Louisiana DOTD's Analysis of the Proposed Cracking Percent Metrics & Related Items

5/6/2015

General Summary

Louisiana DOTD recognizes the extensive effort of the Federal team to review all of the potential options, to identify the most appropriate methodology for going forward, and the need to compromise the desired goal with the current practical reality.

Louisiana DOTD believes that in addition to determining the condition of the nation's pavement and bridge assets, a primary intent of MAP-21 is to advance and expand the concepts of full asset management for the nation's transportation infrastructure. Louisiana DOTD supports the intent of MAP-21 with respect to these concepts. Many states who were already moving in this asset management direction at varying speeds, will speed up their efforts, while for a few states, this may be a new important and expensive paradigm change.

This document is the result of several contributors. Any issues with this analysis, findings, or proposals will be the result of the limit of the researcher's ability to understand and convey the intended message of the contributors.

Louisiana DOTD has attempted to review all referenced documents relating to Cracking Percent found in the NPRM rule, ***2014-30085 federal register.pdf***. Louisiana DOTD believes that the "currently proposed" reporting requirements for this metric, and extenuating circumstances related to Cracking Percent, will significantly limit the intended valuable insight into the condition of the nation's pavements and believes that, as currently proposed, the Cracking Percent metric and the proposed reporting requirement for this metric, would compromise any potential asset management intent. Cracking Percent, as currently proposed, appears to take a big step backwards and could defeat the new paradigm by forcing the use of much older concepts and practice on future efforts. It appears to encourage a status quo approach.

Louisiana DOTD feels that rather than making significant compromises with respect to data requirements which greatly water down this metric, it would seem that delaying the implementation timeline, or giving a longer phase in period, and requiring states to begin to capture data using Automated Vehicles, would serve the best interest of the nation's infrastructure and the long term goals of transportation asset management. At the very least, more detailed definitions need to be realized to go forward with this metric.

Missing Method or Procedure to Calculate Cracking Percent

The following is found on NPRM Page 39 and the **NCHRP 401** study incorrectly suggests that Cracking Percent is a standard data capture item in 94 percent of the states.

DOTs use. A survey conducted as part of the 2009 National Cooperative Highway Research Program (NCHRP) Synthesis 401 study[38] revealed that 98 percent of State DOTs collect distress data (e.g., faulting, cracking) and 95 percent collect roughness data to monitor network level pavement conditions. Similarly, an assessment of pavement management practices conducted by FHWA indicated that, for the NHS, all State DOTs monitor roughness and rutting, 94 percent monitor Cracking_Percent, 95 percent monitor faulting (with concrete surfaced pavements), and 31 percent monitor structural capacity.

What the NCHRP 401 study fails to recognize is that this is only *"theoretically"* true with respect to "Cracking Percent". Since the **HPMS Field Manual** mandates the submittal of Cracking Percent, most states actually do report Cracking Percent; however; what the NCHRP study appears to completely miss is that Cracking Percent is not a standard calculation with a set formula or methodology.

We also find on page 5-4 copied below, in the **July 2012, FHWA-HIF-12-049 "Improving FHWA's Ability to Assess Highway Infrastructure Health Pilot Study Report"** the following is indicated with respect to Cracking. As the footnote identifies, for these 3 states "the methods used by each State to develop HPMS cracking data sets vary."

Cracking

Cracking data were reviewed for consistency. The State DOT pavement management data were not collected using the same protocol as HPMS data. South Dakota DOT uses a modified version of the Long Term Pavement Performance Distress Identification Manual that results in a composite surface index, Minnesota DOT uses an internal cracking protocol that results in a surface rating, and Wisconsin DOT is transitioning to the ASTM standard that results in a PCI value. Because of the differences in State DOT pavement management distress data collection techniques, this review was limited to the HPMS[10] and field data. The field data were aggregated to the HPMS reporting interval for comparison.

[10] It should be noted that the methods used by each State to develop HPMS cracking data sets vary.

Louisiana DOTD can find no documented method or procedure to calculate Cracking Percent in the NPRM or any other defined reference including the only other place it is actually mentioned, the **2014 HPMS Field Manual**.

Since every state is basically allowed to make up its own method for converting these mostly linear (feet) measures (longitudinal and transverse cracks) into a percentage measure, the results do not provide a valid "apples to apples" comparison. In fact, since many states have different definitions and methods for identifying cracking types, extents, severities, wheel path sizes, etc. the value and reliability of this measure would appear to be completely compromised.

The NPRM confirms, on page 125, the need for consistent definitions, but it does not provide those definitions. If roughness is not consistently collected, as noted below, how can the data needed for Cracking Percent, with all the variables just identified, be calculated consistently? Clearly it is not.

> The need for consistent definitions was reinforced by a national study on pavement roughness[62] and a regional study on highway infrastructure health.[63] These studies found that both measured roughness and distress data are not consistently collected and reported by State DOTs across the country. The FHWA is addressing this need by proposing definitions for cracking, faulting, IRI, punchout, and rutting.[64]

On page 5-9, in **FHWA-HIF-12-049,** the following is indicated in an analysis of the HPMS data submittals, with respect to "Percent Cracking." There is very low correlation found between submitted HPMS Item 52 Cracking Percent data and actual field data. The same goes for HPMS Item 53 "Cracking Length", which by the way is being eliminated as of the very recent **"Summary of Field Manual Edits, February 2015 FHWA / Office of Highway Policy Information", "**Changes to the HPMS Field Manual for 2015".

Improving FHWA's Ability to Assess Highway Infrastructure Health

Table 5.2 Correlation Between HPMS and Field Cracking Data

Data Set	Correlation between 2009 HPMS and Field	Correlation between 2010 HPMS and Field
Asphalt surface, percent cracking	.45	.46
Asphalt surface, crack length	.08	.00
PCC Surface, percent cracking	.57	.59

On page 5-21 in **FHWA-HIF-12-049,** we find that for "cracking percentage, cracking length and faulting, additional work is required to standardize data collection and processing at the national level." The next section begins that discussion.

5.3 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions were developed based upon the data and condition assessment findings presented in Sections 5.1 and 5.2:

- The level of confidence associated with the various pavement condition measures evaluated within the context of good/fair/poor is summarized in Table 5.7 as well as below:
  - There is a high-level of confidence with IRI given the acceptable correlation found in the study between the HPMS, State DOT PMS and field data sources.
  - A medium-level of confidence exists for the rut depth data and additional investigation is required to resolve the bias issue between the HPMS or State DOT PMS data and the field data.
  - For the remaining condition measures (cracking percentage, cracking length and faulting), additional work is required to standardize data collection and processing at the national level.

Table 5.7 Confidence Levels for Pavement Condition Measures Evaluated

Condition Indicator	Confidence in Data
IRI	High
Cracking %	Low/Med
Cracking Length	Low
Rutting	Medium
Faulting	Low

Critical Need for Standard Definitions

As much of this document will detail, the proposed rules and every reference document associated with these proposed rules, often contradict each other with respect to concepts, definitions, classifications, rounding issues, measures and reporting. This is especially true with respect to "Cracking Percent." The resulting burden of trying to get a grasp of this complex rule making proposal has been very challenging and exceptionally time consuming.

In an effort to somehow standardize these items, we find that AASHTO has issued, or is about to issue, the following request for proposal that will provide a much needed focus on the subject. When finished and published, **NCHRP 01-57 [RFP] - Standard Definitions for Comparable Pavement Cracking Data**, should recommend the comprehensive and definitive definitions that are currently missing and appear to be seriously compromising this rule making effort.

NCHRP 01-57 BACKGROUND

Many state and local agencies collect downward pavement imagery using highway-speed data collection vehicles. The images are subsequently processed using proprietary semi- or fully-automated crack detection and classification software to identify pavement cracking for use in asset management systems. There are multiple methods and software for defining, classifying, and reporting cracking data. In addition, these methods and the cracking data they produce are not always comparable between states, even if similar data collection and detection technologies are used. One outcome of this situation is that vendors must customize the cracking definitions for each client they serve. In order to unify data reporting, sharing, and evaluation, standardization of pavement cracking definitions is needed. Research is needed to define cracking measurement terms for uniformity and potential standardization, building upon work done in AASHTO PP 67 and 68. Additionally, research is needed to produce user and system requirements to aid in the future development of production-grade evaluation software for classifying cracking type, extent, and severity. The standard definitions will aid in sharing information among agencies and vendors as well as reporting to FHWA and setting national, state, and local performance goals.

NCHRP 01-57 OBJECTIVE
The objective of this research is to develop standard, discrete definitions for common cracking types in flexible, rigid, and composite pavements. The **definitions shall classify cracking type, extent, and severity based on information from images collected by highway-speed data collection vehicles, including orientation, length, density, displacement, location, and other relevant factors.** The standard definitions shall be used to facilitate comparable measurement and interpretation of pavement cracking in the highway community. The definitions shall be of sufficient detail to serve as the basis for user and system requirements for cracking evaluation software for automated data collection. Application to both existing and emerging image-based data collection technologies shall be considered.

As a result of an extensive review, and in an effort to provide the Cracking Percent metric with a more relevant data opportunity, Louisiana has attempted to start the conversion of moving Cracking Percent towards being a more defined and comprehensive metric that could support the asset management needs of states and actually provide the valuable insight into the condition of the nation's pavements that it is intended to do.

The general proposals are summarized in the next section with the remainder of the document providing details that explain and support these proposals. These proposals provide options to include the "other visible defects" in the proposals.

These proposals are strongly biased towards agencies that have automated data collection capabilities at their disposals. Consideration for other states must be factored into any implementation time line.

Summary of Louisiana DOTD Proposals for Cracking Percent

Louisiana DOTD Proposes that, since the US Government has decided not to convert to metric standards, the NPRM rules, the appropriate AASHTO Standards, the HPMS guide, etc. be revised to all English units of measure to make them consistent with each other and to eliminate the numerous Metric to English conversion rounding issues. The English units should be the primary units with the metric equivalent listed as well.

Louisiana DOTD Proposes that corrections be made to the NPRM, HPMS Guide, AASHTO Guidelines for a number of definitions, terms, proposed averages, proposed thresholds, etc. to sync these documents up and eliminate the numerous conflicts.

Louisiana DOTD Proposes that the FHWA evaluate all proposed metrics or any new proposed metrics with respect to data capture vehicle calibration capabilities and validate that standards can be developed, and are reproducible, to allow for calibrating automated data capture vehicles for the proposed metrics.

Louisiana DOTD proposes that until the final results of **NCHRP 01-57** are published and vetted, that the following proposals, or some similar vetted proposals, be "temporarily" adopted as standards for states to report on the NPRM rules and metrics. These proposals should be completely reviewed by an expert panel, and revised as necessary, before being temporarily adopted for the rulemaking, and certainly again after the findings of **NCHRP 01-57** are completed.

Temporary Proposals While Waiting on NCHRP 01-57

Louisiana DOTD Proposes that "Composite Pavements" be added to the mix and used to differentiate these pavements from Flexible or Asphalt Pavement. Cracking distress types between these two pavement types are fundamentally different as are the respective deterioration models.

Louisiana DOTD proposes that the definition of a Longitudinal Crack be any visible crack that projects **on or within 45 degrees of parallel** to the longitudinal centerline.

Louisiana DOTD proposes that the definition of a Transverse Crack is any visible crack that projects **within 45 degrees of perpendicular** to the longitudinal centerline. Cracks that originate and end in a wheel path, on Asphalt Pavements only, will not be considered Transverse Cracks (see Fatigue (Alligator) Cracking). Cracks that extend uniformly across the pavement into the wheel path will be Transverse Cracks and not counted as Fatigue (Alligator) Cracks.

Louisiana DOTD Proposes that the FHWA adopt the Austroads term **"Straight-Line Crack"** for transverse joints, longitudinal joints, skewed joints, and saw cut joints (which would include concrete patches). This allows for a correct identification and differentiation between transverse cracks and designed joints. Please see Louisiana DOTD's faulting comments.

Louisiana DOTD Proposes that Fatigue (Alligator) Cracking would consist of any longitudinal and transverse cracks located within the wheel path of Flexible or Asphalt Pavements only, not on Composite Pavements or Rigid Pavements. It would "Not" include Transverse Cracks that extend uniformly across the pavement into the wheel path.

Louisiana DOTD Proposes that the definition of **Pattern Cracking** be defined as Longitudinal Cracks and Transverse Cracks which intersect to generally form polygons.

Louisiana DOTD Proposes that all patches on Asphalt Pavement, Composite Pavement, and Rigid pavements be treated as part of the primary pavement surface and rated with the identified distress measures for that pavement type. **Patches** made with a different material than the surrounding pavement surface will automatically result in a High Severity distress rating. For **Patches** of different materials, the area would be the longest dimension of the patch in the longitudinal direction multiplied by the longest dimension of the patch in the transverse direction.

Louisiana DOTD Proposes that Cracking Extent be used to convert the linear Longitudinal and Transverse Cracks into area measures to allow for Cracking Percent determinations. Cracking Extent would include severity levels of distresses in their calculations. Cracking Extent area would be determined by multiplying a crack length by an extent width, based on distress severity.

Louisiana DOTD Proposes that the **distresses used to identify Flexible or Asphalt Pavements** comprise of Longitudinal Cracking, Transverse Cracking and potholes for non-wheel paths and Fatigue (Alligator) Cracking for wheel paths. Cracks that have been sealed shall not be rated.

Louisiana DOTD Proposes that a wheel path shall be defined as either 3 feet or 36 inches wide to eliminate any metric conversion error. The wheel path centerline for each 3 foot wheel path would be located 2 ½ feet (average vehicle wheel track is 5 feet) from the centerline of the travel lane. The wheel paths, and the area between the wheel paths, would account for 8 feet (3 feet, 2 feet, 3 feet) of the lane width, allowing the remainder of the lane width to be equally divided on either side of the wheel paths. Wheel paths will only be used for Fatigue (Alligator) Cracking determinations at this time.

Louisiana DOTD Proposes that the Fatigue (Alligator) Cracking Severity Levels found in the LTPP Manual, be used until the final NCHRP 01-57 report.

Louisiana DOTD Proposes that **Potholes,** and **Patches** of different materials than the existing pavement, would automatically be rated in the high severity level.

Louisiana DOTD Proposes that Cracking Extent for Fatigue (Alligator) Cracking, or "Asphalt Only" wheel path cracking, be calculated as follows for wheel paths defined as 3 feet wide.

- Low Severity cracking would multiply the length of the cracking by (1) one foot.
- Medium Severity cracking would multiply the cracking length by (2) two feet.
- High Severity cracking would multiply the cracking length by (3) three feet.

The sum of these areas would provide an area (square feet) of cracking extent for the pavement wheel path segments. Dividing that sum, by the area of the wheel path segments (segment length (usually 528 feet) times 3 feet times 2 wheel paths) would determine the Cracking Percent.

Louisiana DOTD Proposes that the **distresses used to identify Composite Pavements** comprise of Longitudinal Cracking, Transverse Cracking, and **Potholes**.

Louisiana DOTD Proposes that Composite Pavements and non-wheel path Flexible or Asphalt Pavements Severity Levels could be defined as follows.

- Cracks that have been sealed shall not be rated.
- Low Severity Level includes longitudinal or transverse cracks <0.25 inches wide with no interconnected longitudinal cracks and no interconnected transverse cracks. Polygons, or Pattern Cracks, formed by crossing longitudinal and transverse cracks, must be greater than 3 feet by 3 feet square.
- Medium Severity Level includes longitudinal or transverse cracks >0.25 inches but <0.5 inches wide with no interconnected longitudinal cracks and no interconnected transverse cracks of the same width. Polygons, or Pattern Cracks, formed by crossing longitudinal and transverse cracks, must be greater than 3 feet by 3 feet square.
- High Severity Level includes longitudinal or transverse cracks >0.5 inches, any polygons, or pattern cracks, formed by crossing longitudinal and transverse cracks, that are less than 3 feet by 3 feet square, all **Potholes** and all **Patches** of different materials than the original surface.

Louisiana DOTD Proposes that Cracking Extent for Composite Pavements and non-wheel path Flexible or Asphalt Pavements include severity levels that could be determined as follows.

- For low severity multiply the length (feet) of the cracks by 0.5 feet (6 inches).
- For medium severity, multiply the length (feet) of the cracks by 0.83 feet (10 inches).
- For high severity, multiply the length (feet) of the cracks >0.5 inches, not included in pattern cracks, by 1.17 feet (14 inches), add the area of the pattern cracks, add the area of the **Potholes** and add the area of **Patches** of different materials.

The sum of these areas would provide an area (square feet) of cracking extent for the pavement segment. Then divided that sum by the area of the pavement segment (segment length (usually 528 feet) times the lane width, or the remaining non-wheel path lane width) to determine Cracking Percent. For Flexible or Asphalt Pavements, report Cracking Percent to be the higher of the two values calculated for either the wheel path or the non-wheel path areas.

Louisiana DOTD Proposes that the **distresses used to identify Jointed Concrete Pavements** comprise of Longitudinal Cracking, Transverse Cracking, **Blowups** and **Patches** of different materials.

Louisiana DOTD Proposes that Jointed Concrete Pavement Severity Levels could be defined as follows.

- Cracks that have been sealed shall not be rated.
- Low Severity Level includes longitudinal or transverse cracks <0.25 inches wide with no spalling
- Medium Severity Level includes longitudinal or transverse cracks >0.25 inches wide with no spalling
- High Severity Level includes longitudinal or transverse cracks with spalling. A crack is considered to be spalled if 10% or more of its length is spalled to a width of 1 inch or greater. It includes **Blowups** and **Patches** of different materials.

Louisiana DOTD Proposes that Cracking Extent for Jointed Concrete Pavements include severity levels that could be determined as follows.

- For low severity multiply the length (feet) of the cracks by 0.5 feet (6 inches).
- For medium severity, multiply the length (feet) of the cracks by 0.83 feet (10 inches).
- For high severity, multiply the length (feet) of the cracks >0.5 inches by 1.17 feet (14 inches) and add the area of Patches of different materials.
- JCP segments with **blowups** would automatically result in a 100% Cracking Percent for that segment.

The sum of these areas would provide an area (square feet) of cracking extent for the pavement segment. Then divided that sum by the area of the pavement segment (segment length (**usually 20 feet)** times the lane width) to determine Cracking Percent. Please note the JCP segment length in not the normal 0.1 mile segment. It appears that this compromise is needed to support earlier constraints forced on the developers of Mechanist-Empirical Design. The follow up question is, do we want to migrate this measure into the 0.1 mile segment length to provide more comparable metrics between pavement types?

Louisiana DOTD Proposes that the **distresses used to identify Continuously Reinforced Concrete Pavements** comprise of Longitudinal Cracking, Transverse Cracks with spalling, **Punchouts** and **Patches** of different materials.

Louisiana DOTD Proposes that Continuously Reinforced Pavement Severity Levels could be defined as follows.

- Cracks that have been sealed shall not be rated.
- Low Severity Level includes longitudinal cracks <0.25 inches wide with no spalling
- Medium Severity Level includes longitudinal cracks >0.25 inches wide with no spalling
- High Severity Level includes longitudinal cracks with spalling, any transverse crack with spalling. It includes all **Punchouts** and all **Patches** of different materials. A crack is considered to be spalled if 10% or more of its length is spalled to a width of 1 inch or greater.

Louisiana DOTD Proposes that Cracking Extent for Continuously Reinforced Pavements include severity levels that could be determined as follows.

- For low severity multiply the length (feet) of the longitudinal cracks by 0.5 feet (6 inches).
- For medium severity, multiply the length (feet) of the longitudinal cracks by 0.83 feet (10 inches).
- For high severity, multiply the length (feet) of the longitudinal and transverse cracks with spalling by 1.17 feet (14 inches) and add the area of the **Punchout**, and add the area of **Patches** of different materials.

The sum of these areas would provide an area (square feet) of cracking extent for the pavement segment. Then divided that sum by the area of the pavement segment (segment length (usually 528 feet) times the lane width) to determine Cracking Percent.

Louisiana DOTD proposes that the proposed ranges for this metric, Cracking Percent, be reviewed in consideration of the Louisiana DOTD temporary proposals, with respect to including severity levels in cracking extent and using cracking extent to determine Cracking Percent. If the temporary proposals are incorporated as is, or in some modified or adjusted fashion, it would be important to determine, via actual data analysis, if the metric ranges provide reasonable or punitive outcomes in the interim until **NCHRP 01-57** can be completed.

Louisiana DOTD Proposes that if Louisiana DOTD's temporary proposals are not adopted, then **LTPP Manual's** distress type identifiers be used for data reporting and that the **HPMS Field Manual** be modified to capture Cracking Percent data, cracking extent, cracking severity and the distress type identifiers.

Louisiana DOTD's Issue with Cracking Percent & Related Items

What is the purpose of the "National Performance Management Measures" with respect to data? One would hope that the data is being captured to gain valuable insight into the condition of the nation's pavements and to provide reasonable data for asset management systems. Cracking percent, as currently proposed, is extremely limiting and does not appear to support either of those concepts.

Data Intelligence

Let's first begin by defining a fundamental understanding of what data really represents by examining the thoughts outlined below.

Data – Analysis – Understanding – Information – Knowledge – Wisdom

When we collect **Data**, and begin to **Analyze** it, we start to gain an **Understanding** of the meaning of the data. As we gain more **Understanding**, we hope to reach a point where the data provides valid **Information** towards the endeavor we are pursuing. As we advance the valid part of the **Information** we uncover, with time that valid **Information** begins to foster a usable **Knowledge** that will aid us in our endeavor. At some further point along this path, it is the hope that this **Knowledge** advances to the point of identifying a certain **Wisdom** that can be used to accurately make long term, informed decisions.

Based on this suggested concept of what data could represent, it is Louisiana DOTD's contention that the proposed "Cracking percent" metric forces a basic rudimentary view of the data, it does not actually provide what it is intended to provide and therefore completely compromises any potential real value the data should provide.

How can the proposed Cracking Percent metric be considered to reasonably identify the condition state of various pavements when the measure does not capture the various differences between load-base cracking and non-load based cracking? The NPRM makes no mention of load based and non-load based cracking.

Unlike other pavements, load based cracking, Fatigue (Alligator) Cracking, on Flexible or Asphalt Pavements is the critical failure mechanism for those pavements. It is the structural failure mechanism for Flexible pavements and once it shows up, if left unaddressed, will result in an extremely rapid failure of the pavement. In most states, it is singled out in analysis and has a very high, or immediate, trigger point with regards to preservation treatments. Louisiana DOTD feels strongly that the NPRM should not take the approach of ignoring Fatigue Cracking as a separate entity by lumping it in with all other cracking, it should be singled out and addressed separately.

As we see below from page "v" in the **"Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures"** we find the absolute need to separately identify cracking "related to load cracking… and cracking that is non load related".

> Another important issue related to the LTPP distress identification procedure used is to modify the existing procedure to better identify longitudinal cracking. It is necessary to identify types of longitudinal (and even alligator cracking) that occur within the wheel paths. At present, there is
>
> v
>
> no known way for researchers, using the database, to distinguish cracking that is solely related to load cracking (it would be assumed that all cracking in any wheel path is load associated) and cracking that is non load related, such as longitudinal cracking reflected from existing construction joints or lane widening. The manner in which distresses are recorded should be reexamined, with the intention that the ultimate goal of the distress database is to use the distress measurements in some form of structural (or even non-structural) models for calibration-validation purposes.

In **AASHTO R55-10**, we find a similar focused intent to "quantify and differentiate between load-associated (fatigue) and non-load-associated (environmental, reflective, etc.) pavement cracking and joints"

4.2. *Cracking Types*—Cracks may include longitudinal cracks, transverse cracks, and interconnected cracks. The intent of this practice is to quantify and differentiate between load-associated (fatigue) and non-load-associated (environmental, reflective, etc.) pavement cracking and joints.

4.2.1. For this practice, increased cracking intensity in the wheel path as compared with the non–wheel path areas is assumed to quantify load-associated cracking.

4.2.2. Non-load-associated cracking is quantified by the cracking measured in the non–wheel path areas.

4.2.3. Sealed cracks will not be quantified by manual surveys. Automated data collection equipment will not quantify any discontinuity greater than 25-mm (1-in.) width.

4.3. *Cracking Estimates by Type*:

4.3.1. *Rating Wheel Path Cracks*—Wheel path cracking is determined in both the inside and outside wheel path as shown in Figure 1.

4.3.2. *Rating between Wheel Path Cracks*—Non–wheel path cracking is determined in the area between the wheel paths as shown in Figure 1.

In the **LTPP Manual** on page we find another reference to the significance of loading with the "wheel path verses non-wheel path" note shown here.

4

LONGITUDINAL CRACKING

Description

Cracks predominantly parallel to pavement centerline. Location within the lane (wheel path versus non-wheel path) is significant.

It appears that compromises were made, and are continuing to be made, to force the data to use an old reporting mechanism, HPMS Item 52 Cracking Percent, or perhaps to fit some old systems still in use by some states, which is what it appears Mechanistic Empirical Design was also force to do. If this is true, it is difficult to consider this to be a reasonable approach since it inaccurately conflates the data into one restrictive measure which completely eliminates the breadth and scope of the data and consequently destroys any technical value the data had in defining the real condition of the nation's pavements.

It is our understanding that MAP-21 seeks to expand the breadth and scope of asset management for transportation assets. Due to cost, available funding and other resource constraints, states will naturally gravitate toward capturing only required data and it is unreasonable to expect otherwise from financially constrained states. The cracking percent metric and proposed reporting requirement for this metric, appear to severely compromise the intent of MAP-21 and may result in limited or reduced data capture by states. As proposed, Cracking Percent encourages states to remain with the status quo and appears to hamper any intent to evolve the asset management.

Another point of contention is that the NPRM completely ignores cracking severity levels? In fact, as currently proposed, a jointed concrete slab is 100% cracked if it has a single 12 inch long hairline transverse shrinkage crack located anywhere on the slab. How can this small crack be equivalent to a slab that could be almost rubbilized?

In the next two sections, we will review the **NCHRP 01-57** proposed concepts of "severity" and "extent."

Review of Severity

Severity Levels are often used to identify the various condition states of pavements. In most cases, severity levels are divided into 3 levels, "Low", "Medium or Moderate" and "High" with various differentiating characteristics defining those levels. We note that Severity Levels often require additional costly measurements like crack width, spalling amount, or some descriptive wording, i.e. "an area of cracks with no or only few connecting cracks." The following excerpt is taken from page 4 of the **LTPP Manual** and identifies severity levels for Fatigue "Alligator" Cracking.

Severity Levels

LOW

An area of cracks with no or only a few connecting cracks; cracks are not spalled or sealed; pumping is not evident.

MODERATE

An area of interconnected cracks forming a complete pattern; cracks may be slightly spalled; cracks may be sealed; pumping is not 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.

Is the value of "Cracking Percent" severely limited without including some method to establish cracking severity, especially when you note the difference between high severity cracking (many wide cracks with spalling) verses low severity cracking (some hairline cracks)? This seems to be a pretty important question that needs to be answered.

The **LTPP Manual** identifies various "Severity Levels" for various crack types on different pavements. In the LTPP Manual example below, we find the following for Longitudinal Cracks on Asphalt Concrete Surfaces. Again we note that the metric values don't smoothly transition to normal English values. Since the US Government has decided not to convert to metric standards, it would seem to be so much simpler to use the English equivalents of ¼ inch and ¾ inch for these measures. It is noted here that HPMS requires English values in the data submittals.

4

LONGITUDINAL CRACKING

Description

Cracks predominantly parallel to pavement centerline. Location within the lane (wheel path versus non-wheel path) is significant.

Severity levels

LOW
A crack with a mean width ≤ 6 mm; or a sealed crack with sealant material in good condition and with a width that cannot be determined.

MODERATE
Any crack with a mean width > 6 mm and ≤ 19 mm; or any crack with a mean width ≤ 19 mm and adjacent low severity random cracking.

HIGH
Any crack with a mean width > 19 mm; or any crack with a mean width ≤ 19 mm and adjacent moderate to high severity random cracking.

Interestingly, our research finds a similar unconcerned approach towards severity in Austroads agencies. On page 26 of **AP-T290-15**, as noted in the last sentence show in the outtake below, that representatives from the Austroad agencies recently decided to reject, and discontinue, the "Cracking Severity" concept since most agencies don't use these measures in their deterioration models. Perhaps "Cracking Severity" is over-rated.

7.1 Collection and Reporting Methods

Methods for the collection of cracking data are separated into two categories, as follows:

- Manual inspections – identification of cracking by manually examining digital images collected from network surveys, or physically surveying the road network at various locations.
- Automated inspections – vehicle-mounted cameras capture images of the road surface, and crack recognition software processes the images either in real-time while the vehicle progresses, or by electronic post-processing after completion of the survey.

Both types of methods measure cracking as a summary of cracks within a sample segment. Sample segment lengths vary based on the method used. Surface cracking is usually summarised in terms of dominant crack type, severity and extent for each sample segment. However, not all collection and reporting methods will use all three classifications for cracking. The definitions of each cracking parameter as defined in the *Guide to Asset Management* (Austroads 2006) are as follows:

- Crack type – the dominant crack type within the sample segment, e.g. longitudinal, crocodile, transverse, etc.
- Cracking severity – average crack width in millimetres within the sample segment, usually described by severity categories or 'bins'.
- Cracking extent – the area affected by cracking as a percentage of the sample segment area (length of segment multiplied by the surveyed lane width).

The working group reached the view that cracking severity should not be reported.

As an aside, we now bring up the concept of deterioration models. What deterioration models are the Austroad's managers referring to? Network Level efforts that use a few functional class level models to predict overall future budget needs or Project Level efforts that can use historical condition data from a specific pavement to identify the deterioration model for specific treatments on that specific pavement. Project level efforts require historical data (3 data points), are currently costly and time consuming, but are the most accurate approach for project level life cycle cost decisions. Initially states will use a functional class level deterioration models on specific pavements to identify what specific treatments will accomplish. Often, even after states have the required 3 historical data points, they will continue to use the functional models on individual pavements for speed, cost and convenience.

It should also be noted that capturing and quantifying "Severity Levels" is more expensive than capturing "Extent" measures. Severity clearly provides a significantly more accurate measure of the current pavement conditions especially when comparing high severity cracking (many wide cracks with spalling) verses low severity cracking (some hairline cracks).

It would be interesting to determine if capturing and quantifying severity levels, relative to just using extent measures, actually leads to improved deterioration models. Intuitively it would seem that more detailed data for the models would result in better models, but a research project could be conducted to see if the extra expense needed to capture and quantify this data provides an equivalent benefit.

One option that some states are using to include severity in deterioration modeling is to generate various indexes (i.e. rutting index, faulting index, etc.) and then apply varying amounts of "deducts" for low, medium and high severity values for any particular index.

Review of Cracking Extent

One potential improvement option for "Cracking Percent" would be to provide a defined method and formula to allow for the linear longitudinal and transverse cracking data to be consistently collected and reported in a manner that would produce an "area" calculation that supports the "Cracking Percent" determination. Cracking Extent could be the answer.

If we look at Austroad's 2015 document **AP-T290-15**, **"A Common Data Output Specification for Texture, Cracking, Strength and Skid Resistance"** efforts to determine standard specifications for linear cracking measures, we find one again that their different agencies use different ways to determine linear cracking measures as well. Only one of the Austroads agencies, on page 33, determines that "cracked area is taken as 0.3 m (11.81 inches) multiplied by the length of the crack," while other agencies greatly vary in their methodology. We find on page 35 of **AP-T290-15**, a general standard is proposed to define "Crack Extent" to encompass "250mm (9.84 inches) on either side of the crack." So the proposal is for the length of the longitudinal or transverse crack to be multiplied by 500mm (19.685 inches) to determine the area of the cracks influence or it's "Cracking Extent".

While Austroad's proposed cracking extent measures seems a bit arbitrary and overstated (19.685 inches per crack), perhaps taking an approach similar to this would provide a standardized and reasonable approach to the conversion of a linear crack length (feet), into an area measure (square feet) by multiply the crack length by a crack extent. This method could then provide an area of cracking extent (square feet) per the area of the pavement segment (528 feet (0.1 miles) times the lane width) for Rigid Pavements.

For Flexible or Asphalt Pavements only, the wheel path area would focus on Fatigue Cracking, an area measure, and the non-wheel path areas would take a similar "Austroads" approach as defined above for rigid pavements (528 feet times the remaining lane width without the wheel path width).

When longitudinal and transverse cracks combine to form an area of polygons, or patterned cracking, an area measure is more easily defined and a slightly different approach would be appropriate which we will note in the next section.

Unfortunately, Austroads does not appear to consider the concept of fatigue cracking, or load based cracking verses non-load based cracking with respect to "Cracking Extent". This appears to be problematic for the proposed "Cracking Percent" metric as well since these differences significantly affect asset management requirements with respect to pavement deterioration and pavement performance. It would seem inappropriate to ignore this reality as we note this to be a basic need in comments identified earlier from the **"Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures"**.

Unfortunately, while the "Cracking Extent" methodology could provide a reasonable method of converting a linear measure into an area measure, the existing methodology for determining "Cracking Extent" still does not address one of the key issues with determining a valid Cracking Percent measure and that is "Cracking Severity."

Enhance Cracking Extent for Cracking Percent Determination

One potential solution is to define a method and formula for Cracking Extent that includes Severity Levels. This would provide significant value and enhance the accuracy and validity of Cracking Percent.

As an example, if we define the "severity" of longitudinal cracking on continuously reinforced concrete pavements as follows:

- Low Severity would be cracks <0.25 inches with no spalling.
- Medium Severity would include cracks >0.25 inches with no spalling.
- High Severity would be any longitudinal or transverse crack with spalling.

In this case a crack is considered to be spalled if 10% or more of its length is spalled to a width of 1 inch or greater.

Now if we convert the CRC Pavement longitudinal crack to an area that includes severity, for low severity cracking extent we could multiply the length of the crack by 0.5 feet (6 inches), for medium severity we could multiply by 0.83 feet (10 inches) and for high severity we could multiply by 1.17 feet (14 inches). The sum of these areas would provide an area of cracking (square feet) when divided by the area of the pavement segment (528 feet (0.1 miles) times the lane width) would provide the measure to be used for Cracking Percent.

When these linear measures combine to form an area of polygons, or patterned cracking, a similar but slightly different approach would be needed. As an example, when low severity longitudinal and transverse cracks from polygons greater than 1 foot by 1 foot square, we could still multiply both the longitudinal and transverse length cracks by 0.5 feet (6 inches) since the crack extent area would be less than the area of the polygons. For higher severity cracking, with larger polygons, the procedure would again be used, until the area of the polygons exceeded the calculate crack extent area. When the polygons are less than (1) one square foot, simply determine the area of the polygons and use that area.

For Flexible or Asphalt Pavements, the linear measures outside the wheel path area would take a similar approach as rigid pavements, but the overall pavement segment area calculation would remove the area of the wheel paths. If we set the wheel paths at 3 feet each, then for a 12 foot lane, the remaining 6 feet would have 2 feet between the wheel paths and 2 feet each outside the wheel paths. So now the non-wheel path segment area would be calculated by multiplying the segment length, generally 528 feet, times 6 feet.

For load based Fatigue (Alligator) Cracking, or "Asphalt Only" wheel path cracking, if the wheel path is defined as 3 feet, for low severity cracking we could multiply the length of the crack by (1) one foot, for medium severity cracking we could multiply the cracking length by (2) two feet, and for high severity cracking we could multiply the cracking length by (3) three feet.

Louisiana DOTD Proposes that a wheel path shall be defined as either 3 feet or 36 inches wide to eliminate any metric conversion error. The wheel path centerline for each 3 foot wheel path would be located 2 ½ feet (average vehicle wheel track is 5 feet) from the centerline of the travel lane. The wheel paths, and the area between the wheel paths, would account for 8 feet (3 feet, 2 feet, 3 feet) of the lane width, allowing the remainder of the lane width to be equally divided on either side of the wheel paths. Wheel paths will only be used for Fatigue (Alligator) Cracking determinations at this time.

Louisiana DOTD Proposes that Cracking Percent be captured in 5 zones per **AASHTO PP 67-14** for Flexible or Asphalt Pavements only. Fatigue (Alligator) Cracking only occurs in wheel paths and the zones defined here provide the opportunity to classify the cracks outside the wheel paths correctly.

7. DATA ANALYSIS— CRACK CLASSIFICATION AND VALUATION

7.1. The summary section distance for cracking data is 0.03 km (100 ft).

7.2. Detected pattern cracks and longitudinal cracks (not transverse) are separated into five measurement zones across the pavement.

7.2.1. Zone 1 is between the inside wheelpath and the lane edge at the adjacent lane.

7.2.2. Zone 2 is the inside wheelpath.

TS-5a PP 67-3 AASHTO

7.2.3. Zone 3 is the space between the wheelpaths.

7.2.4. Zone 4 is the outside wheelpath.

7.2.5. Zone 5 is between the outside wheelpath and the outside lane edge.

Review of Proposed Metric Ranges

The proposed rule, ***2014-30085 federal register.pdf***, sets the Cracking Percent metrics as summarized in Table 5 on pages 146.

Table 5: Proposed Pavement Condition Rating Thresholds

Surface Type	Metric	Metric Range	Rating
		least 1.000.000	
Asphalt Pavement and Jointed Concrete Pavement	Cracking_Percent	< 5%	Good
		5-10%	Fair
		> 10%	Poor
Asphalt Pavement	Rutting	< 0.20	Good
		0.20 – 0.40	Fair
		> 0.40	Poor
Jointed Concrete Pavement	Faulting	< 0.05	Good
		0.05 – 0.15	Fair
		> 0.15	Poor
CRCP	Cracking_Percent	< 5%	Good
		5-10%	Fair
		> 10%	Poor

Louisiana DOTD proposes that the metric ranges for Cracking Percent be reviewed in consideration of the Louisiana DOTD temporary proposals with respect to including severity levels in cracking extent and using cracking extent to determine Cracking Percent. If the temporary proposals are incorporated as is, or in some modified or adjusted fashion, it would be important to determine, via actual data analysis, if the metric ranges provide reasonable or severely punitive outcomes in the interim until **NCHRP 01-57** can be completed.

Inconsistent Cracking Definition Issues – Longitudinal, Transverse, & Joints

Louisiana DOTD does not concur with the **LTPP Manual**, and the **HPMS Field Manual** which mirrors the LTPP Manual, and the **AASHTO standards** with respect to the definition of Longitudinal and Transverse cracks. Louisiana DOTD also does not concur with the lack of definition for Fatigue (Alligator) Cracking on Flexible or Asphalt pavements, or the lack of definition for straight line joints and saw cuts.

Longitudinal Cracks

Louisiana DOTD proposes that the definition of a Longitudinal Crack be any visible crack that projects ***on, or within*, 45 degrees of parallel** to the longitudinal centerline.

Louisiana DOTD does not concur with the **LTPP Manual's** identification of Longitudinal Cracks. In Figure 54, show below, taken from page 38 in the LTPP Manual and we find the following diagram with the formula of "E >> Width/2" for Longitudinal cracks. The diagram does not provide a clear picture or explanation of what the "Width" actually is. Is it the "Width of Spall" at the top of the diagram or is it the width of the pavement, or is it the measure from the pavement edge to the crack endpoint at the joint? Why then would you include the "Width/2" in the measure? Would it be more appropriate to use "F" for the measure and then divide by 2 in the formula? What does ">>" actually mean?

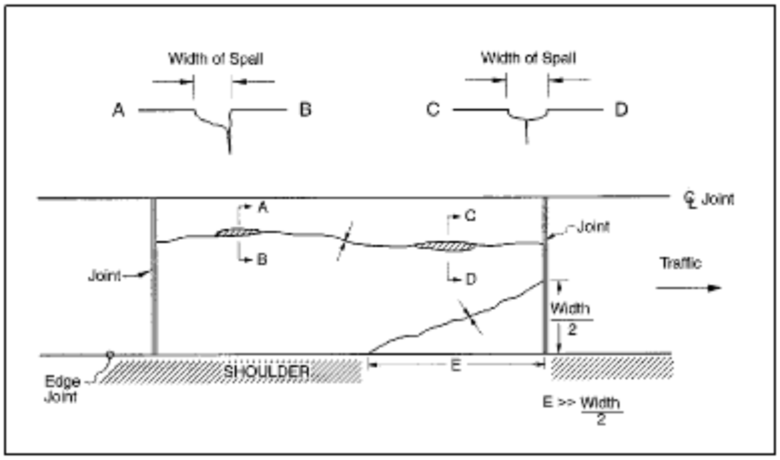


FIGURE 54
Distress Type JCP 3—Longitudinal Cracking

On page 8 in the **LTPP Manual** we find the following longitudinal description.

4

LONGITUDINAL CRACKING

Description

Cracks predominantly parallel to pavement centerline. Location within the lane (wheel path versus non-wheel path) is significant.

Louisiana DOTD also does not concur with the definition of longitudinal cracks provided on page PP67-2 in **AASHTO PP 67-14 "Standard Practice for Quantifying Cracks in Asphalt Pavement Surfaces from Collected Images Utilizing Automated Methods"**. If we examine that definition copied below, we have to ask, what are the cracks that are greater than 10 degrees going to be called?

> "3.9. *longitudinal crack*—a crack **at least 0.3 m (12 in.) long** and with a crack **orientation between +10 and –10 degrees of the lane centerline**."

Transverse Cracks

Louisiana DOTD proposes that the definition of a Transverse Crack is any visible crack that projects ***within*** **45 degrees of perpendicular** to the longitudinal centerline. Cracks that originate and end in a wheel path on Flexible or Asphalt Pavements will not be considered Transverse Cracks (see Fatigue (Alligator) Cracking). Cracks that extend uniformly across the pavement into the wheel path will be Transverse Cracks and not counted as Fatigue (Alligator) Cracks on Flexible or Asphalt Pavements.

For transverse cracks, Louisiana DOTD does not concur with the definition of transverse cracks found in Figure 58 on page 40 in the **LTPP Manual** which defines "transverse" cracks with the formula "E > Width/2 > F". We point out that the only definition of "Width" in the figure is the "Width of Spall" and width is found nowhere else in the image, so how do we interpret that measure? If we know what the width is for this formula, what does the formula really tell us? If "E" is greater than "F", it is a Transverse crack?

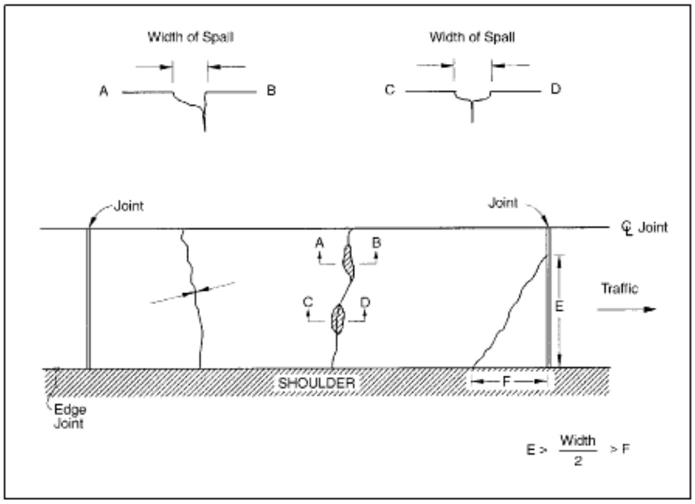


FIGURE 58
Distress Type JCP 4—Transverse Cracking

Then on page 64 of the **LTPP Manual** we see another potential qualification defining a transverse crack for Continuously Reinforced Concrete pavements.

TRANSVERSE CRACKING

Description

Cracks that are predominantly perpendicular to the pavement centerline. This cracking is expected in a properly functioning CRCP. All transverse cracks that intersect an imaginary longitudinal line at midlane, and propagate from the pavement edges, shall be counted as individual cracks, as illustrated below. Cracks that do not cross midlane are not counted.

Louisiana DOTD also does not concur with the definition of transverse cracks provided on page PP67-2 in **AASHTO PP 67-14 "Standard Practice for Quantifying Cracks in Asphalt Pavement Surfaces from Collected Images Utilizing Automated Methods"**.

> "3.16. *transverse crack*—a crack **at least 0.3 m (12 in.) long** and with a crack **orientation between 80 and 100 degrees to the centerline**."

Combined with the earlier "longitudinal" definition, the question that needs to be asked is what would the cracks found between 10 degrees for a longitudinal crack and the 80 degrees for a transverse crack be called?

Fatigue (Alligator) Cracks

As stated earlier, Louisiana DOTD feels strongly that the NPRM should NOT take the approach of ignoring structural or load based Fatigue Cracking on Flexible or Asphalt Pavements and has identified a potential method to include it in "Cracking Percent."

Louisiana DOTD Proposes that Fatigue (Alligator) Cracking would consist of any longitudinal and transverse cracks located within the wheel path of Flexible or Asphalt Pavements only, not on Composite Pavements or Rigid Pavements. It would "Not" include Transverse Cracks that extend uniformly across the pavement into the wheel path.

On page 85 of the **LTPP Manual**, the glossary identifies Fatigue Cracking as follows.

> **FATIGUE CRACKING**
> a series of small, jagged, interconnecting cracks caused by failure of the AC surface under repeated traffic loading (also called alligator cracking)

On page 4 of the **LTPP Manual**, Fatigue Cracking is identified to apply to Asphalt Pavements within wheel paths only and provides an image of the severity levels as a guide.

> 1
>
> **FATIGUE CRACKING**
>
> **Description**
>
> Occurs in areas subjected to repeated traffic loadings (wheel paths). Can be a series of interconnected cracks in early stages of development. Develops into many-sided, sharp-angled pieces, usually less than 0.3 meters (m) on the longest side, characteristically with a chicken wire/alligator pattern, in later stages.
>
> Must have a quantifiable area.

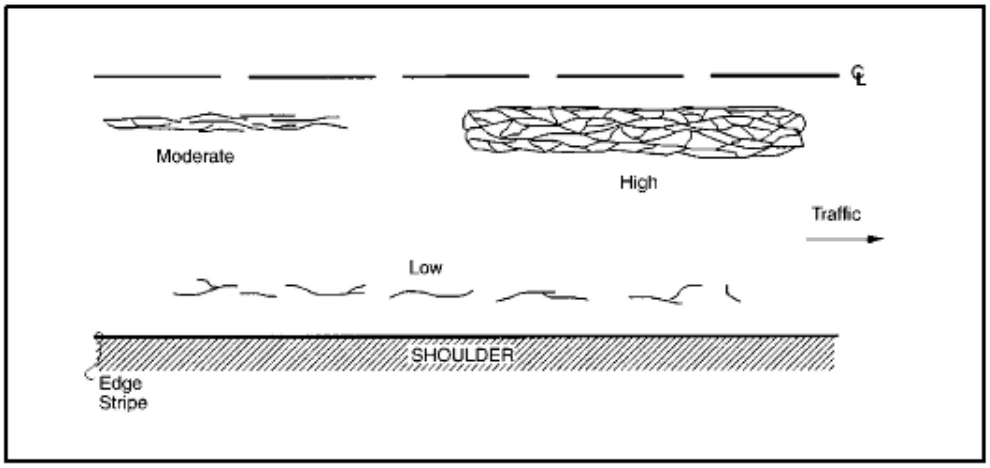


FIGURE 3
Distress Type ACP 1—Fatigue Cracking

Straight Line Cracks

Louisiana DOTD Proposes to adopt the Austroads term “Straight-Line Crack” for transverse joints, longitudinal joints, skewed joints, and saw cut joints (which would include concrete patches). This allows for a correct identification and differentiation between unplanned transverse cracks and designed joints.

When we analyze the Cracking Percent proposed metric along with the proposed Faulting metrics, it appears that a significant analysis benefit would be incurred by borrowing the term “straight line cracks” from the Austroad’s lexicon.

If you review the Louisiana DOTD comments for faulting, you will note the numerous issues with the proposed faulting metrics which, in summary, could include many false positives in fault identification. Louisiana DOTD strongly feels that Faulting should only occur at joints and not transverse cracks. Transverse Cracks should be handled by Cracking Percent, with significant transverse cracks also being captured via their influence on IRI, and as such double counted against the pavement condition. It should also be noted that various setting can cause faulting algorithms to “struggle” when skewed joints are encountered.

So if all designed and built transverse joints, longitudinal joints, skewed joints and saw cut joints would be classified as straight line cracks, opportunities would be gained with respect to both properly classifying the collected data, defining the pavements condition ratings and gaining information to support asset management functionality.

Other Various Types of Cracks

There are numerous cracking “types” found in different references, with no indication as to what types of cracks to use for “Cracking Percent”, or how to actually use them.

Louisiana DOTD Proposes to only use Longitudinal Cracking, Transverse Cracking, Fatigue (Alligator) Cracking and Pattern Cracking to determine Cracking Percent.

In **AASHTO R55-10** on page R55-2 we find another cracking type called **"Interconnected"** cracks.

4.2. *Cracking Types*—Cracks may include longitudinal cracks, transverse cracks, and interconnected cracks. The intent of this practice is to quantify and differentiate between load-associated (fatigue) and non-load-associated (environmental, reflective, etc.) pavement cracking and joints.

In the **LTPP Manual** on page 6 for Asphalt Surfaces we find the term, **"block"** cracking and also **"adjacent … random cracking"**

2

BLOCK CRACKING

Description

A pattern of cracks that divides the pavement into approximately rectangular pieces. Rectangular blocks range in size from approximately 0.1 m^2 to 10 m^2.

Severity Levels

LOW
Cracks with a mean width ≤ 6 millimeters (mm); or sealed cracks with sealant material in good condition and with a width that cannot be determined.

MODERATE
Cracks with a mean width > 6 mm and ≤ 19 mm; or any crack with a mean width ≤ 19 mm and adjacent low severity random cracking.

HIGH
Cracks with a mean width > 19 mm; or any crack with a mean width ≤ 19 mm and adjacent moderate to high severity random cracking.

In the **LTPP Manual** on page 10 we find **"Reflection Cracking".**

5

REFLECTION CRACKING AT JOINTS

Description

Cracks in asphalt concrete overlay surfaces that occur over joints in concrete pavements.

Note: The slab dimensions beneath the AC surface must be known to identify reflection cracks at joints.

In the **LTPP Manual** on page 37 we find **"Durability Cracking".**

DURABILITY CRACKING ("D" CRACKING)

2

Description

Closely spaced crescent-shaped hairline cracking pattern.

Occurs adjacent to joints, cracks, or free edges; initiating in slab corners. Dark coloring of the cracking pattern and surrounding area.

In the Austroad's document **AP-T290-15** on page 34 we find **"Crocodile"** cracking and **"Irregular"** cracking.

7.4.2 Crack Type Output Specification

It is proposed that crack type will be reported as the dominant type within each 100 m reporting segment. The dominant type represents the type of cracking that covers the largest percentage area over the 100 m reporting segment.

The working group considered that the dominant crack type was the one that had the greatest impact on the performance of the area affected by cracking.

In order to cover the full range of cracking that may occur in pavements, it is suggested that the following five types of cracking be used to report any visible cracking:

1. Longitudinal – linear cracks that run longitudinally along the pavement surface.
2. Transverse – unconnected linear cracks running transverse to the pavement surface.
3. Crocodile/block – interconnected or interlaced cracks forming a series of small polygons resembling a crocodile skin. May be also referred to as alligator or polygon cracking.
4. Block – interconnected cracks forming a series of blocks approximately rectangular in shape that are usually distributed over the whole pavement.
5. Irregular – used to describe irregular cracks that do not fall in the above four types and includes meandering, diagonal, crescent-shaped and corner or edge cracking. Any of the following crack types will be reported as an irregular crack:
   - meandering – unconnected irregular cracks varying in line and direction
   - diagonal – unconnected cracks running diagonally across the pavement surface
   - crescent – crescent-shaped or half-moon-shaped cracks that occur in closely spaced parallel groups
   - corner or edge cracking – cracking across the corner or near an edge of a rigid slab.

The working group considered that types 1, 2 and 3 were the most dominant and sufficient to report crack type. This was done in consideration of the different equipment used to collect cracking and that all the equipment considered will be able to produce these crack types.

Other "Visible" Defects

From page 138 in **the NPRM** shown below, we find a conflict as the proposed measure forces the cracking measure to use the AASHTO standards identified. It is noted here that we can find no AASHTO Standard listed in the NPRM that ever uses the term Cracking Percent.

We also note that "Percentage of pavement surface with longitudinal cracking and/or punchouts, spalling or other visible defects (as described in the HPMS field manual)." We can find no mention of "other visible defects" in the **HPMS Field Manual** or any other referenced documents.

Louisiana DOTD Proposes that the **distresses used to identify Flexible or Asphalt Pavements** comprise of Longitudinal Cracking, Transverse Cracking and potholes for non-wheel paths and Fatigue (Alligator) Cracking for wheel paths.

Louisiana DOTD Proposes that the **distresses used to identify Composite Pavements** comprise of Longitudinal Cracking, Transverse Cracking, and **Potholes**.

Louisiana DOTD Proposes that the **distresses used to identify Jointed Concrete Pavements** comprise of Longitudinal Cracking, Transverse Cracking, **Blowups** and **Patches** of different materials.

Louisiana DOTD Proposes that the **distresses used to identify Continuously Reinforced Concrete Pavements** comprise of Longitudinal Cracking, Transverse Cracks with spalling, **Punchouts** and **Patches** of different materials.

Louisiana DOTD Proposes that a crack is considered to be spalled if 10% or more of its length is spalled to a width of 1 inch or greater.

Table 4 - A summary of proposed data collection standards

Data Metric	Proposed Protocol
IRI for all Pavement Types	• IRI collection device in accordance with AASHTO Standard M328-14. • Collection of IRI data in accordance with AASHTO Standard R57-14.
Cracking_Percent for all Pavement Types (Except CRCP)	• Either manual cracking data collection and analysis in accordance with AASHTO Standard R55-10 (2013) or Automated Cracking Data Collection and Analysis in accordance with AASHTO Standard PP67-14 and AASHTO Standard PP68-14.
Cracking_Percent for CRCP	• Percentage of pavement surface with longitudinal cracking and/or punchouts, spalling or other visible defects (as described in the HPMS field manual). • Transverse cracking in CRCP is not included in the cracking computation.

From page 141 we find the cracking percent for CRCP is limited to "longitudinal cracking" but oddly adds additional phrase "non-cracking related items". What are these "items"? We cannot find definitions of "non-cracking related items" in the NPRM.

The type and extent of cracking used for the Cracking_Percent metric varies by pavement type. For asphalt pavement the Cracking_Percent metric considers all cracking present in the section area, for jointed concrete pavements the Cracking_Percent metric considers any crack present in a slab within the section, and for CRCP the Cracking_Percent metric considers only longitudinal cracking in the section area (plus the additional non-cracking related items discussed in § 490.311(b)(3)). The metric calculations of Cracking_Percent for different pavements are proposed to align with existing HPMS practices and avoid the need for major changes in measurement and calculation practices by State DOTs.

From the previous page 140, we find the following further identifying that in addition to longitudinal cracks we must include punchouts, spalling and other visible defects in the measure for cracking percent. Once again, we can find no mention of "other visible defects" in the **HPMS Field Manual** or any other referenced documents.

average depth of rutting, to the nearest 0.05 inch, for the section. The FHWA proposes in § 490.311(b)(3) that for CRCP, the Cracking_Percent metric would be computed as the percentage of the area, to the nearest whole percent, of the full section exhibiting longitudinal cracking, punchouts, spalling, or other visible defects. In addition, FHWA

We can only find a definition for punchouts in the NPRM on Page 220, but there is nothing else mentioned with respect as to how to measure a punchout to include it in cracking percent. When we look at the **HPMS Field Manual**, it copies the images from the **LTPP Manual**, but does not define any mechanism for calculating is area of influence or cracking percent and only requires that the user record the number of punchouts.

Punchout means a distress specific to CRCP described as the area between two closely spaced transverse cracks and between a short longitudinal crack and the edge of the pavement (or a longitudinal joint) that is breaking up, spalling, or faulting.

As for "spalling", other than repeating the word multiple times in various places, **the NPRM** provides no definition or means to identify spalling. We find no mention of spalling, with respect to CRCP pavements in the **HPMS Field Manual**. In the **LTPP Manual** we find that spalling is defined and only captured in "severity levels" for various crack types and in punchouts. There is no mention anywhere as to how to calculate a cracking percent for spalling.

Missing Information for Cracking Percent

From **the NPRM** on page 125, the FHWA will define Cracking Percent for each pavement type, but we cannot locate this information.

> The FHWA proposes to define "Cracking" as a metric that would be used for determining pavement condition and a definition for "Cracking Percent" that would be used to express the percentage of cracking exhibiting in a pavement surface. The FHWA proposes to define "Cracking Percent" separately for each type of pavement.

The NPRM on page 226, directs us the **HPMS Field Manual** to find these metrics.

> **§ 490.311 Calculation of pavement metrics**
>
> (a) The condition metrics and data elements needed to calculate the pavement performance measures shall be calculated in accordance with the HPMS Field Manual (incorporated by reference, see § 490.111), except as noted below.
>
> (b) State DOTs shall calculate metrics in accordance with the following relevant HPMS requirements.

When we review the **2014 HPMS Field Manual** we find the following for "Item 52: Cracking_Percent". The **HPMS Field Manual** strictly identifies that this measure is used to capture only "fatigue" type cracking, which is actually "wheel path only" cracking found only on Asphalt Pavements. So the reference is not accurate and the **HPMS Field Manual** needs to be updated.

Item 52: Cracking_Percent (Cracking Percent)

Description: Estimate of percent area with fatigue type cracking for all severity levels for AC pavements (in wheel path) and percent of slabs with cracking for PCC (jointed and continuous) pavements.

Use: For pavement modeling purposes.

Extent: Required for all AC, PCC, and composite paved Sample Panel sections; optional for all other sections beyond the limits of the Sample Panel.

Functional System		1	2	3	4	5	6	7
	NHS	Int	OFE	OPA	MiA	MaC	MiC	Local
Rural	SP	SP	SP	SP	SP	SP		
Urban	SP	SP	SP	SP	SP	SP	SP	

FE = Full Extent SP = Sample Panel Sections

Coding Requirements for Fields 8, 9, and 10:

Value_Numeric: Report the percent of total AC section area and percent of PCC slabs (jointed and continuous) cracked to the nearest 5% at a minimum.

Value_Text: No entry required. Available for State Use.

Value_Date: Report the month and year for which the IRI data reported was collected. A default date may be used for new pavement surface. If the month is unknown, use a default month.

It should be noted again that the HPMS Field Manual copies the images and definitions directly from the LTPP Manual, so the original source is the **LTPP Manual**. But as we noted above, the **HPMS Field Manual** does not provide a method or formula for calculation Cracking Percent and **LTPP Manual** doesn't mention Cracking Percent.

Issues with Jointed Concrete Pavement Cracking Percent

In **The NPRM** on pages 227 and 228, we find that for Jointed Concrete that "exhibit cracking" we have to count the slab as cracked and determine how many of the slabs verses the total number of slabs are cracked. This appears to currently propose, a jointed concrete slab to be 100% cracked if it has a single 12 inch long hairline transverse shrinkage crack located anywhere on the slab. How can this small crack be equivalent to a slab that could be almost rubbilized?

It is possible that this method is proposed based on the input needs of Mechanist-Empirical Design, which it appears was forced to conform to existing constraints of other systems. If this is accurate, it would appear to be a compromise due to a compromise due to the capabilities of an older data source or the needs of an older solution. Cracking Percent for Jointed Concrete Pavements can be update and more accurately supply value to all systems involved.

(2) For asphalt pavements –

(i) The Cracking Percent metric shall be computed as the percentage of the total area containing visible cracks to the nearest whole percent in each section; and

(ii) The rutting metric shall be computed as the average depth of rutting, in inches to the nearest 0.05 inches, for the section.

(3) For CRCP, the Cracking Percent metric shall be computed as the percentage of the area of the section to the nearest whole percent exhibiting longitudinal cracking, punchouts, spalling or other visible defects. Transverse cracking shall not be considered in the Cracking_Percent metric.

(4) For jointed concrete pavements –

(i) The Cracking Percent metric shall be computed as the percentage of slabs to the nearest whole percent within the section that exhibit cracking;

(ii) Partial slabs shall contribute to the section that contains the majority of the slab length; and

But, as we see below from page "iv" in the **"Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures"** we find a relative reference in a need to improve level of effort in determining inputs so the "error associated with the prediction of a given distress" would decrease and a more accurate "life cycle cost of pavement" would ensue. Using the proposed NPRM method for Jointed Concrete Pavements would appear to diminish the opportunity to reduce the "error" levels.

Calibration-Validation of Prediction Models for Level 1, 2, and 3 Inputs

The major premise, upon which the hierarchical input system was devised, is that the standard error associated with the prediction of a given distress mode decreases as the level of engineering effort, intensity and testing is increased. This can be stated in an alternate manner by understanding that the reliability of the design prediction should logically increase when the level of the engineering effort used to obtain inputs is increased. This would logically lead to a reduction in life cycle costs of pavements.

In the Design Guide, it was only possible to demonstrate that this concept was applicable and valid for the thermal fracture module. It is recommended that this hypothesis be confirmed, to the practicing profession, for at least one major mode of load-associated distress. This is necessary because it is very important to illustrate to the engineering community that additional time, effort and design funding will actually result in a lower cost and longer performing product. If this is not demonstrated quickly, it is possible that engineers may simple be lulled into

using a Level 3 (empirical correlations and default values) as the primary (and perhaps only) procedure to obtain inputs.

Louisiana DOTD Proposes that the **distresses used to identify Jointed Concrete Pavements** comprise of Longitudinal Cracking, Transverse Cracking, **Blowups** and **Patches** of different materials.

Louisiana DOTD Proposes that Jointed Concrete Pavement Severity Levels could be defined as follows.

- Cracks that have been sealed shall not be rated.
- Low Severity Level includes longitudinal or transverse cracks <0.25 inches wide with no spalling
- Medium Severity Level includes longitudinal or transverse cracks >0.25 inches wide with no spalling
- High Severity Level includes longitudinal or transverse cracks with spalling. A crack is considered to be spalled if 10% or more of its length is spalled to a width of 1 inch or greater. It includes **Blowups** and **Patches** of different materials.

Louisiana DOTD Proposes that Cracking Extent for Jointed Concrete Pavements include severity levels that could be determined as follows.

- For low severity multiply the length (feet) of the cracks by 0.5 feet (6 inches).
- For medium severity, multiply the length (feet) of the cracks by 0.83 feet (10 inches).
- For high severity, multiply the length (feet) of the cracks >0.5 inches by 1.17 feet (14 inches) and add the area of Patches of different materials.
- JCP segments with **blowups** would automatically result in a 100% Cracking Percent for that segment.

The sum of these areas would provide an area (square feet) of cracking extent for the pavement segment. Then divided that sum by the area of the pavement segment (segment length (**usually 20 feet)** times the lane width) to determine Cracking Percent. Please note the JCP segment length in not the normal 0.1 mile segment. It appears that this segment length compromise may have been suggested to support earlier constraints forced on the developers of Mechanist-Empirical Design. The follow up question is, do we want to migrate this measure into the 0.1 mile segment length to provide more comparable metrics between pavement types?

We reference Page 140 in **the NPRM** shown below and later on Page 141, to find the conflicting statement that says "all cracking" on asphalt pavements should be used, and "any cracking" on JCP. For CRCP the limit is set for "longitudinal cracking" but oddly adds additional "non-cracking related items" which are claimed to be defined elsewhere; however, we cannot find these definitions.

> a pavement failure indicator for CRCP. The FHWA proposes in § 490.311(b)(4) that for jointed concrete pavement, the Cracking_Percent metric would be computed as the percentage of slabs, to the nearest whole percent, within the section that exhibit cracking. The FHWA proposes that partial slabs should contribute to the section that contains the majority of the slab length. In addition, FHWA proposes that the faulting metric would

Issues with References, Definitions & Other Details

The following discussion explains this further. On page 125 or **the NPRM** we see the following:

> The need for consistent definitions was reinforced by a national study on pavement roughness[62] and a regional study on highway infrastructure health.[63] These studies found that both measured roughness and distress data are not consistently collected and reported by State DOTs across the country. The FHWA is addressing this need by proposing definitions for cracking, faulting, IRI, punchout, and rutting.[64]

If we investigate footnote 64, copied from **the NPRM** and shown below, we find the only actual reference for the **June 2003 FHWA-RD-03-031 "The Distress Identification Manual for the Long Term Pavement Performance Program" (LTPP Manual)** in the NPRM. This is somewhat disappointing since this manual provides the examples that are copied and used in the HPMS guide.

Louisiana DOTD proposes that the June 2003 FHWA-RD-03-031 "The Distress Identification Manual for the Long Term Pavement Performance Program" be referenced more directly to agencies for the purpose of implementing the NPRM or that the NPRM more directly define, in very similar scope and methods, metrics based on the LTPP Manual.

The **LTPP Manual** is also the only place where punchouts and other visible defects are defined.

pavement, which is what would actually be measured and evaluated to assess pavement

[62]AASHTO (2008).Comparative Performance Measurement: Pavement Smoothness, NCHRP 20-24(37B). http://onlinepubs.trb.org/onlinepubs/archive/NotesDocs/20-24(37)B_FR.pdf

[63]FHWA (2012).Improving FHWA's Ability to Assess Highway Infrastructure Health Pilot Study Report, FHWA-HIF-12-049.http://www.fhwa.dot.gov/asset/pubs/hif12049/hif12049.pdf

[64] More information about the defined terms associated with pavement "cracking", "faulting," "punchouts," "rutting," etc., can be found in the "Distress Identification Manual" published by FHWA. See FHWA 2003, Publication No. FHWA-RD-03-031 "Distress Identification Manual for the Long-Term Pavement Performance Program." http://www.fhwa.dot.gov/publications/research/infrastructure/pavements/ltpp/reports/03031/03031.pdf

125

The **LTPP Manual** provides a method for identifying distress types for Asphalt Concrete Surfaced Pavement, Jointed Concrete Surfaced Pavement, and Continuously Reinforced Concrete Surfaced Pavements. One would expect that many states may have adopted some of these June 2003 methods for their distress type measures.

The **LTPP Manual** defines the various distress types and then provides details and photos explaining how to measure that distress, for each individual distress type. Valid distress types all have units of measure defined and in many cases these measures require the identification of severity levels based on low, moderate and high severity measures that are identified when severity level is applicable.

Please note that Cracking Percent is not mentioned one time in the **LTPP Manual**. Of course many states don't capture all of these distress types identified in this document because of the cost associated with capturing all this data; however, it would not be considered unreasonable for states to be required to capture cracking, rutting and faulting measures.

In the **LTPP Manual**, when we further review the Asphalt measures, we note the various distress types are combined for both asphalt and composite pavements (asphalt over concrete) similar to the proposed rules. This is a little disconcerting since cracking on these two different pavements do not represent the same thing. i.e. fatigue cracking only applies to asphalt not composite pavements.

As we review further, we note that a Unit of Measure is defined for each Distress Type. Our concern is slightly mitigated because we note the exception for Reflective Cracking at joints. For both Transverse and Longitudinal Reflective cracks on composite pavements, the unit of measure is defined as "Not Measured" because these are topical and not considered failure type distresses. The point made here is that only a valid failure type distresses should be required in the proposed rules, which is not currently the case.

The reporting mechanism outlined in the **LTPP Manual** provides the means for fully overcoming this concern. For instance, reflective cracking at joints on composite pavements have a defined distress type of ACP5, while transverse cracks, which are valid distresses in asphalt pavements, have a distress type of ACP6. Similar distress type identifiers are identified for JCP and CRCP pavement types. If these distress type identifiers are used in the reporting requirement, then a valid assessment of the pavement can be performed.

Louisiana DOTD Proposes that if Louisiana DOTD's temporary proposals are not adopted, then **LTPP Manual's** distress type identifiers be used for data reporting and that the **HPMS Field Manual** be modified to capture Cracking Percent data, cracking extent, severity and distress type identifiers

Thresholds and Rounding Issues for Cracking Percent

Also note that HPMS requires that Cracking Percent be round to the nearest 5%, while **the NPRM** "Table 5 - Proposed Pavement Condition Rating Thresholds" found on pages 145 and 146, shows the threshold for "Good" pavements to be 5% or lower. So if this remains as is, the **HPMS Field Manual** technically forces the pavement to really be less than 2.49% cracks to be a "Good" pavement since rounding of 2.5% become 5%?

Table 5: Proposed Pavement Condition Rating Thresholds

Surface Type	Metric	Metric Range	Rating
		least 1,000,000	
Asphalt Pavement and Jointed Concrete Pavement	Cracking_Percent	< 5%	Good
		5-10%	Fair
		> 10%	Poor
Asphalt Pavement	Rutting	< 0.20	Good
		0.20 – 0.40	Fair
		> 0.40	Poor
Jointed Concrete Pavement	Faulting	< 0.05	Good
		0.05 – 0.15	Fair
		> 0.15	Poor
CRCP	Cracking_Percent	< 5%	Good
		5-10%	Fair
		> 10%	Poor

Wheel Path Discrepancies & Survey Areas

Louisiana DOTD Proposes for Flexible or Asphalt Pavements only that the pavement survey area be defined into (5) five zones as per **AASHTO PP 67-14**.

Louisiana DOTD Proposes that a wheel path be defined as either 3 feet or 36 inches wide to eliminate any metric conversion errors. The centerline of each 3 foot wheel path would be located 2 ½ feet (average vehicle wheel track is 5 feet) from the centerline of the travel lane. The wheel paths and the area between the wheel paths would account for 8 feet (3 feet, 2 feet, 3 feet) of the lane width allowing the remainder of the lane width to be equally divided on either side of the wheel paths. Wheel paths and survey area zones will only apply to Fatigue (Alligator) Cracking determinations at this time.

Review of Wheel Path, Zones, & Survey Areas

In the February 2013 FHWA released, **"Practical Guide for Quality Management of Pavement Condition Data Collection", Contract or Grant No. DTFH61-07-D-00028**, we find the following with respect to quality assurance indicating a validation for reasonableness. The wheel path is defined to be 3 feet wide. We again note that this document also does not contain the term Cracking Percent or Percent Cracking.

- Check for reasonableness of the maximum extent of distress. For example, if fatigue cracking is present in both wheel paths for a section length of 0.10 mi (0.16 km), and a wheel path is considered to be 3 ft (0.9 m) wide, the resulting extent of fatigue cracking would be 3,168 sq-ft (295 sq-m). In this example, the service provider data for fatigue cracking should not exceed 3,168 sq-ft (295 sq-m).

In **AASHTO R55-10**, we find diagrammed in figure 1 copied below, a 2.5 m (8 ft) survey strip, which is actually 8.2 feet wide using a true math conversion; but in the same document "4.1.1" also allows us to use the full lane width of 3.6 m (12 ft) if we choose. Note again that 3.6 m actually converts to 11.81 feet, not 12 feet.

4.1.1. Survey a 2.5-m (8-ft) strip in the outside lane as shown in Figure 1. As another option, survey the 3.6-m (12-ft) full lane width.

4.2. *Cracking Types*—Cracks may include longitudinal cracks, transverse cracks, and interconnected cracks. The intent of this practice is to quantify and differentiate between load-associated (fatigue) and non-load-associated (environmental, reflective, etc.) pavement cracking and joints.

4.2.1. For this practice, increased cracking intensity in the wheel path as compared with the non–wheel path areas is assumed to quantify load-associated cracking.

4.2.2. Non-load-associated cracking is quantified by the cracking measured in the non–wheel path areas.

4.2.3. Sealed cracks will not be quantified by manual surveys. Automated data collection equipment will not quantify any discontinuity greater than 25-mm (1-in.) width.

4.3. *Cracking Estimates by Type*:

4.3.1. *Rating Wheel Path Cracks*—Wheel path cracking is determined in both the inside and outside wheel path as shown in Figure 1.

4.3.2. *Rating between Wheel Path Cracks*—Non–wheel path cracking is determined in the area between the wheel paths as shown in Figure 1.

From figure 1, we have 0.75 m wheel paths that are either 2.46 feet (29.52 inches) wide if you use the true math conversion from meters to feet, or if you go by the image provided, rounded up nearly ½ an inch to 2.5 feet (30 inches). Here again we find Metric to English conversions that are rounded up or down and have provide images of the actual measures identified below from an internet conversion calculator.

Oddly the "Survey Strip" found in Figure 1 above defines zones the leave out 0.125 m (0.41 foot) sections from the analysis and also allows for anything outside the wheel path to be ignored. This does not match the **PP 67-14** description of "zones" shown below.

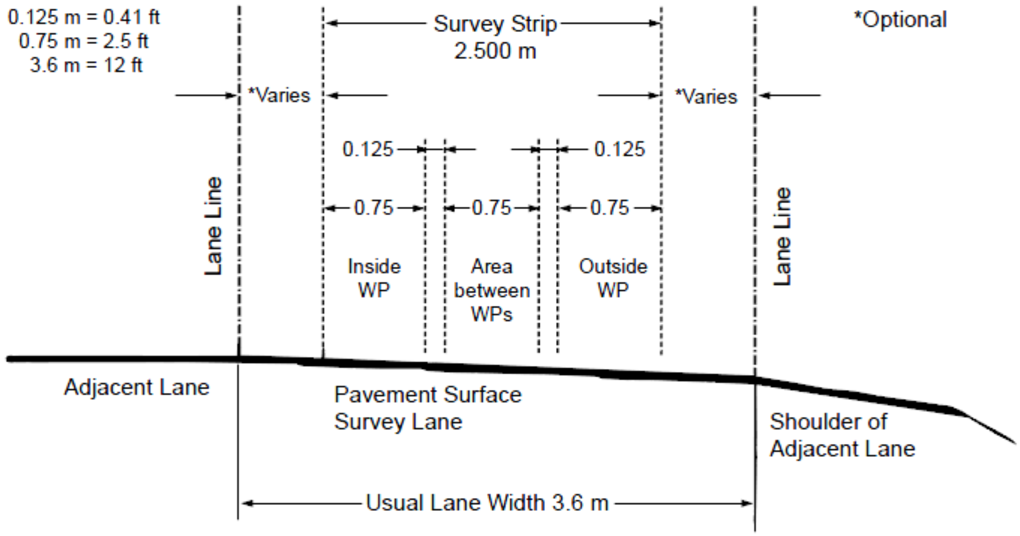
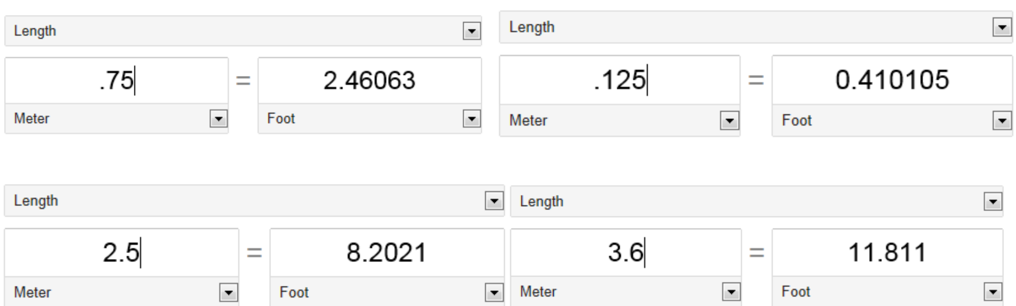


Figure 1—Cross Section of Survey Lane Showing Wheel Paths and Defined Survey Area Between Wheel Paths



We also need to identify the issue with the 100 foot summary section distance in **PP 67-14**.

7. DATA ANALYSIS— CRACK CLASSIFICATION AND VALUATION

7.1. The summary section distance for cracking data is 0.03 km (100 ft).

7.2. Detected pattern cracks and longitudinal cracks (not transverse) are separated into five measurement zones across the pavement.

7.2.1. Zone 1 is between the inside wheelpath and the lane edge at the adjacent lane.

7.2.2. Zone 2 is the inside wheelpath.

7.2.3. Zone 3 is the space between the wheelpaths.

7.2.4. Zone 4 is the outside wheelpath.

7.2.5. Zone 5 is between the outside wheelpath and the outside lane edge.

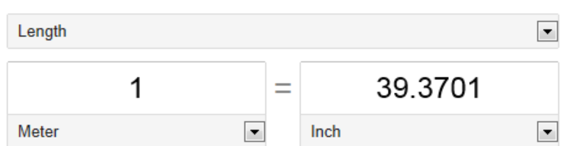
In **PP 67-14** we have wheel paths that are 1.0 m (39 inches) wide, when the actual conversion of meter to inches is show to be 39.37 inches per meter.

3.8. *inside wheelpath*—a longitudinal strip of pavement 1.0 m (39 in.) wide and centered 0.875 m (34 in.) to the left of the centerline of the lane in the direction of travel.

3.9. *longitudinal crack*—a crack at least 0.3 m (12 in.) long and with a crack orientation between +10 and –10 degrees of the lane centerline.

3.10. *measurement zone*—one of the five strips of pavement created by the wheelpaths and the areas between and outside the wheelpaths.

3.11. *outside wheelpath*—a longitudinal strip of pavement 1.0 m (39 in.) wide and centered 0.875 m (34 in.) to the right of the centerline of the lane in the direction of travel.



The **HPMS Field Manual** gives an example of converting fatigue cracking into area by using a 2 foot wide wheel path.

For AC pavements an estimate of the total area of fatigue cracking for the Sample Panel section should be reported. As an example, if the Sample Panel section is a single lane, 12 foot in width, 1 mile in length; total area = 63,360 sq. ft.

The fatigue cracking in the sample is 500 foot in length and 2 foot in width in each wheel path:

500 ft. * 2 ft * 2 wheelpaths = 2,000 sq. ft.

2,000 sq. ft. / 63,360 sq. ft. = 3.2 percent area of fatigue cracking which can be reported as 5 percent

And finally with respect to wheel paths, the **LTPP Manual** on page 90 identifies the wheel paths to be 0.76 m (2.49 ft/29.92 inches) wide.

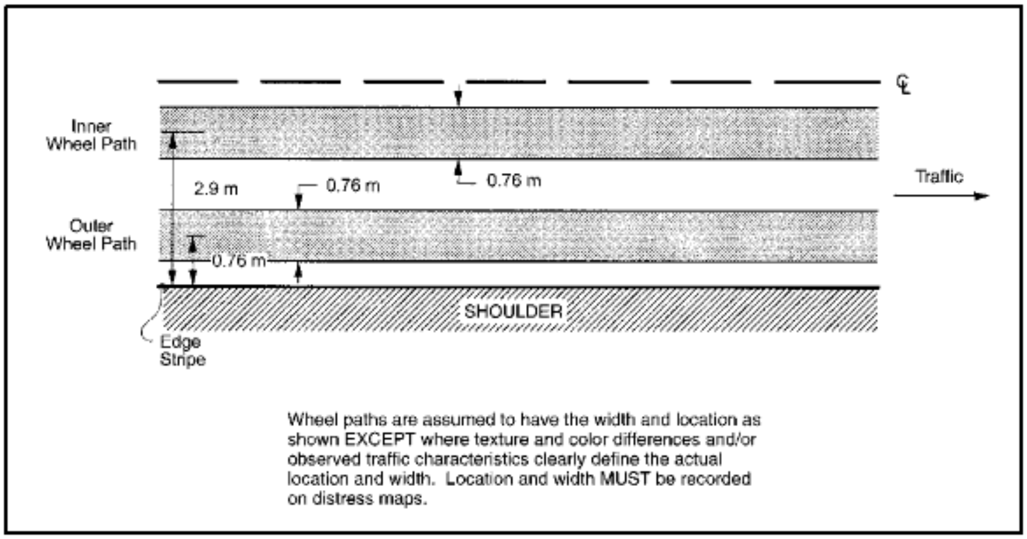
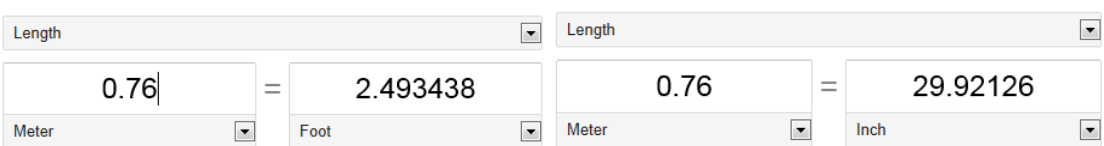


FIGURE A3
Locating Wheel Paths in Asphalt Concrete-Surfaced Pavements



Also in **AASHTO R55-10** we find that we should classify cracking by severity, with reporting quantity in meters per square meter or feet per square feet. So these linear measures are not actually defined as Cracking Percent and no method is provided to do so.

4.3.4. Classify cracking by severity and intensity as indicated below:

4.3.4.1. *Severity Level 1*—Cracks ≤3 mm (≤$^1/_8$ in.).

4.3.4.2. *Severity Level 2*—Cracks with dimensions >3-mm (>$^1/_8$-in.) and ≤6-mm (≤$^1/_4$-in.) width.

4.3.4.3. *Severity Level 3*—Cracks with dimensions >6-mm (>$^1/_4$-in.) width.

4.3.5. Quantify intensity of cracking at each level as the total length of cracking per unit area (m/m^2 or ft/ft^2) for each defined survey strip as shown in Figure 1.

Note 3—The sample area is a function of the sample length the agency has chosen in Section 5.

Later in **AASHTO R55-10** we find an example of how to report and quantify the data, noting that "Edge Cracking, Joints, and Transverse Cracking" are optional and user defined.

6. REPORT

6.1. An example of a report is given in Table 2.

Table 2—Example of Data Reporting

Severity Level	Outside Wheel Path, m/m^2	Inside Wheel Path, m/m^2	Between Wheel Paths, m/m^2	Optional Areas and Distress		
				Edge Cracking	Joints	Transverse Cracking
1	12	19	5	User defined	User defined	User defined
2	25	10	2	User defined	User defined	User defined
3	10	12	4	User defined	User defined	User defined

We also note here that the term "section area" is only used in this location on page 141 of the **NPRM** and is not defined elsewhere. We do however encounter terms such as Summary Section, Sample Panel Section, and other similar phrases.

The type and extent of cracking used for the Cracking_Percent metric varies by pavement type. For asphalt pavement the Cracking_Percent metric considers all cracking present in the section area, for jointed concrete pavements the Cracking_Percent metric considers any crack present in a slab within the section, and for CRCP the Cracking_Percent metric considers only longitudinal cracking in the section area (plus the additional non-cracking related items discussed in § 490.311(b)(3)). The metric

HPMS Guide Changes for 2015

In the just released, (Friday, March 13, 2015 3:22 PM From: joseph.hausman@dot.gov) **"Summary of Field Manual Edits, February 2015 FHWA / Office of Highway Policy Information"**, "Changes to the HPMS Field Manual for 2015" no mention is made of changes to Item 52, but the document does eliminate "Item 53: Cracking Length" which appears to have been the measure used to report Transverse Cracking for Flexible or Asphalt Pavement and Composite Pavement.

Chapter/ Appendix	Section	Figure or Table	Data Item	Data Item #	2014 Page Number	Change
1	4	NA	NA	NA	1-4	Updated and clarified guidance for HPMS Staff Roles and Responsibilities
2	4	2.1	Cracking Length	53	2-3	Cracking Length data item removed from table of 'Data Items to be Reported'

Item 53: Cracking_Length (Cracking Length)

Description: Estimate of relative length in feet per mile (ft/mi) of transverse cracking for AC pavements and reflection transverse cracking for composite pavements where AC is the top surface layer.

Use: For pavement modeling purposes.

Extent: Optional for all AC (transverse cracking), and composite (transverse reflection cracking) paved Sample Panel sections and all other sections beyond the limits of the Sample Panel.