (JCP ONLY)

Faulting is vertical misalignment of transverse joints in Jointed Concrete Pavement surfaces. It is evaluated in the right wheel path, according to automated fault measurement procedures in AASHTO R 36-17, from longitudinal profiles. Faulting is reported for HPMS.

Identification

A fault is a difference in elevation across a transverse joint, where the edge of a slab is higher or lower than its adjacent slab. Do not include faulting at transverse cracks.

How to Measure

Use automated measurement procedures to collect the longitudinal profile in the right wheel path. The maximum sampling interval is 1.5 inches. Measure the fault at each transverse joint. Do not measure faulting at cracks. Process measurements according to either Method A or Method B as described in AASHTO R 36-17. Report the **average absolute faulting for all transverse joints** to the nearest **0.01 inch** for each 0.10-mile segment.

SECTION 2

ASPHALT CONCRETE PAVEMENTS (ACP)

The evaluation of asphalt concrete pavements is completed by rating the distress in the pavement according to the descriptions and severity levels as summarized on the following pages. Distresses are measured and reported for segments in the travel direction and lane consistent with IRI measurements.

DISTRESS TYPES

Fatigue Cracking
Longitudinal Cracking – Non-Wheel Path
Transverse Cracking
Patches
Potholes
Raveling
Bleeding

Summary of ACP Distress

Fatigue Cracking – Measure **Length of Affected Lane Zone** (max. 1,056 ft. in wheel paths).	
Sealed	Cracks having the characteristics of low severity fatigue cracks (as defined below) that are sealed with sealant material in good condition. Interconnected crack patterns are rated as moderate or high severity fatigue cracks regardless of presence of sealant. Includes sealed Wheel Path Longitudinal Cracks.
Low	An area of cracks with no or only a few connecting cracks. Cracks are not spalled. Cracks may be unsealed or sealed but have opened back up. No pumping is evident. Includes unsealed Wheel Path Longitudinal Cracks.
Moderate	An area of interconnected cracks forming a complete pattern. Cracks may be slightly spalled or 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 – Non-Wheel Path – Measure **Length of Affected Non-Wheel Path Lane Zones** (max. 1,584 ft.).	
Sealed	A well-sealed crack with sealant material in good condition and a width that cannot be determined.
Low	An unsealed crack with a mean width of ≤ 0.25”; or a sealed crack that has opened with a mean width of ≤ 0.25”.
Moderate	Any crack with a mean width > 0.25” and ≤ 0.75”; or any crack with a mean width < 0.75” 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 Cracking – Count **Number of Cracks** spanning at least ½ way across the lane (max. 44). Rate entire transverse crack at highest severity level present over 10% of the crack.	
Sealed	A well-sealed crack with sealant material in good condition and a width that cannot be determined.
Low	An unsealed crack with a mean width of ≤ 0.25”; or a sealed crack that has opened with a mean width of ≤ 0.25”.
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.
Patches – Measure **Patch Area** (max. 6,336 sf.). **Also measure all cracking inside the Patch.**	
Low	A well-constructed patch with good to fair riding qualities. The patch may have distress but it is mostly low severity with very little moderate or high; rutting or deformation < 0.25”; pumping is not evident.
Moderate	The patch is moderately deteriorated or has extensive moderate severity distress; or rutting or deformation from 0.25” to 0.5”; pumping may be evident. Ride quality is fair to poor. Also includes non-smooth irregular-shaped patches with uneven edges.
High	The patch is severely deteriorated, or has extensive high severity distress; or rutting or deformation > 0.5”; or the patch has additional different patch material within it. Ride quality is fair to poor. Pothole patches are rated as high severity, regardless of ride quality.
Potholes – Count **Number of Potholes** (max. 44). A continuous pothole or multiple potholes within a 12-ft. long zone shall be counted as one pothole.	
Low	Depth < 1” (Typically delamination of thin patch or seal coat creating a shallow pothole.)
Moderate	1” ≤ Depth ≤ 2” (Remains within top lift of wearing course.)
High	Depth > 2” (Extends beyond top lift of wearing course.)
Raveling – Measure **Length of Affected Wheel Path and Center Lane Zones** (max. 1,584 ft.).	
Low	Aggregate has worn away resulting in noticeably rough or pitted pavement surface texture in the left wheel path, right wheel path, or center lane zone.
Moderate	Surface texture is moderately rough and/or pitted with moderate loss of pavement surface aggregate in the left wheel path, right wheel path, or center lane zone. Loose aggregate particles may be present outside the traffic area.
High	Surface texture is very rough and/or pitted with severe loss of pavement surface aggregate in the left wheel path, right wheel path, or center lane zone. Flat bottom potholes may be present where complete loss of aggregate has occurred.
Bleeding – Record as either **existing or not existing** (Yes or No).	
Y or N	None, record bleeding if multiple (2 or more) locations ≥ 25 ft. are present.

FATIGUE CRACKING

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

Identification

Fatigue cracking occurs in areas subjected to repeated traffic loading (most often in the wheel paths) but also may be present anywhere in the lane due to traffic wander. Following the lane zone definitions from AASHTO R 85-18, wheel paths are 39 inches (1 meter) wide and are separated by the center zone of 30 inches (0.75 meter). The left and right edge zones are outside of the wheel paths. Fatigue cracking in the wheel paths is reported for HPMS, while fatigue cracking anywhere in the lane is reported for ODOT. A series of interconnected cracks characterizes early stages of fatigue cracking development. It eventually develops into many-sided, sharp-angled pieces, usually less than 1 foot on the longest side. In later stages, fatigue cracking characteristically has a chicken wire/alligator pattern. An area of short closely spaced (< 1 foot) transverse cracks in the wheel path should be recorded as fatigue cracking.

Severity Levels

Sealed – Cracks having the characteristics of low severity fatigue cracks (as defined below) that are well sealed with sealant material in good condition. Interconnected crack patterns are rated as moderate or high severity fatigue cracks regardless of presence of sealant.

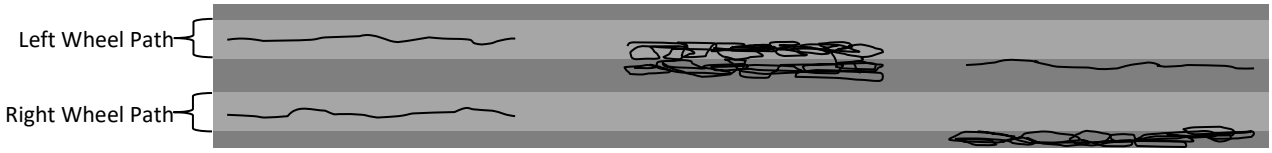
Low – An area of cracks with no or only a few connecting cracks. Cracks are not spalled. Cracks may be unsealed or sealed but have opened back up. No pumping is evident. **Longitudinal cracks occurring in the wheel paths are rated as sealed or low severity fatigue cracks, as appropriate.**

Moderate – An area of interconnected cracks forming a complete pattern. Cracks may be slightly spalled or 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

Measure the longitudinal length of **wheel path** and **non-wheel** path lane zone where fatigue cracking is present. Record the **linear feet** of affected lane zone at each crack severity level. Record wheel path and non-wheel path zone lengths separately. If different severity levels exist within an area that cannot easily be distinguished, use the highest severity level. The maximum wheel path quantity is **1,056 feet** per 0.10-mile. The maximum non-wheel path quantity is **1,584** feet per 0.10 mile.

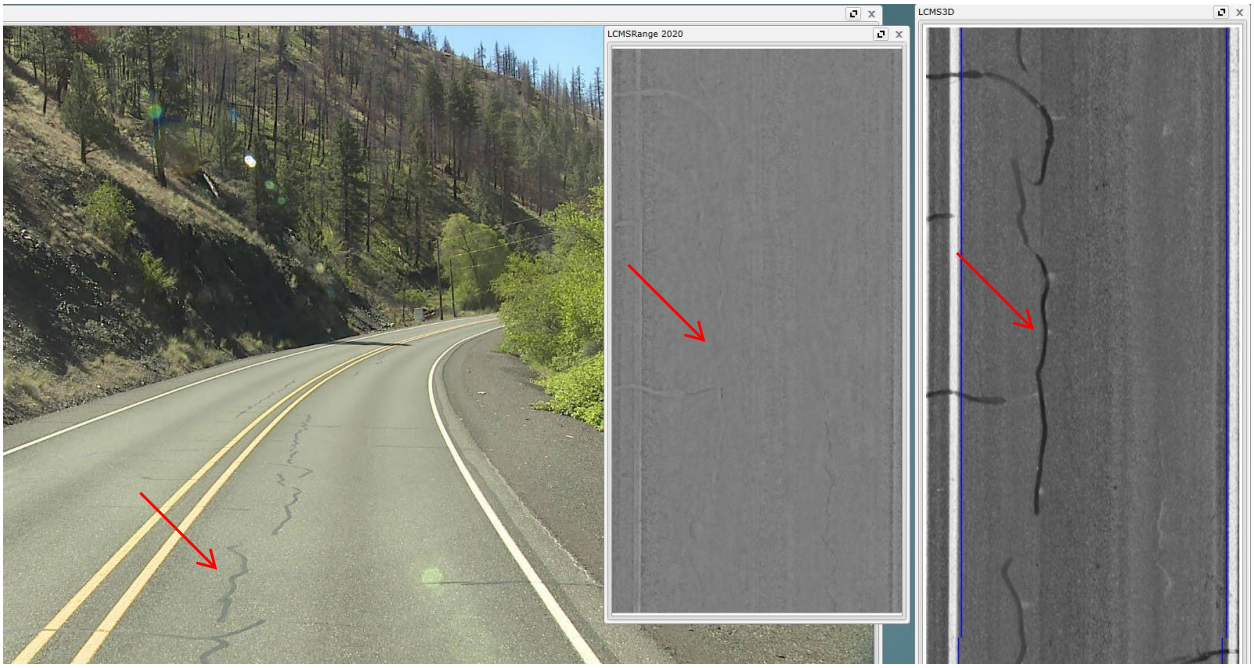


Wheel Path Longitudinal Cracks are rated as Sealed or Low Severity Fatigue Cracking (as appropriate) (Measure for ODOT and HPMS)

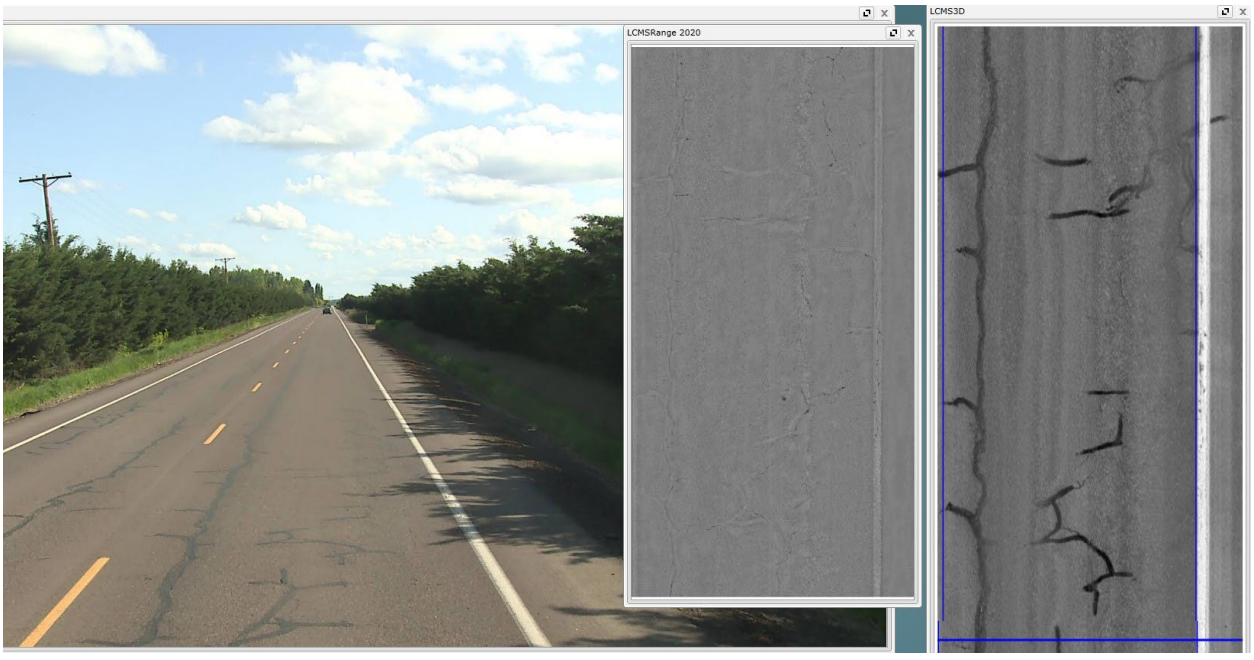
Fatigue Cracking in Left Wheel Path (Measure for ODOT and HPMS); Fatigue Cracking in Center Zone (Measure for ODOT only)

Longitudinal Crack in Center Zone is not Fatigue Cracking; Fatigue Cracking in Right Edge Zone (Measure for ODOT only)

FATIGUE CRACKING – SEALED SEVERITY



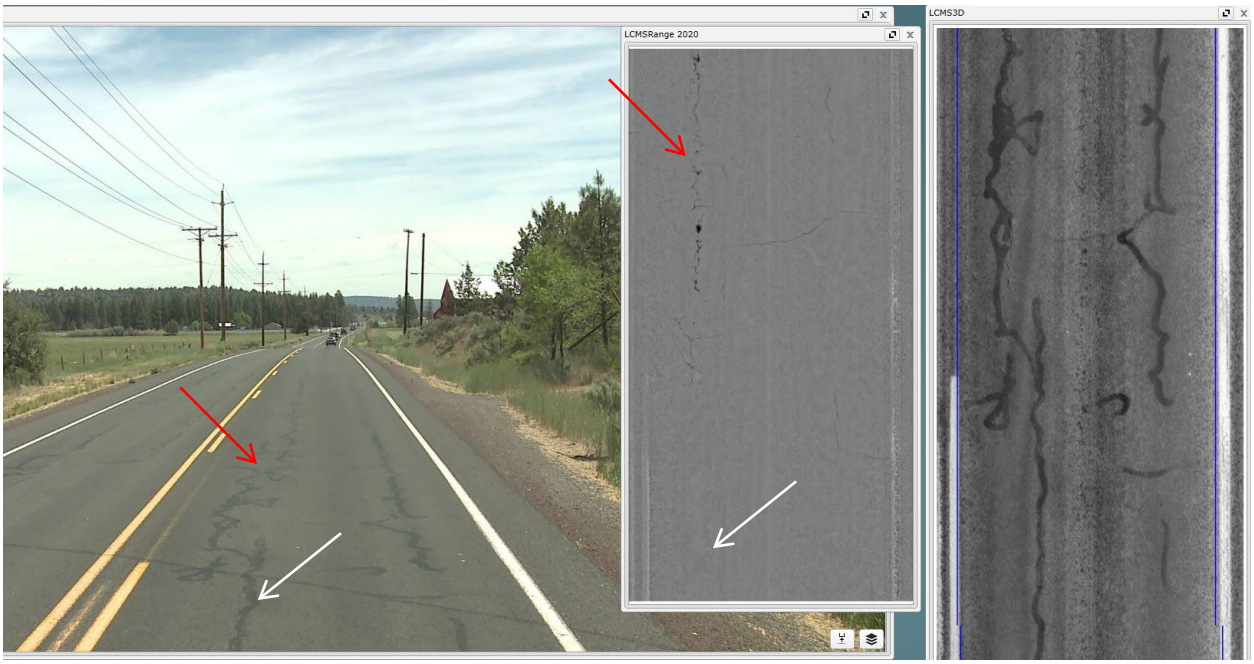
Well-sealed longitudinal crack in the wheel path (red arrows). Crack is not open.



Well-sealed fatigue and longitudinal wheel path cracks. Crack are still mostly closed and sealed.

FATIGUE CRACKING – LOW SEVERITY

Sealed but open (red arrows) and unsealed (yellow arrows) longitudinal wheel path cracks.



Sealed but open (red arrows) longitudinal wheel path crack is low severity. Well-sealed longitudinal wheel path crack (white arrows) should be rated as sealed severity level.

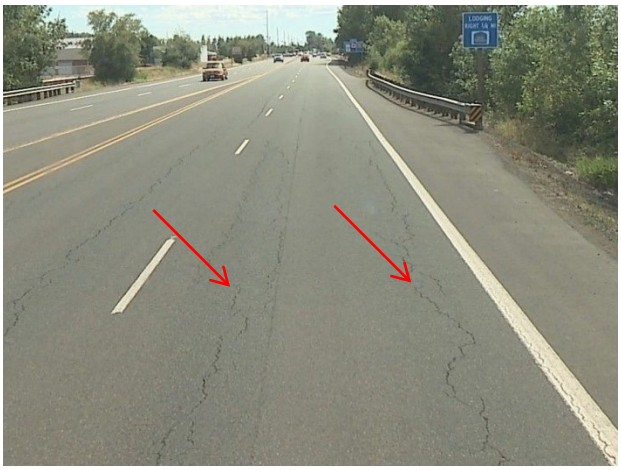
FATIGUE CRACKING – LOW SEVERITY

Picture #1 – Longitudinal cracks in the wheel path with a few interconnected cracks (red arrows).

Picture #2 – Although the main crack is sealed, there are several small cracks branching off from it (red arrows) that are not sealed; therefore rate as low severity rather than the sealed severity level.

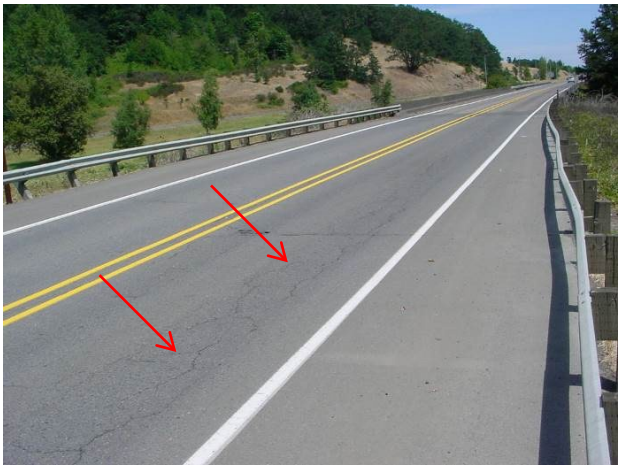
Picture #3 – There are two cracks in the right wheel path that interconnect in several places (red arrows), but a complete pattern has not formed.

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



Picture #1

Picture #2



Picture #3

Picture #4

FATIGUE CRACKING – MODERATE SEVERITY

Picture #1 – Some of the fatigue cracking has been sealed, but the cracks are forming a complete pattern (red circles), making this moderate severity.

Picture #2 – This pattern cracking is predominantly moderate severity fatigue and should be rated as such, although portions of it are borderline high severity due to spalled edges (red arrows).

Picture #3 – A majority of the cracks are not spalled, but form a complete pattern.

Picture #4 – A close up of slightly spalled fatigue crack edges in the cracking pattern (red arrows).

Picture #1


Picture #2


Picture #3


Picture #4

FATIGUE CRACKING – HIGH SEVERITY

Picture #1 – Sections of the fatigued area are missing or have been patched (both circled in red). Missing pavement at least 6 inches across is also rated as a pothole.

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

Picture #3 – The crack edges are spalled and a depression is visible in the right wheel path.

Picture #4 – A close up of spalled fatigue crack edges (red arrows).

Picture #1

Picture #2

Picture #3

Picture #4

LONGITUDINAL CRACKING – NON-WHEEL PATH

Longitudinal cracks are cracks that are predominantly parallel to the pavement centerline. Longitudinal cracking may occur laterally anywhere within the rated lane, and is categorized by its location within the lane as either fatigue cracking (when in the wheel path) or longitudinal cracking (when not in the wheel path). Only longitudinal cracks that are not in a wheel path should be recorded as this form of distress.

Identification

Cracks that are predominantly parallel to the pavement centerline where a majority of cracks are located out of the wheel paths as defined in AASHTO R 85-18. The cracks may meander into the wheel path but general stay in the left edge, right edge, and center (between wheel paths) lane zones. Left and right edge zone cracks are between 54 inches (1.375 meters) of the centerline of the lane and the roadway centerline, lane line, or edge line. Center zone cracks are within 15 inches (0.375 meter) of the centerline of the lane.

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

Severity Levels

Sealed – A well-sealed crack with sealant material in good condition and a width that cannot be determined.

Low – An unsealed crack with a mean width of ≤ 0.25”; or a sealed crack that has opened back up with a mean width of ≤ 0.25”.

Moderate – Any crack with a mean width > 0.25” and ≤ 0.75”; or any crack with a mean width < 0.75” 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.

* Random cracking is considered adjacent when it is within 1’ of the primary crack.

How to Measure

Measure the longitudinal length of cracking and record the **linear feet** of affected non-wheel path lane zones at each severity level. The maximum quantity is **1,584 feet** per 0.10-mile segment. If questionable whether cracking is longitudinal or fatigue cracking, record as fatigue.

LONGITUDINAL CRACKING – NON-WHEEL PATH

Left edge – sealed severity

Left edge – low severity

Center – low severity

Left edge – moderate severity (low severity with adjacent random cracking)

Center – high severity

Center – high severity

TRANSVERSE CRACKING

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

Identification

Transverse cracks are predominantly perpendicular to the pavement centerline. **Cracks must extend at least half way across the travel lane (6 feet for a 12-foot wide lane) before being counted.** Rate the entire transverse crack at the highest severity level present (must be present over 10% of the crack).

Severity Levels

Sealed – A well-sealed crack with sealant material in good condition and a width that cannot be determined.

Low – An unsealed crack with a mean width of ≤ 0.25”; or a sealed crack that has opened back up with a mean width of ≤ 0.25”.

Moderate – Any crack with a mean width > 0.25” and ≤ 0.75”; or any crack with a mean width < 0.75” and adjacent low severity random* cracking.

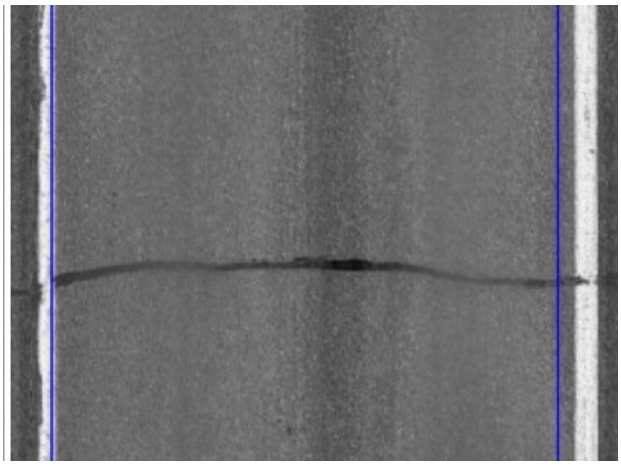
High – Any crack with a mean width > 0.75”; or any crack with a mean width ≤ 0.75” and adjacent moderate to high severity random* cracking.

* Random cracking is considered adjacent when it is within 1’ of the primary crack.

How to Measure

Record the **number** of transverse cracks at each severity level. The maximum number of transverse cracks per 0.10-mile segment is **44.**

TRANSVERSE CRACKING



Sealed severity (downward image)

Low severity

Moderate severity

Moderate severity (due to adjacent low severity cracks)

High severity

High severity

PATCHES

A patch is an area where a portion of the original pavement surface greater than or equal to 1 ft^2 that has been removed and replaced, or where additional material has been applied to the pavement surface to cover distress, fill ruts or address a localized ride issue. **Utility or cross pipe repair patches and pavement repairs associated with intersection or pedestrian improvements should not be rated as patching.**

Identification

Patches are generally intermittent and/or affect only part of the roadway width. Applications of sealant without aggregate are not to be recorded as patches. Repairs with uneven surfaces or edges or feathered edges are indicators of a blade or rut fill patch repair and should be rated as patches regardless of length. Partial lane width repairs should also be rated as patches regardless of length. Continuous full lane width inlays or overlays that appear to have been placed with a paver and exceed approximately 0.50 mile in length, or paving incidental to an improvement project (e.g. bridge surfacing or intersection widening), should be considered as normal pavement and not rated as patches. The type of patch, severity of distresses present in the patch, and the ride quality of the patch determine the severity level.

Severity Levels

Low – A well-constructed patch with good to fair riding qualities. The patch may have distress but it is mostly low severity with very little moderate or high; rutting or deformation < 0.25”; pumping is not evident.

Moderate – The patch is moderately deteriorated or has extensive moderate severity distress; or rutting or deformation from 0.25” to 0.5”; pumping may be evident. Ride quality is fair to poor. **Also includes non-smooth irregular-shaped patches with uneven edges.**

High – The patch is severely deteriorated, or has extensive high severity distress; or rutting or deformation > 0.5”; or the patch has additional different patch material within it. Ride quality is fair to poor. **Pothole patches are rated as high severity, regardless of ride quality.**

How to Measure

Record the **square feet** of affected area at each severity level. The maximum area of patching is **6,336 square feet** per 0.10-mile segment.

Note 1: If a patch has cracking distress, also rate those cracking distresses.

Note 2: Do not rate raveling distress on patches. However, raveling may increase patch severity level of the patch.

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.

PATCHES – LOW SEVERITY

Picture #1 – Smooth partial lane width patches with no distresses in the left wheel path and low severity wheel path cracking in the right (red arrow). Both patches would be rated as low severity. The cracking is also rated in addition to the patching distress.

Picture #2 – A smooth full lane blade patch with no distress.

Picture #3 – Two wheel path rut patches that touch in the middle of the lane.

Picture #4 – A continuous full lane width inlay in the right lane placed with a paving machine. If over half a mile in length, it should be considered as normal pavement and not a patch. If less than half a mile, it is rated as a patch.

Picture #1


Picture #2


Picture #3

Picture #4

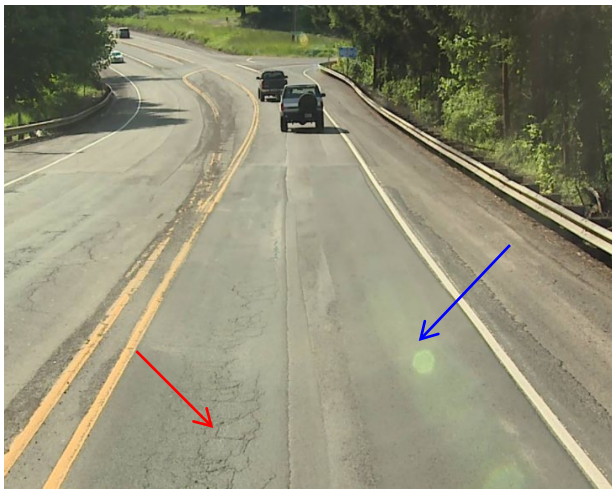
PATCHES – MODERATE SEVERITY

Picture #1 – The left wheel path patch has extensive moderate severity fatigue (red arrow). The right wheel path is a low severity patch (blue arrow).

Picture #2 – A non-smooth irregular-shaped patch with uneven edges.

Picture #3 – A blade patch with extensive moderate severity fatigue (red arrow).

Picture #4 – A patch with 0.25” to 0.5” deformation and fair quality ride.



Picture #1

Picture #2

Picture #3

Picture #4

PATCHES – HIGH SEVERITY

Picture #1 – A partial width patch with high severity fatigue (red arrow). The cracking is also rated in addition to the patching distress.

Picture #2 – A patch with > 0.5” deformation and poor ride quality. (Also multiple generations of patch ages).

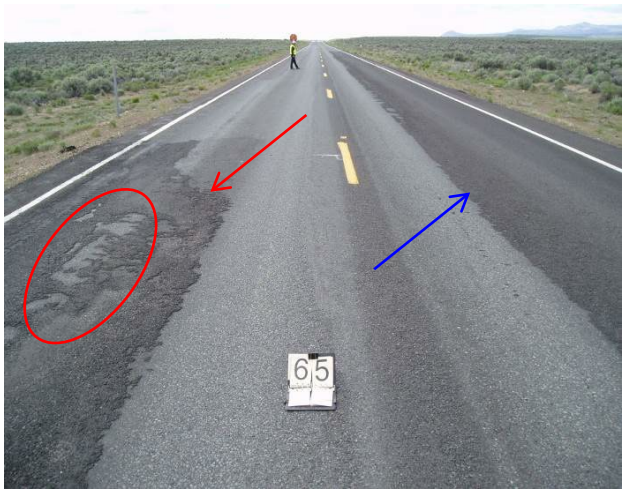
Picture #3 – Filled potholes (red arrows) are considered high severity patches.

Picture #4 – The patch on the left (red arrow) is severely deteriorated (red circle) and has a jagged edge. The patch on the right (blue arrow) is low severity.

Picture #1

Picture #2

Picture #3



Picture #4

NOT PATCHES

Picture #1 – Utility patch (red arrow) associated with manhole cover (blue arrow) is rated as regular pavement.

Picture #2 – Paving due to pedestrian improvement project (red arrow) is not a patch.

Picture #3 – Area of surface grind (red arrow) is not a patch.

Picture #4 – Uniform paving at an intersection improvement (red arrow) is not a patch.

Picture #1

Picture #2

Picture #3

Picture #4

POTHOLES

A pothole is a shallow or deep bowl-shaped hole in the pavement surface resulting from loss of pavement surfacing material, with a minimum plan dimension of 6 inches.

Identification

Potholes are bowl-shaped holes of various sizes in the pavement surface. The minimum plan dimension is **6 inches** to be rated as a pothole.

Severity Levels

Low – Depth < 1” (Typically delamination of thin patch or seal coat creating a shallow pothole.)

Moderate – 1” ≤ Depth ≤ 2” (Remains within top lift of asphalt wearing course.)

High – Depth > 2” (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- mile segment.

A continuous pothole or multiple potholes within a 12 foot long zone shall be counted as one pothole. Longer or more continuous strings of potholes should be counted as separate potholes every 12 feet. For example, a 50-foot continuous string of potholes would be counted as 4 potholes.

POTHOLES

Low severity

Low severity – count as two potholes
(continuous shallow pothole is 25’ long)

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 water and traffic action. The severity of raveling is based on the texture resulting from aggregate loss in the pavement surface as described below. The quantity of raveling is estimated based on the extent of raveling occurring in left wheel path, right wheel path, and center (between wheel paths) lane zones, as defined in AASHTO R 85-18.

Identification

Raveling is identified by a roughened or pitted texture on the pavement surface. Mechanical abrasion from tire chains, studs, snowplows, or dragging equipment which results in significant loss of aggregate should be rated as raveling. Studded tire rutting which does not roughen up the texture significantly should not be rated as raveling. Raveling is most often found in the wheel paths, but can be elsewhere on the pavement surface. Raveling should not be rated on patches. Chip seals are normally rough textured and should not be confused with raveling. Only rate raveling on chip sealed roads if there is complete loss of chip seal and additional loss of aggregate in original wearing course underneath the chip seal.

Severity Levels

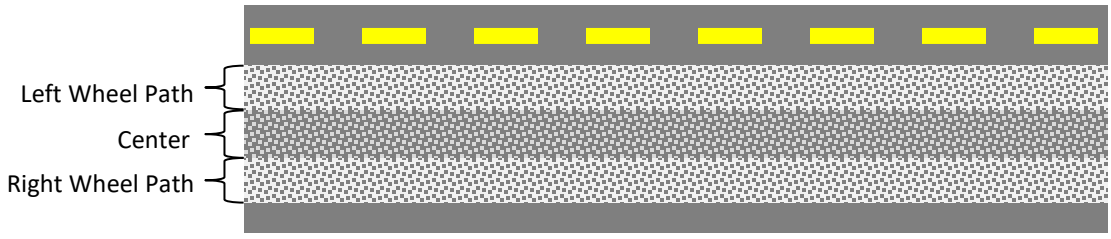
Low – Aggregate has worn away resulting in noticeably rough or pitted pavement surface texture in the left wheel path, right wheel path, or center lane zone. Loss of chip seal rock should not be rated as raveling unless there is also loss of aggregate in the original wearing course underneath the chip seal.

Moderate – Surface texture is moderately rough and/or pitted with moderate loss of pavement surface aggregate in the left wheel path, right wheel path, or center lane zone. Loose aggregate particles may be present outside the traffic area.

High – Surface texture is very rough and/or pitted with severe loss of pavement surface aggregate in the left wheel path, right wheel path, or center lane zone. Flat bottom potholes may be present where there is complete loss of aggregate.

How to Measure

Record the **linear feet** of each severity level for the left wheel path, right wheel path, and center lane zones. The maximum quantity is 528 feet for each zone and **1,584 feet** per 0.10-mile.



RAVELING

No raveling (open-graded surface)

No raveling (open-graded surface)

Low in wheel paths (open graded surface)

Low (close up)

Moderate (both wheel paths, open graded surface)

Moderate (close up)

RAVELING

Moderate (both wheel paths, open graded surface)

Moderate (in left wheel path) and low (in right wheel path)

High (inner wheel path)

High

High (close up)

High (with potholes)

BLEEDING

Bleeding is indicated by excess bituminous material on the pavement surface, which creates a shiny, glass-like reflective surface. Bleeding is not rated by severity level, but is recorded when severe enough to cause a reduction in skid resistance. A segment is considered to have measurable bleeding if it has multiple areas ≥ 25 linear feet of bleeding. Bleeding will simply be recorded as either existing or not existing for each 0.10-mile segment.

Identification

Bleeding is excess bituminous binder on the pavement surface, and may create a shiny, glass-like, reflective surface that may be tacky to the touch. It is usually found in the wheel paths.

Preventative maintenance treatments (slurry seals, chip seals, fog seals, etc.) sometimes exhibit bleeding characteristics. These occurrences should be rated as bleeding when a shiny glass-like reflective surface exists.

Severity Levels

None, bleeding is rated as Yes if multiple (2 or more) locations of **25 feet** or larger are present in a 0.10-mile segment.

How to Measure

Recorded as either existing or not existing (**Yes** or **No**).

BLEEDING

SECTION 3

JOINTED CONCRETE PAVEMENTS (JCP)

The evaluation of jointed concrete pavements will be completed by rating the distress in the pavement according to the descriptions and severity levels as summarized on the following pages. Distresses are measured and reported for segments in the travel direction and lane consistent with IRI measurements.

DISTRESS TYPES

Corner Breaks
Longitudinal Cracking
Transverse Cracking
Shattered Slabs
Patches

Summary of JCP Distress

Corner Breaks – Count **Number of Corner Breaks** (max. total number of slabs in 0.10-mile segment).	
Low	Crack is not spalled for more than 10% 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% 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 (≥ 3” and <6”) to high severity (≥ 6” and <10”) for more than 10% of its total length; or faulting of the crack or joint is ≥ 0.5”; or the corner piece is broken into two or more pieces or contains patch material.
Longitudinal Cracking – Measure **Lengths of Wheel Path and Non-Wheel Path Lane Zones** Affected by Longitudinal Cracks (max. 1,056 ft. for wheel path cracking and 1,584 ft. for non-wheel path cracking). Map cracking and fine hairline cracking not visible in the Right of Way image should not be included in the measurement of longitudinal cracking on PCC pavements.	
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”.
Transverse Cracking – Count **Number of Cracked Slabs** at highest severity present where cracks span at least ½ way across the lane **and Total Number of Slabs in 0.10-mile segment**.	
Low	Crack widths < 0.125”, and no spalling, and no measurable faulting; or well-sealed and with a width that cannot be determined.
Moderate	Crack widths ≥ 0.125” and < 0.25”; or with spalling < 3”; or faulting up to 0.25”.
High	Crack widths ≥ 0.25”; or with spalling ≥ 3”; or faulting ≥ 0.25”.
Shattered Slabs – Count **Number of Shattered Slabs** (max. total number of slabs in 0.10-mile segment).	
Low	Slab is broken into 4 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 4-5 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 6 or more pieces; or the cracks describing the broken sections are spalled ≥ 3” for > 10% of its total length; or faulting is ≥ 0.5”.
Patches – Measure **Patch Area** (max. 6,336 sf.).	
Low	Patch is constructed from durable, non-asphalt concrete materials with straight edges that are joints or saw cuts. Patch may have distress but it is mostly low severity distress with very little moderate or high; no visible faulting or settlement; pumping is not evident.
Moderate	Patch is moderately deteriorated; or has extensive moderate severity distress; or visible faulting or settlement up to 0.25”; pumping is not evident. Also includes small, irregular-shaped patches that may be made from either asphalt concrete or non-asphalt concrete materials; or asphalt concrete leveling patches.
High	Patch is severely deteriorated; or has extensive high severity distress; or faulting or settlement ≥ 0.25”; or the patch has additional different patch material within it; pumping may be evident.

CORNER BREAKS

A corner break is the separation of a corner portion of concrete from the rest of the PCC slab. Corner breaks occur when a crack intersects the adjacent transverse and longitudinal joints, describing approximately a 45-degree angle with the direction of traffic. Corner break severity is based on spalling, faulting, or number of broken pieces, not crack width.

Identification

A corner break is identified by 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% 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% 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 (≥ 3” and < 6”) to high severity (≥ 6” and < 10”) for more than 10% of its total length; or faulting of the crack or joint is ≥ 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 (maximum is the **total number of slabs** per 0.10-mile segment).

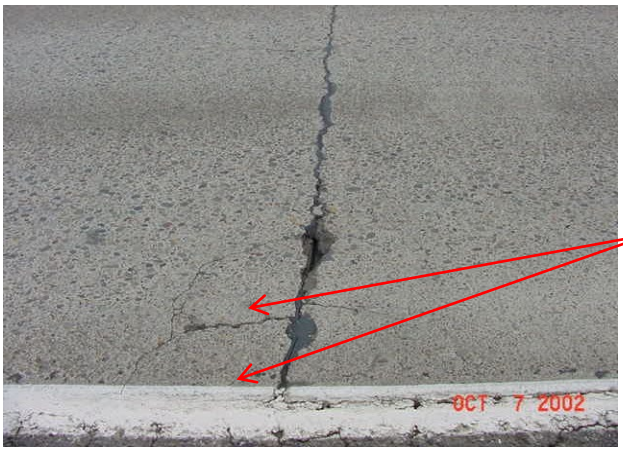
CORNER BREAKS

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 crack is less than 1’ from the transverse joint

LONGITUDINAL CRACKING

Longitudinal cracks are cracks that are predominantly parallel to the pavement centerline. The shape is typically linear and parallel to the lane, although may be diagonal or crescent shaped. Longitudinal cracking may occur laterally anywhere within the rated lane, and is categorized by its location within the lane as **wheel path** or **non-wheel path**. The crack severity is based on width, spalling, and faulting. Map cracking and fine hairline cracking not visible in the Right of Way image should not be included in the measurement of longitudinal cracking on PCC pavements.

Identification

Wheel Path Longitudinal Cracks – Majority of crack length is located laterally within the inner and outer wheel path zones. Apply the same lane zone definitions as for ACP from AASHTO R 85-18. Wheel paths are 39 inches (1 meter) wide and are separated by 30 inches (0.75 meter).

Non-Wheel Path Longitudinal Cracks – Majority of crack length is located out of the wheel paths. Apply the same lane zone definitions as for ACP from AASHTO R 85-18. The cracks may meander into the wheel path but generally stay in the left edge, right edge, and center (between wheel paths) lane zones. Left and right edge zone cracks are between 54 inches (1.375 meters) of the centerline of the lane and the roadway centerline, lane line, or edge line. Center zone cracks are within 15 inches (0.375 meter) of the centerline of the lane.

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

Measure the **longitudinal length of wheel path and non-wheel path lane zones** where longitudinal cracking is present. When there are two or more parallel cracks in the same lane zone only measure longitudinal length of lane zone, not total length of cracks. Record the **linear feet** at each severity level. The maximum quantities are **1,056 feet** for wheel path cracking and **1,584 feet** for non-wheel path cracking, per 0.10-mile segment.

LONGITUDINAL CRACKING – WHEEL PATH

Wheel path – low severity

Up close picture of the crack

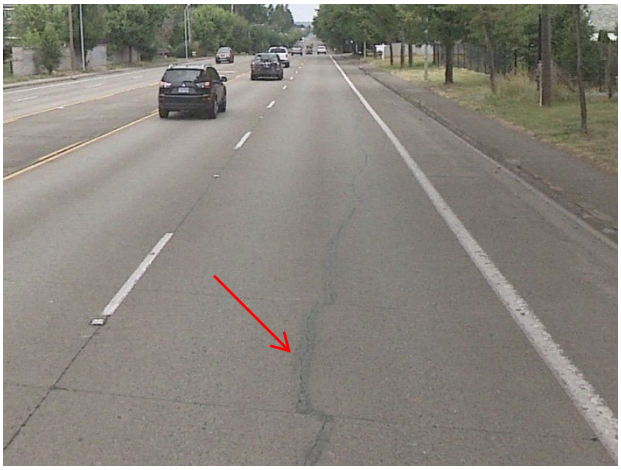
Wheel path – moderate severity

Up close picture of the crack

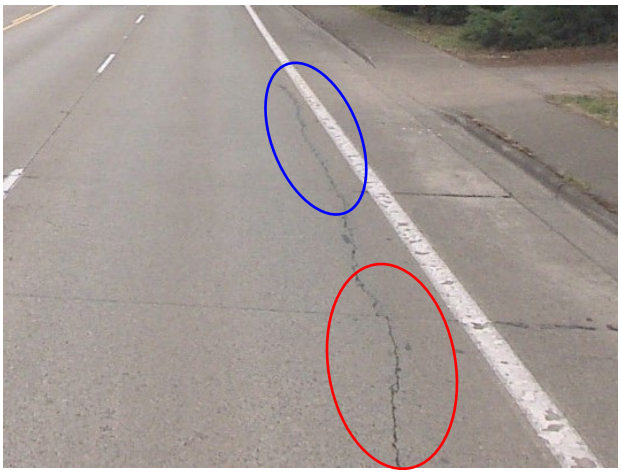
Wheel path – high severity

Up close picture of the crack

LONGITUDINAL CRACKING – NON-WHEEL PATH

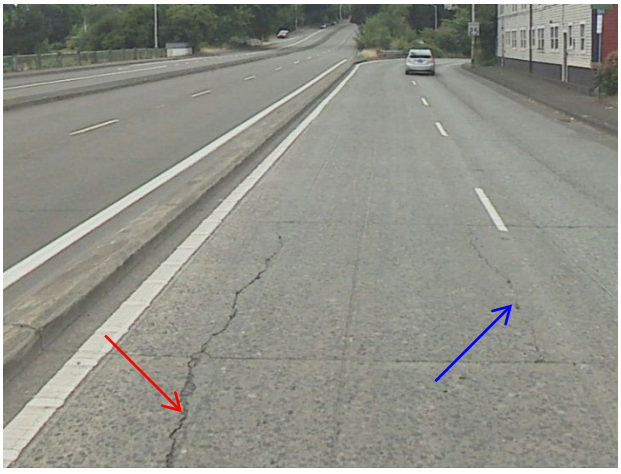


Center – low severity (red arrow)



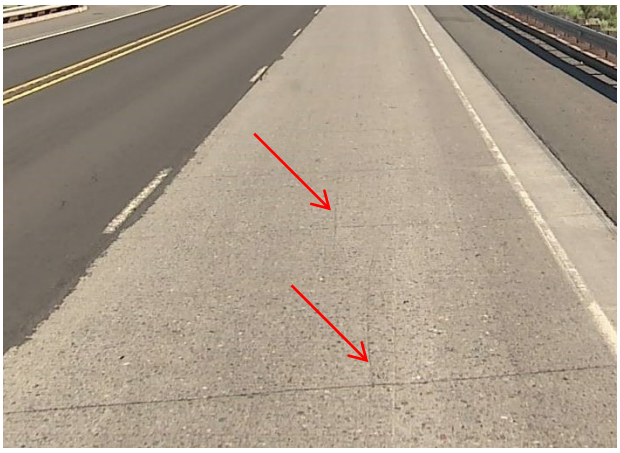
Right wheel path – low severity (red circle) becomes right edge – low severity (blue circle)

Center – moderate severity (red arrow)



Left wheel path – high severity (red arrow); and right edge – moderate severity (blue arrow)

NOT LONGITUDINAL CRACKING



Surface marks (red arrows) are not rated as longitudinal cracks.

Worn surface may have barely visible hairline cracking, which is not rated.

Longitudinal tining is not rated as longitudinal cracking.

Uneven surface grooves are not rated as longitudinal cracking.

Do not rate map cracking (image from LTPP Distress Identification Manual).

TRANSVERSE CRACKING

Transverse cracks are cracks that are predominantly perpendicular to the pavement centerline. These cracks extend all or part way across the travel lane, at least one half of the lane width. 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 cracked slabs that occur in the travel lane being rated. Counting the number of slabs containing one or more transverse cracks per segment is used for HPMS.

Identification

Transverse cracks are predominantly perpendicular to the pavement centerline and extend across at least one half of the lane width (6 feet of a 12-foot wide lane) to be counted. If a slab also has longitudinal cracking and is divided into at least 4 pieces, the slab may also be counted as a shattered slab.

Severity Levels

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

Moderate – Crack widths ≥ 0.125” and < 0.25”; or with spalling < 3”; or faulting up to 0.25”.

High – Crack widths ≥ 0.25”; or with spalling ≥ 3”; or faulting ≥ 0.25”.

How to Measure

Record the **number of cracked slabs** containing at least one transverse crack at each severity and the **total number of slabs** per 0.10-mile segment. Rate the entire slab at the highest severity level of transverse crack present for at least 10% of the total length of the crack. A slab that spans two segments is only counted in the segment containing the majority of the slab length.

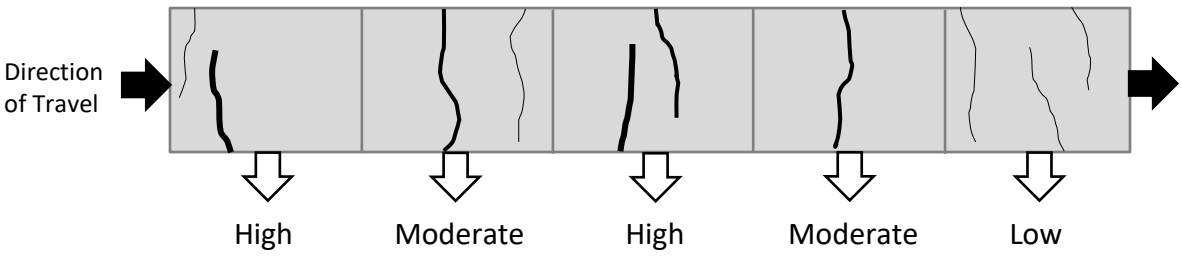
TRANSVERSE CRACKING

Low – transverse crack width < 0.125”, no faulting or spalling

Moderate – transverse crack has spalling

High – transverse crack width is over 1/4”

Example Slab Severity Determination:



SHATTERED SLABS

A shattered slab is a concrete slab that is broken into four or more pieces, as defined in the Concrete Surfaced Airfields PAVER™ Distress Identification Manual (June 2009, USACE ERDC-CERL). Slabs that are divided solely by transverse cracks are 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 0.10-mile segment.

Identification

A shattered slab is a concrete slab that is broken into four or more pieces. Do not include slabs that are divided only by three or more transverse cracks (creating four or more pieces). The cracks dividing the slab must intersect for a shattered slab.

Severity Levels

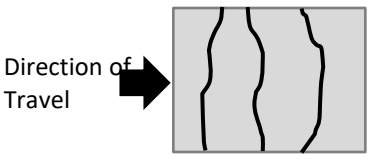
Low – Slab is broken into 4 pieces. The cracks describing the broken sections are not spalled or are spalled for < 10% of the length of the crack; no measurable faulting.

Moderate – Slab is broken into 4-5 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”.

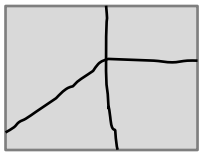
High – Slab is broken into 6 or more pieces; or the cracks describing the broken sections are spalled ≥ 3” for > 10% of its total length; or faulting is ≥ 0.5”.

How to Measure

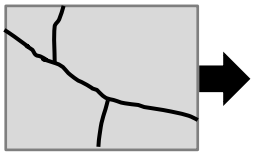
Record the **number** of shattered slabs at each severity level (maximum is the **total number of slabs** per 0.10-mile segment). If a shattered slab contains at least one transverse crack, also count slab for transverse cracking.



Slab is divided into 4 pieces, but is not a shattered slab. Count only as a transverse cracked slab.



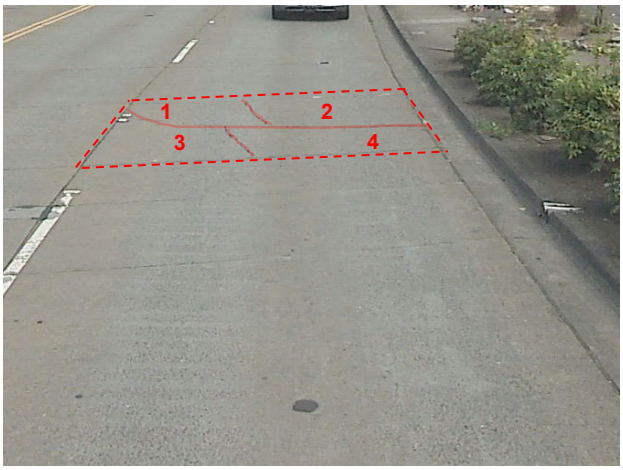
Slab is divided into 4 pieces and has a transverse crack. Count as a low or moderate severity shattered slab and a transverse cracked slab.

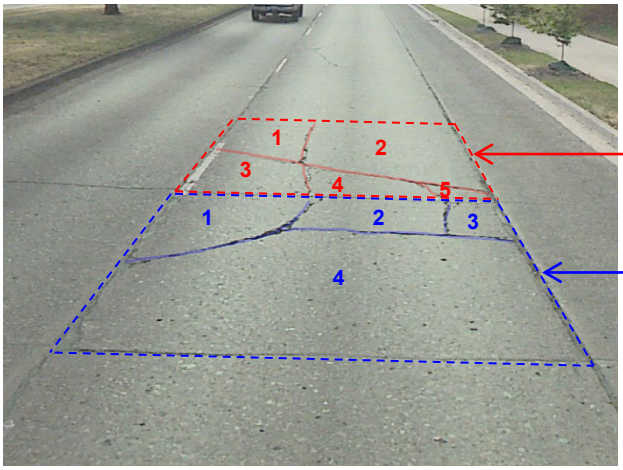


Slab is divided into 4 pieces. Count only as a shattered slab. The transverse cracks do not span half of the lane width, so are not rated.

SHATTERED SLABS

Low – slab is broken into four pieces and no spalling or faulting exists

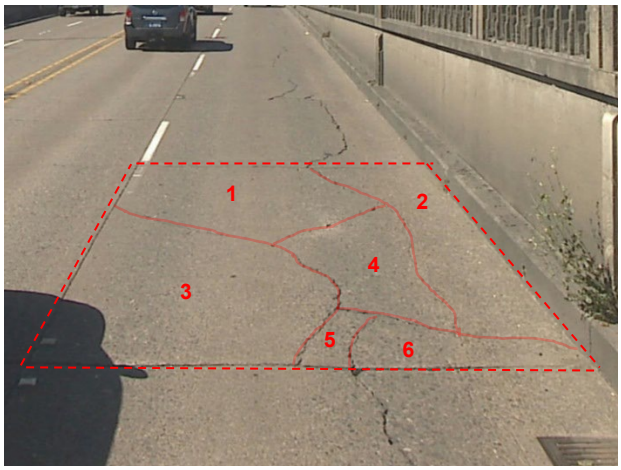




Moderate – slab is broken into five pieces

Moderate – slab is broken into four pieces and are spalled

High – slab is broken into six pieces



PATCHES

A patch is an area where a portion (greater than or equal to 1 ft^2) of or the entire original concrete slab has been removed and replaced, or where additional material has been applied to the pavement surface after original construction to cover distress or address a localized ride issue.

Identification

Patches are generally intermittent and/or affect only part of the roadway width. The patch severity is based on how the patch is constructed, distresses present in the patch, and faulting. The amount of patching is measured by the area of the rated lane that is patched.

Patches may be non-concrete materials. Applications of sealant without aggregate are not to be recorded as patches.

Severity Levels

Low – Patch is constructed from durable, non-asphalt concrete materials with straight edges that are joints or saw cuts. Patch may have distress but it is mostly low severity with very little moderate or high; no visible faulting or settlement; pumping is not evident.

Moderate – Patch is moderately deteriorated; or has extensive moderate severity distress; or visible faulting or settlement up to 0.25”; pumping is not evident. **Also includes small, irregular-shaped patches** that may be made from either asphalt concrete or non-asphalt concrete materials; **or asphalt concrete leveling patches**.

High – Patch is severely deteriorated; or has extensive high severity distress; or faulting or settlement ≥ 0.25”; or the patch has additional different patch material within it; pumping may be evident.

How to Measure

Record the **square feet** at each severity level (**6,336 square feet** maximum).

PATCHES

Low – patch is in good condition

Low – patch has no distress

Moderate – patch displays faulting < 0.25”

Moderate – small irregular-shaped asphalt concrete patches

High – patch has high severity distress

High – patch is severely deteriorated

SECTION 4

CONTINUOUSLY REINFORCED CONCRETE PAVEMENTS (CRCP)

The evaluation of continuously reinforced concrete pavements will be completed by rating the distress in the pavement according to the descriptions and severity levels as summarized below. Distresses are measured and reported for segments in the travel direction and lane consistent with IRI measurements.

DISTRESS TYPES

Longitudinal Cracking
Punchouts
Patches

Summary of CRCP Distress

Longitudinal Cracking – Measure **Lengths of Wheel Path and Non-Wheel Path Lane Zones** Affected by Longitudinal Cracks (max. 1,056 ft. for wheel path cracking and 1,584 ft. for non-wheel path cracking). **Map cracking and fine hairline cracking not visible in the Right of Way image should not be included in the measurement of longitudinal cracking on PCC pavements.**	
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".
Punchouts – Count **Number of Punchouts** (max. 36).	
Low	Longitudinal and at least one transverse crack defining the block is spalling < 3" or faulting < 0.25". Does not include "Y" cracks.
Moderate	Spalling ≥ 3" and < 6" or faulting ≥ 0.25" and < 0.5". Include "Y" cracks that exhibit ≥ 3" spalling, breakup or ≥ 0.25" and < 0.5" faulting in the branch portion of the "Y".
High	Spalling ≥ 6" or concrete within the punchout is punched down by ≥ 0.5" or is loose and moves under traffic, or is broken into two or more pieces, or contains patch material. Includes "Y" cracks that exhibit ≥ 6" spalling, breakup, or ≥ 0.5" faulting in the branches of the "Y".
Patches – Measure **Patch Area** (max. 6,336 sf.). **If a punchout has been patched but the patch does not completely repair the fractured concrete, then also rate as a high severity punchout.**	
Low	Patch is constructed from durable, non-asphalt concrete materials with straight edges that are joints or saw cuts. Patch may have distress but it is mostly low severity distress with very little moderate or high; no visible faulting or settlement; pumping is not evident.
Moderate	Patch is moderately deteriorated; or has extensive moderate severity distress; or visible faulting or settlement up to 0.25"; pumping is not evident. Also includes small, irregular-shaped patches that may be made from either asphalt concrete or non-asphalt concrete materials; or asphalt concrete leveling patches.
High	Patch is severely deteriorated; or has extensive high severity distress; or faulting or settlement ≥ 0.25" or the patch has additional different patch material within it; pumping may be evident.

LONGITUDINAL CRACKING

Longitudinal cracks are cracks that are predominantly parallel to the pavement centerline. The shape is typically linear and parallel to the lane, although may be diagonal or crescent shaped. Longitudinal cracking may occur laterally anywhere within the rated lane, and is categorized by its location within the lane as **wheel path** or **non-wheel path**. The crack severity is based on width, spalling, and faulting. Map cracking and fine hairline cracking not visible in the Right of Way image should not be included in the measurement of longitudinal cracking on PCC pavements.

Identification

Wheel Path Longitudinal Cracks – Majority of crack length is located laterally within the inner and outer wheel path zones. Apply the same lane zone definitions as for ACP from AASHTO R 85-18. Wheel paths are 39 inches (1 meter) wide and are separated by 30 inches (0.75 meter).

Non-Wheel Path Longitudinal Cracks – Majority of crack length is located out of the wheel paths. Apply the same lane zone definitions as for ACP from AASHTO R 85-18. The cracks may meander into the wheel path but generally stay in the left edge, right edge, and center (between wheel paths) lane zones. Left and right edge zone cracks are between 54 inches (1.375 meters) of the centerline of the lane and the roadway centerline, lane line, or edge line. Center zone cracks are within 15 inches (0.375 meter) of the centerline of the lane.

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

Measure the **longitudinal length of wheel path and non-wheel path lane zones** where longitudinal cracking is present. When there are two or more parallel cracks in the same lane zone only measure longitudinal length of lane zone, not total length of cracks. Record the **linear feet** at each severity level. The maximum quantities are **1,056 feet** for wheel path cracking and **1,584 feet** for non-wheel path cracking, per 0.10-mile segment.

LONGITUDINAL CRACKING – WHEEL PATH

Low – left wheel path (sealed crack)


Low – right wheel path

Moderate – left wheel path (due to spalling)


Moderate – right wheel path


High – right wheel path (based on width) and spalling)


High – right wheel path (based on width

LONGITUDINAL CRACKING – NON-WHEEL PATH

Low – center (based on sealant)

Low – right edge (based on width)

Moderate – left edge (based on width)

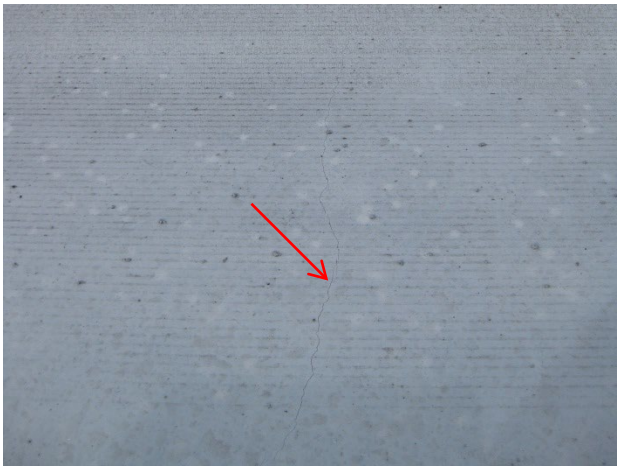
High – left edge (based on width and spalling)

NOT LONGITUDINAL CRACKING

Rough surface may have barely visible longitudinal cracks that should not be rated.

Do not rate map cracking (image from LTPP Distress Identification Manual).

Hairline cracking and scaling should not be rated.



Do not rate thin hairline cracks.

PUNCHOUTS

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 reinforcing steel may rupture 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.

Identification

A punchout is a localized separation of a block of concrete from the rest of the PCC slab. The longitudinal crack defining the block may be any length, but punchouts are only rated when spalling or faulting is evident along the boundary of the block. **The longitudinal crack which outlines the punchout is also recorded under longitudinal cracking.** Adjacent transverse cracks may be more than 2' apart.

Punchouts also include "Y" cracks that exhibit spalling, breakup, and faulting within the branches of the "Y". The branch portion of a "Y" crack must be less than 1/2 of the lane.

Punchouts that have been repaired by completely removing all broken pieces and replacing them with patching material (rigid or flexible) should be rated as a patch, not a punchout. However, if the punchout is still evident beyond the patch boundaries or the patch does not completely repair the fractured concrete, then also rate as a high severity punchout.

Severity Levels

Low – Longitudinal and at least one transverse crack defining the block is spalling < 3" or faulting < 0.25". Does not include "Y" cracks.

Moderate – Spalling ≥ 3" and < 6", or faulting ≥ 0.25" and < 0.5". Include "Y" cracks that exhibit ≥ 3" spalling, breakup, or ≥ 0.25" and < 0.5" faulting in the branch portion of the "Y".

High – Spalling ≥ 6" or concrete within the punchout is punched down by ≥ 0.5" or is loose and moves under traffic, or is broken into two or more pieces, or contains patch material. Includes "Y" cracks that exhibit ≥ 6" spalling, breakup, or ≥ 0.5" faulting in the branches of the "Y".

How to Measure

Record the **number** of punchouts at each severity level (total **36** maximum). The cracks which outline the punchout are also recorded under longitudinal cracking when appropriate.

PUNCHOUTS

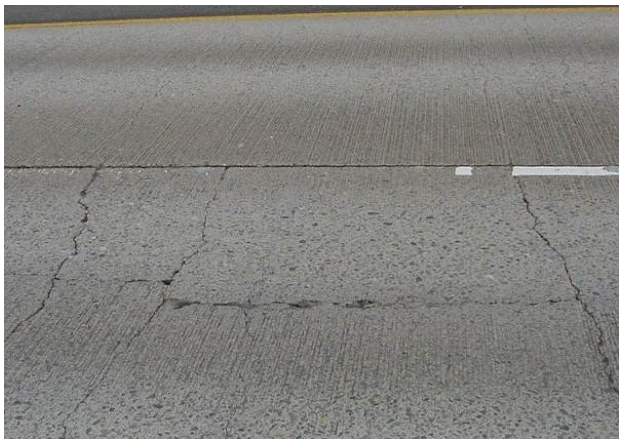
Not a punchout, spalling on L-crack only

Not a "Y"-crack based on the 1/2 lane rule

Do **not** record as a punchout – punchout is completely patched to visible boundaries. Record as patch, not punchout.

"Y"-crack – do **not** record as a punchout since branches are not exhibiting spalling, only the trunk is spalling

Low – spalling on T-crack and L-crack
(if faulted over 0.25", rate as moderate)



Two low punchouts near centerline

PUNCHOUTS

Moderate severity punchout – “Y”-crack with > 10% spalling in the branches


Moderate – spalling between 3” and 6”


High – more than 0.5” faulting


Multiple high severity punchouts covered with high severity patch, this is localized within a single area


High severity punchout covered with high severity patch


High severity punchout covered with high severity patch

PATCHES

A patch is an area where a portion of the original pavement has been removed and replaced, or additional material has been applied to the pavement surface after original construction to cover distress or address a localized ride issue.

Identification

Patches are generally intermittent and/or affect only part of the roadway width. The patch severity is based on how the patch is constructed, distresses present in the patch, and faulting. The amount of patching is measured by the area of the rated lane that is patched.

Patches may be non-concrete materials. Applications of sealant without aggregate are not to be recorded as patches.

If a punchout has been patched to its visible boundaries and is considered repaired, rate as a patch, not a punchout.

Severity Levels

Low – Patch is constructed from durable, non-asphalt concrete materials with straight edges that are joints or saw cuts. Patch may have distress but it is mostly low severity with very little moderate or high; no visible faulting or settlement; pumping is not evident.

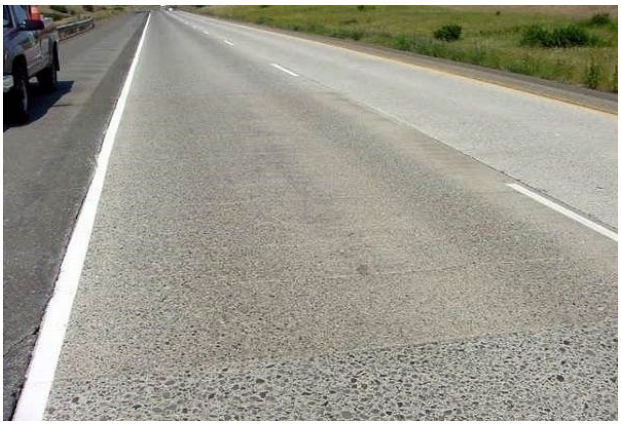
Moderate – Patch is moderately deteriorated; or has extensive moderate severity distress; or visible faulting or settlement up to 0.25”; pumping is not evident. **Also includes small, irregular-shaped patches** that may be made from either asphalt concrete or non-asphalt concrete materials; **or asphalt concrete leveling patches**.

High – Patch is severely deteriorated; or has extensive high severity distress; or faulting or settlement ≥ 0.25” or the patch has additional different patch material within it; pumping may be evident.

How to Measure

Record the **square feet** at each severity level (**6,336 square feet** maximum).

PATCHES



Low severity patch, note tight T-cracks

Moderate – irregular concrete patch completely repairing a punchout; record as patch not punchout

Moderate – patch has longitudinal crack with spalling

Moderate – patch has moderate longitudinal cracks

High – patch has spalled transverse and moderate/high severity longitudinal cracks

High – patch has high severity distress and additional patch material