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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

This document provides added clarifications for several distress types from the April 2018 version, which was a significant revision to the former “ODOT Distress Survey Manual” that incorporated changes needed to comply with new federal requirements for pavement data collection and reporting mandated in 2017. ODOT has collected pavement distress information on the State Highway System since the early 1990’s using manual rating processes. The distress protocol has been updated over time as needed to keep up with developing technologies in semi-automated and automated

\(^1\) HPMS Field Manual (December 2016) and Errata (February 2018)
\(^2\) Distress Identification Manual for the LTPP Program (Fifth Revised Edition, FHWA-HRT-13-092)
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. The earlier version of the manual went through a major update in 2010 as ODOT moved from manual survey methods to more automated data collection methodologies. ODOT regularly assesses the data collection process and makes improvements to its survey methods and procedures, resulting in an updated manual. 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.

**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 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.
  o Joint Condition – Added additional images of joint conditions.

- Continuously Reinforced Concrete Pavement (CRCP) Distresses:
  o 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:
  o Clarified that condition surveys are primarily to be accomplished using Data Collection Vehicles (DCV’s) rather than a manual survey method.
  o 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.
  o Added the requirement that manual raters must be certified by ODOT, as required by the ODOT Pavement Data Quality Management Plan 3.
  o Added and updated language regarding collection direction, lane, lighting and weather conditions, and event marking.
  o Clarified that all pavement adjacent to bridge structures should be rated.

- Added Surface Profile Section:
  o 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.
  o Added protocols for IRI and Faulting in accordance with AASHTO and HPMS requirements.

- Asphalt Concrete Pavement (ACP) Distresses:
  o 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.
  o Longitudinal Cracking – Minor changes; based on LTPP protocol for non-wheel path longitudinal cracks only.
  o Transverse Cracking – Minor changes; based on LTPP protocol; removed requirement for recording transverse crack length.

3 ODOT Data Quality Management Plan for Pavement Condition (October 2018)
Block Cracking – Removed from distress protocol since it is not compatible with automated collection methods and redundant to transverse and longitudinal crack measurements.

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

The condition survey is 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 images are 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.

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 and certified by ODOT, as required by the ODOT Pavement Data Quality Management Plan. Training of personnel should include proper distress identification using control sections. These control sections should include examples of each of the three pavement types. For a given pavement type, the control sections should include typical examples of each type of distress.

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. Distresses will be identified according to the descriptions provided in this manual, measured following the procedures, and recorded for each segment rated. Distress collection should be consistent with IRI inventory direction and lane.

The following is a brief summary of the survey procedure:

1. Begin at the appropriate milepoint marker.
2. Identify the appropriate wearing course type (ACP, JCP, or CRCP).
3. Survey the 0.10-mile (or smaller where designated) segment.
4. Record the information in the database.
5. Return to step one and repeat the process.

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

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 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.

IRI and rut data should be continuously collected across all structures and non-pavement features and recorded for all 0.10-mile segments. Distress should not be rated on bridge deck surfaces, only rate distress on pavement surfaces next to bridges. Distress quantities reported in the 0.10-mile segments should not include any distress on bridges. All 0.10-mile segments should have distress reported unless the entire segment is a bridge. Segments with construction lane detours, roadway closures, safety hazards, or other legitimate reason may be excluded from reporting. If this occurs, the segments will be marked as excluded from the pavement data set with the reason why noted.

When recording the pavement survey data in the data table, note any unusual conditions or non-pavement elements in the event code field as appropriate. The event code should be used to mark beginning and ending points of features that may cause abnormal readings. The events listed below should be marked:

- The beginning and ending points of every bridge, tunnel, 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.

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.
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 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.

An alternative equipment type may be used on non-NHS routes or when a 3-D imaging system is not available; a 5-point laser system conforming to AASHTO R 48-10 (2013). It is widely recognized that this system has accuracy limitations due to differences between rut location and DCV wheels during measurement and this should be considered when interpreting results from this equipment.
RUTTING

Low Rutting

Moderate Rutting

High Rutting
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

<table>
<thead>
<tr>
<th>Fatigue Cracking – Measure Length of Affected Wheel Path (max. 1,056 ft.)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>An area of cracks with no or only a few connecting cracks. Cracks are not spalled or sealed. No pumping is evident. <strong>Includes Wheel Path Longitudinal Cracks.</strong></td>
</tr>
<tr>
<td>Moderate</td>
<td>An area of interconnected cracks forming a complete pattern. Cracks may be slightly spalled or sealed. No pumping is evident.</td>
</tr>
<tr>
<td>High</td>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Longitudinal Cracking – Non-Wheel Path – Measure Length of Affected Non-Wheel Path Lane Zones (max. 1,584 ft.)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>A crack with a mean width of ≤ 0.25&quot;; or a sealed crack with sealant material in good condition and a width that cannot be determined.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Any crack with a mean width &gt; 0.25&quot; and ≤ 0.75&quot;; or any crack with a mean width &lt; 0.75&quot; and adjacent low severity random cracking.</td>
</tr>
<tr>
<td>High</td>
<td>Any crack with a mean width &gt; 0.75&quot;; or any crack with a mean width ≤ 0.75&quot; and adjacent moderate to high severity random cracking.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transverse Cracking – Count Number of Cracks spanning at least ½ way across the lane (max. 44).</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>An unsealed crack with a mean width of ≤ 0.25&quot;; or a sealed crack with sealant material in good condition and the width cannot be determined.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Any crack with a mean width &gt; 0.25&quot; and ≤ 0.75&quot;; or any crack with a mean width &lt; 0.75&quot; in and adjacent low severity random cracking.</td>
</tr>
<tr>
<td>High</td>
<td>Any crack with a mean width &gt; 0.75&quot;; or any crack with a mean width ≤ 0.75&quot; and adjacent moderate to high severity random cracking.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patches – Measure Patch Area (max. 6,336 sf.). <strong>Also measure all cracking inside the Patch.</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>A good quality patch with good riding qualities. The patch has, at most, low severity distress, rutting or deformation &lt; 0.25&quot;; pumping is not evident.</td>
</tr>
<tr>
<td>Moderate</td>
<td>The patch is moderately deteriorated or has moderate severity distress, or rutting or deformation from 0.25&quot; to 0.5&quot;; pumping may be evident. Ride quality is good to fair.</td>
</tr>
<tr>
<td>High</td>
<td>The patch is severely deteriorated, or has high severity distress, or rutting or deformation &gt; 0.5&quot;; or poor ride quality. Includes cold patches and patched potholes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>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.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Depth &lt; 1&quot; (Typically delamination of thin patch or seal coat creating a shallow pothole.)</td>
</tr>
<tr>
<td>Moderate</td>
<td>1&quot; ≤ Depth ≤ 2&quot; (Remains within top lift of wearing course.)</td>
</tr>
<tr>
<td>High</td>
<td>Depth &gt; 2&quot; (Extends beyond top lift of wearing course.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Raveling – Measure Length of Affected Wheel Path and Center Lane Zones (max. 1,584 ft.)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>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 be rated as raveling, but this is the maximum severity for chip sealed surfaces.</td>
</tr>
<tr>
<td>Moderate</td>
<td>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.</td>
</tr>
<tr>
<td>High</td>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bleeding – Record as either <strong>existing or not existing</strong> (Yes or No).</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Y or N</td>
<td>None, bleeding is present if multiple (2 or more) areas exist of 25 ft² or larger.</td>
</tr>
</tbody>
</table>
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

Low – An area of cracks with no or only a few connecting cracks. Cracks are not spalled or sealed. No pumping is evident. Longitudinal cracks (sealed or unsealed) occurring in the wheel paths are rated as low severity fatigue 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.

How to Measure

Measure the length of each wheel path where fatigue cracking is present. Record the linear feet of affected lane zone at each crack severity level. If fatigue cracking occurs in a non-wheel path zone due to traffic wander, only measure the length in a maximum of two lane zones per 0.10-mile segment. Record wheel path, non-wheel path, and total zone lengths separately. If different severity levels exist within an area that cannot easily be distinguished, use the highest severity level. The maximum quantity is 1,056 feet per 0.10-mile.
FATIGUE CRACKING – LOW SEVERITY

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

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

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 as seen in the right wheel path (red circles).
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).
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).
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

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" 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 – low severity

Center – low severity

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

Center – moderate severity

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.**

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” 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.

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

Low severity

Moderate severity

High severity
Patches

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

Identification

Patches are generally intermittent and/or affect only part of the roadway width. Repairs with uneven surfaces or edges or feathered edges are indicators of a blade or screed patch repair and should be rated as patches regardless of length. Partial lane width repairs should also be rated as patches regardless of length. Chip seals, 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 severity of distresses present in the patch and the quality of the patch determine the severity level.

Severity Levels

Low – A good quality patch with good riding qualities. The patch has, at most, low severity distress, rutting or deformation < 0.25"; pumping is not evident.

Moderate – The patch is moderately deteriorated or has moderate severity distress, or rutting or deformation from 0.25" to 0.5"; pumping may be evident. Ride quality is good to fair.

High – The patch is severely deteriorated, or has high severity distress, or rutting or deformation > 0.5"; or poor ride quality. Includes cold patches and patched potholes.

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. Do not rate raveling distress on patches.

Note 2: Do not include utility patches, intersection improvements, or pedestrian improvements. 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.
PATCHES – LOW SEVERITY

Picture #1 – Good quality, smooth, partial 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 good quality smooth blade patch with no distress.

Picture #3 – Two good quality 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.
**PATCHES – MODERATE SEVERITY**

Picture #1 – 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 – A blade patch with moderate severity fatigue (red arrow).

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

Picture #4 – A wheel path patch with fair quality ride (red arrow).
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 cold patch is considered a high severity patch.

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.
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.
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 are only rated as low severity raveling if there is clearly evident aggregate loss present in either wheel path or center lane zones.

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 be rated as raveling, but this is the maximum severity for chip sealed surfaces.

**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)

Low in wheel paths (open graded surface)

Moderate (both wheel paths, open graded surface)

No raveling (open-graded surface)

Low (close up)

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 square 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 noted, but not rated as bleeding.

Severity Levels

None, bleeding is present if multiple (2 or more) areas exist of 25 square feet or larger.

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
Joint Condition
Summary of JCP Distress

<table>
<thead>
<tr>
<th>Corner Breaks – Count Number of Corner Breaks</th>
<th>(max. total number of slabs in 0.10-mile segment).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>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.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Crack is spalled at low severity (&lt; 3&quot;) for more than 10% of its total length; or faulting of crack or joint is &lt; 0.5&quot;; and the corner piece is not broken into two or more pieces.</td>
</tr>
<tr>
<td>High</td>
<td>Crack is spalled at moderate (≥ 3&quot; and &lt;6&quot;) to high severity (≥ 6&quot; and &lt;10&quot;) for more than 10% of its total length; or faulting of the crack or joint is ≥ 0.5&quot;; or the corner piece is broken into two or more pieces or contains patch material.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Longitudinal Cracking – Measure Lengths of Wheel Path and Non-Wheel Path Lane Zones Affected by Longitudinal Cracks</th>
<th>(max. 1,056 ft. for wheel path cracking and 1,584 ft. for non-wheel path cracking).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Crack widths &lt; 0.125&quot;, no spalling, and no measurable faulting; or well-sealed and with a width that cannot be determined.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Crack widths ≥ 0.125&quot; and &lt; 0.5&quot;; or with spalling &lt; 3&quot;; or faulting up to 0.5&quot;.</td>
</tr>
<tr>
<td>High</td>
<td>Crack widths ≥ 0.5&quot;; or with spalling ≥ 3&quot;; or faulting ≥ 0.5&quot;.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transverse Cracking – Count Number of Cracked Slabs</th>
<th>at highest severity present where cracks span at least ½ way across the lane and Total Number of Slabs in 0.10 mile segment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Crack widths &lt; 0.125&quot;, and no spalling, and no measurable faulting; or well-sealed and with a width that cannot be determined.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Crack widths ≥ 0.125&quot; and &lt; 0.25&quot;; or with spalling &lt; 3&quot;; or faulting up to 0.25&quot;.</td>
</tr>
<tr>
<td>High</td>
<td>Crack widths ≥ 0.25&quot;; or with spalling ≥ 3&quot;; or faulting ≥ 0.25&quot;.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shattered Slabs – Count Number of Shattered Slabs</th>
<th>(max. total number of slabs in 0.10-mile segment).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Slab is broken into 4 pieces. The cracks describing the broken sections are not spalled or are spalled for &lt; 10% of the length of the crack; no measurable faulting.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Slab is broken into 4-5 pieces; or the cracks describing the broken sections are spalled at low severity (&lt; 3&quot;) for &gt; 10% of its total length; or faulting is &lt; 0.5&quot;.</td>
</tr>
<tr>
<td>High</td>
<td>Slab is broken into 6 or more pieces; or the cracks describing the broken sections are spalled ≥ 3&quot; for &gt; 10% of its total length; or faulting is ≥ 0.5&quot;.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patchess – Measure Patch Area</th>
<th>(max. 6,336 sf.).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Patch has at most low severity distress of any type; no visible faulting or settlement; pumping is not evident. Patch is constructed from durable, non-asphalt concrete materials with straight edges that are joints or saw cuts.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Patch is moderately deteriorated; or has moderate severity distress of any type; or faulting or settlement to 0.25&quot;; 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.</td>
</tr>
<tr>
<td>High</td>
<td>Patch is severely deteriorated; or has a high severity distress of any type; or faulting or settlement ≥ 0.25&quot;; or the patch has additional material within it; pumping may be evident.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Joint Condition – Record predominant condition</th>
<th>of the joints in each 0.10 mile segment. The condition of the transverse, lane, and shoulder joints of each panel are rated separately.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Joint is in good condition and seal is in good condition.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Joint is slightly spalled with seal in good condition or joint is in good condition with seal in poor condition.</td>
</tr>
<tr>
<td>High</td>
<td>Joint is badly spalled or joint is slightly spalled with seal in poor condition.</td>
</tr>
</tbody>
</table>
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. *Fine hairline map cracking 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 affected by longitudinal cracking. 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 tiling 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:

Direction of Travel

High Moderate High Moderate Low
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.

Direction of Travel

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 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 distresses present in the patch, faulting, and how the patch is constructed. 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 has at most low severity distress of any type; no visible faulting or settlement; pumping is not evident. Patch is constructed from durable, non-asphalt concrete materials with straight edges that are joints or saw cuts.

Moderate – Patch is moderately deteriorated; or has moderate severity distress of any type; or faulting or settlement 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 a high severity distress of any type; or faulting or settlement ≥ 0.25"; or the patch has additional material within it; pumping may be evident.

How to Measure

Record the square feet at each severity level (6,336 square feet maximum).
Pavement Data Collection Manual
Revised April 2019

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
JOINT CONDITION

Jointed concrete pavements have transverse joints, left edge longitudinal joints, and right edge longitudinal joints. The severity of the joint condition is based on both the joint itself and the joint seal.

Severity Level

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.

How to Measure

Rating is based on a combination of the joint and joint seal condition. The condition of the transverse, lane, and shoulder joints of each panel will be rated separately, and the predominant condition of the joints will be recorded for each 0.10-mile segment.
JOINT CONDITION

Low – joint is not spalled and seal is in good condition

Moderate – seal is missing

High – joint is badly spalled

Low – joints are in good condition

Moderate – seal is missing

High – seals are in poor condition
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
  Joint Condition
# Summary of CRCP Distress

## Longitudinal Cracking – Measure Lengths of Wheel Path and Non-Wheel Path Lane Zones

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Crack widths &lt; 0.125&quot;, no spalling, and no measurable faulting; or well-sealed and with a width that cannot be determined.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Crack widths ≥ 0.125&quot; and &lt; 0.5&quot;; or with spalling &lt; 3&quot;; or faulting up to 0.5&quot;.</td>
</tr>
<tr>
<td>High</td>
<td>Crack widths ≥ 0.5&quot;; or with spalling ≥ 3&quot;; or faulting ≥ 0.5&quot;.</td>
</tr>
</tbody>
</table>

## Punchouts – Count Number of Punchouts (max. 36).

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Longitudinal and at least one transverse crack defining the block is spalling &lt; 3” or faulting &lt; 0.25”. Does not include “Y” cracks.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Spalling ≥ 3” and &lt; 6” or faulting ≥ 0.25” and &lt; 0.5”. Include “Y” cracks that exhibit ≥ 3” spalling, breakup or ≥ 0.25” and &lt; 0.5” faulting in the branch portion of the “Y”.</td>
</tr>
<tr>
<td>High</td>
<td>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”.</td>
</tr>
</tbody>
</table>

## 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.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Patch has at most low severity distress of any type; no visible faulting or settlement; pumping is not evident. Patch is constructed from durable, non-asphalt concrete materials with straight edges that are joints or saw cuts.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Patch is moderately deteriorated; or has moderate severity distress of any type; or 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.</td>
</tr>
<tr>
<td>High</td>
<td>Patch is severely deteriorated; or has a high severity distress of any type; or faulting or settlement ≥ 0.25” or the patch has additional material within it; pumping may be evident.</td>
</tr>
</tbody>
</table>

## Joint Condition – Record predominant condition of the joints in each 0.10 mile segment. The conditions of the lane and shoulder joints are rated separately.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Joint is in good condition and seal is in good condition.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Slab is broken into 4-5 pieces; or the cracks describing the broken sections are spalled at low severity (&lt; 3&quot;) for &gt; 10% of its total length; or faulting is &lt; 0.5&quot;.</td>
</tr>
<tr>
<td>High</td>
<td>Joint is badly spalled or joint is slightly spalled with seal in poor condition.</td>
</tr>
</tbody>
</table>
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. Fine hairline map cracking 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 affected by longitudinal cracking. 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)  High – right wheel path (based on width and spalling)
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 map 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

“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 small area

High severity punchout covered with high severity patch
High severity punchout covered with high severity patch
Pavement Data Collection Manual
Revised April 2019

PAVEMENT SERVICES UNIT

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 distresses present in the patch, faulting, and how the patch is constructed. 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 has at most low severity distress of any type; no visible faulting or settlement; pumping is not evident. Patch is constructed from durable, non-asphalt concrete materials with straight edges that are joints or saw cuts.

Moderate – Patch is moderately deteriorated; or has moderate severity distress of any type; or 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 a high severity distress of any type; or faulting or settlement ≥ 0.25” or the patch has additional 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; do not record as a 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
JOINT CONDITION

Continuously reinforced concrete pavements have left edge and right edge longitudinal joints. The severity of the joint condition is based on both the joint itself and the joint seal.

Severity Levels

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.

How to Measure

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 predominant condition of the joints in each 0.10-mile segment.
**JOINT CONDITION**

- Low – shoulder joint is in good condition
- Low – lane joint is in good condition
- Moderate – seal is missing
- Moderate – joint is slightly spalled
- High – joint is badly spalled
- High – joint is in poor condition