Research Report
KTC-05-29/SPR-267-02-1F

KENTUCKY TRANSPORTATION CENTER

IDENTIFICATION OF PAVEMENT DISTRESS IN KENTUCKY

UNIVERSITY OF KENTUCKY
College of Engineering

OUR MISSION

We provide services to the transportation community through research, technology transfer and education. We create and participate in partnerships to promote safe and effective transportation systems.

OUR VALUES

Teamwork
Listening and communicating along with courtesy and respect for others.

Honesty and Ethical Behavior
Delivering the highest quality products and services.

Continuous Improvement
In all that we do.

Research Report
KTC-05-29/SPR-267-02-1F

Identification of Pavement Distress in Kentucky

Research Report
KTC-05-29/SPR-267-02-1F

Identification of Pavement Distress in Kentucky

by

Tim C. Scully Jr,
Transportation Research Investigator

R. Clark Graves. P.E., P.G.
Transportation Research Engineer

and

David L. Allen, P.E., P.G
Transportation Research Engineer

Kentucky Transportation Center
College of Engineering
University of Kentucky
Lexington, Kentucky

April 2006

1. Report No. KTC-05-29/SPR-267-02-1F	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Identification of Pavement Distress in Kentucky		**5. Report Date** April 2006 **6. Performing Organization Code** **8. Performing Organization Report No.** KTC-05-29/SPR-267-02-1F
7. Authors Tim Scully, R. Clark Graves, and David Allen		**10. Work Unit No. (TRIAS)**
9. Performing Organization Name and Address University of Kentucky College of Engineering Kentucky Transportation Center 176 Oliver Raymond Building Lexington, KY 40506-0281		**11. Contract or Grant No.**
12. Sponsoring Agency Name and Address Kentucky Transportation Cabinet 200 Mero Street Frankfort, KY 40622		**13. Type of Report and Period Covered** Final **14.Sponsoring Agency Code**
15. Supplementary Notes Prepared in cooperation with the Federal Highway Administration, US Department of Transportation		

16. Abstract

In Kentucky, the roads are comprised primarily of two types of pavement. The first being Portland Cement Concrete (PCC) a rigid pavement, and the other is Asphaltic Concrete (AC), a flexible pavement. There is a noticeable difference in their appearance, ride, cost and performance. Since Kentucky utilizes both pavements, as many states do, it is necessary to have a system in place to consistently identify pavement distress and categorize their overall performance.

17. Key Words Pavement Distress, Pavement Management, Cracking, Faulting, Rutting		18. Distribution Statement Unlimited, with approval of the Kentucky Transportation Cabinet	
19. Security Classification (of this report) **None**	**20. Security Classification (of this page)** **None**	**21. No. of Pages**	**22. Price**

Table of Contents

Introduction

In Kentucky, the roads are comprised primarily of two types of pavement. The first being Portland Cement Concrete (PCC) a rigid pavement, and the other is Asphaltic Concrete (AC), a flexible pavement. There is a noticeable difference in their appearance, ride, cost and performance. Since Kentucky utilizes both pavements, as many states do, it is necessary to have a system in place to consistently identify pavement distress and categorize their overall performance.

This manual was designed to assist with the process of determining pavement type, distress type, and level of distress on any pavements in Kentucky. Distresses documented in this report are as follows:

AC Pavements
Longitudinal Cracking, Alligator Cracking, Rutting, Block Cracking, Reflective Cracking Transverse Crack, Bleeding, Shoving, Raveling, Water Pumping, and Pothole.

PCC Pavements
Corner Cracking, Transverse Cracking, Longitudinal Cracking, Durability (D) Cracking, Faulting of Longitudinal Joints, Faulting of Transverse Joints, Pop Out, Spalling, Joint Seal Failure,

To reference surface defects with PCC or AC pavements, turn to the appropriate page to review a description and photograph of distress.

LOAD ASSOCIATED DISTRESS
FOR
ASPHALT CONCRETE

Longitudinal Cracking

Description

Cracks traveling parallel with the pavement, usually located near the wheel paths, between wheel paths, or in the centerline of the pavement.

Severity Levels

Slight

Very small cracks often undefined in width and length. It is usually harder to determine how long cracks travel, do to their undefined nature.

Gap up to 1/32 inch or slight depression
Gap up to 1/8 inch or depression > 1/4

Moderate

More pronounced cracking traveling for longer distances and penetrating deeper into the pavement.

Gap up to 3/16 inch or depression >1/2
Gap up to 1/4 inch or depression > 3/4

Severe

Bold, wide cracking that travel long distances, and penetrate deep into the pavement.

Gap > 1/4 inch or depression > 1 inch

Figure 1a. Longitudinal Cracking (Slight)

Figure 1b. Longitudinal Cracking (Moderate)

Figure 1c. Longitudinal Cracking (Severe)

Alligator Cracking

Description

Alligator cracking is a very common distress for asphaltic concrete. Alligator cracks look like alligator's skin. These cracks are very visible and easy to classify.

Severity Levels

Slight

There is light cracking with an alligator pattern usually forming in the wheel paths.

Gap up to 1/32 inch or slight depression
Gap up to 1/8 inch or depression > 1/4

Moderate

A more severe alligator-shaped cracking with some mild spalling.

Gap up to 3/16 inch or depression >1/2
Gap up to 1/4 inch or depression > 3/4

Severe

Heavy cracking with some pieces faulting and others popping out. Many times there will be areas of potholes forming.

Gap > 1/4 inch or depression > 1 inch

Figure 2a. Alligator Cracking (Slight)

Figure 2b. Alligator Cracking (Moderate)

Figure 2c. Alligator Cracking (Severe)

Rutting

Description

Rutting is a longitudinal depression in the wheel paths caused by repeated loading from vehicles. As the pavement is forced downward you will see channels forming in the wheel paths. These ruts will continue to worsen until rehabilitated.

Severity Levels

Slight

There may be early signs of depressions in the wheel paths. Refer to the chart below to categorizing the rutting.

Ruts measuring 1/4 inch and less

Moderate

The depressions are forming deeper into wheel paths. Some longitudinal cracking may also be present. Refer to the chart below to categorizing the rutting.

Ruts measuring 5/16 to 5/8 inches

Severe

When there are deep depressions formed in the wheel paths. There will often be longitudinal cracks present. Refer to the chart below to categorizing the rutting.

Ruts measuring 11/16 and greater

Figure 3a. Rutting (Slight)

Figure 3b. Rutting (Moderate)

Figure 3c. Rutting (Moderate)

OTHER CRACKING
FOR
ASPHALT CONCRETE

Block Cracking

Description

A pattern of cracks that divide the pavement into square shaped segments.

Severity Levels

Slight

Gap up to 1/32 inch and no spalling
Gap up to 1/8 inch or slight spalling

Very small cracks, uniform in shape, but not very distinct having widths that are difficult to determine.

Moderate

These are larger cracks with a more distinct pattern. The crack widths are more visible and defined.

Gap up to 3/16 inch
Gap up to 1/4 inch

Severe

Severe block cracking that shows heavy cracks in bold square shapes that are very wide.

Gap > 1/4 inch

Figure 4a. Block Cracking (Slight)

Figure 4b. Block Cracking (Moderate)

Figure 4c. Block Cracking (Severe)

Reflective Cracking

Description

Reflective cracks are those which form over the joints of old Portland cement concrete. In the days prior to break and seating of pavements reflective cracking was very common when placing asphaltic concrete over Portland cement concrete.

Severity Levels

Slight

Light transverse cracking reflecting upward from existing pavement.

Gap up to 1/32 inch and no spalling
Gap up to 1/8 inch or slight spalling

Moderate

A larger transverse crack with a more pronounced hump or blow up at the joint.

Gap up to 3/16 inch
Gap up to 1/4 inch

Severe

A severe hump has formed in the pavement where the transverse crack is located. This usually is indicative of a larger problem below with the original pavement.

Gap > 1/4

Figure 5a. Reflective Cracking (Slight).

Figure 5b. Reflective Cracking (Moderate).

Figure 5c. Reflective Cracking (Severe).

Transverse Cracking

Description

These cracks propagate across the road. They may range from very small insignificant cracks to large severely damaging cracks.

Severity Levels

Slight

In the early stages of transverse cracking the crack is very faint with little or no pavement separation.

Gap up to 1/32 inch
Gap up to 1/8 inch

Moderate

More pronounced transverse cracking is visible. There is more separation, and the cracks appear to travel deeper into the pavement.

Gap up to 3/16 inch
Gap up to 1/4 inch

Severe

Transverse cracks that are wide and deep. The crack may propagate across an entire lane.

Gap > 1/4 inch

Figure 6a. Transverse Cracking (Slight).

Figure 6b. Transverse Cracking (Moderate).

Figure 6c. Transverse Cracking (Severe).

OTHER DISTRESS
FOR
ASPHALT CONCRETE

Bleeding

Description

Bleeding occurs when there is an excess of bituminous binder working its way up to the pavements surface. Bleeding usually occurs in the wheel paths do to continuous loading in areas with elevated levels of binder. Signs of bleeding are a shiny black residue in the wheel paths that may be sticky on warm days.

Severity Levels

Slight

The wheel paths are showing signs of binder residue starting to migrate to the surface.

Moderate

There is a more distinct change in pavement color in wheel paths caused from migrating binder. Often the pavements voids will be filled with the residue.

Severe

Areas of heavy black residue shining through in the pavement wheel paths.

Figure 7a. Bleeding (Slight)

Figure 7b. Bleeding (Moderate)

Figure 7c. Bleeding (Severe)

Shoving

Description

Shoving occurs when the pavement is pushed longitudinally. This is usually caused by repetitive braking in particular areas such as hills and intersections. The continuous braking in these areas forces the pavement forward causing a rippling, or humping effect.

Severity Levels

Slight

A minimal amount of shoving is present.

Moderate

An increased amount of shoving is present, causing pavement to ride uncomfortably.

Severe

Larger humps are visible causing an uncomfortable ride to passengers passing over these areas.

Figure 7a. Shoving (Slight)

Figure 7b. Shoving (Moderate)

Figure 7c. Shoving (Severe)

Raveling

Description

The erosion of a pavement caused by the loss of fine and coarse aggregate. This is usually most common in the wheel paths, but may occur over an entire lane.

Severity Level

Slight

When there is a visible loss of material, but not at an alarming rate.

Moderate

The lack of small aggregate particles is more visible. The pavement has a pitted, or worn appearance. Small loose pieces of aggregate are often present.

Severe

There is an extensive loss of aggregate. The pavement is very rough with an open textured appearance.

Figure 8a. Raveling (Slight)

Figure 8b. Raveling (Moderate)

Figure 8c. Raveling (Severe)

Water Pumping

Description

Water rises to the surface of the pavement, usually, but not always at the longitudinal paving joints. This occurs in are where edge drains are not operating properly, or in areas where there is a high volume of underground water. Pumping is easy to detect after a good rain, however on dry days you may notice deposits of fine materials left on the pavements surface that have migrated up through the pavement with the water.

Severity Levels

Slight

Small areas of water or staining are visible at the surface.

Moderate

Medium sized areas of water or staining are present along with an increased amount of fine materials

Severe

In severe cases of pumping, water may be standing. When water is not present there will be large areas of heavy staining.

Figure 9a. Water Pumping (Slight)

Figure 9b. Water Pumping (Moderate)

Figure 9c. Water Pumping (Severe)

Pothole

Description

Round holes forming in the pavement often associated with freezing and thawing conditions. Once potholes have started they will grow rapidly if not repaired.

Severity Levels

Slight

Radius of the pothole is small and the depth is shallow. Refer to chart below to aid in classifying severity.

Moderate

Radius is larger and the pothole is deeper. Refer to chart below to aid in classifying severity.

Severe

Large holes in pavement which are very deep. Refer to chart below to aid in classifying severity.

Figure 10a. Pothole (Slight)

Figure 10b. Pothole (Moderate)

Figure 10c. Pothole (Severe)

OTHER CRACKING
FOR
PORTLAND CEMENT CONCRETE

Corner Cracking

Description

A crack that is formed in the corner of a slab that extends for the transverse joint to the longitudinal joint. These cracks are common on Portland Cement Concrete (PCC), and usually run at a 45 degree angle.

Severity Levels

Slight

The corner crack shows no signs of spalling or faulting, and there are no broken pieces.

Gap up to 1/32 inch and no spalling
Gap up to 1/16 inch or slight spalling

Moderate

The corner crack displays minimal spalling and faulting, and there are no broken pieces.

Gap up to 1/8 inch
Gap up to 3/16 inch

Severe

The corner crack shows sign of moderate to severe spalling and faulting, and there may be broken pieces.

Gap > 3/16 inch

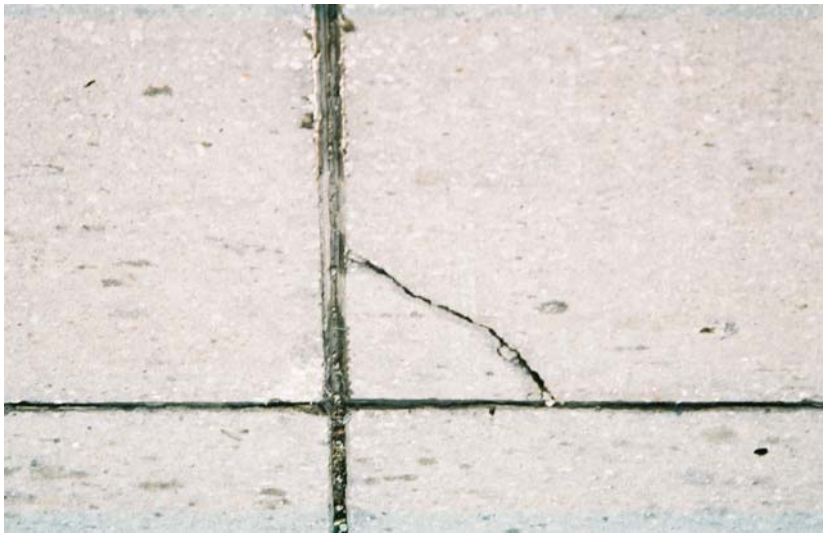

Figure 11a. Corner Cracking (Slight)

Figure 11b. Corner Cracking (Moderate)

Figure 11c. Corner Crack (Severe)

Transverse Cracking

Description

These cracks travel across the road. They may range from very small insignificant cracks to large severely damaging cracks that have a great deal of spalling and faulting.

Severity Levels

Slight

In the early stages of transverse cracking the crack is very faint with little or no pavement separation.

Gap up to 1/32 inch and no spalling
Gap up to 1/16 inch or slight spalling

Moderate

More pronounced transverse cracking is visible. There is more separation and cracks appear to travel deeper into the pavement.

Gap up to 1/8 inch
Gap up to 3/16 inch

Severe

Transverse cracks that are wide and deep. The crack may travel across an entire lane, and usually has areas of spalling or potholing around the crack.

Gap > 3/16 inch

Figure 12a. Transverse Crack (Slight)

Figure 12b. Transverse Crack (Moderate)

Figure 12c. Transverse Crack (Severe)

Longitudinal Cracking

Description

Cracks traveling parallel with the pavement, usually located near the wheel paths, between wheel paths, or in the centerline of the pavement.

Severity Levels

Slight

In the early stages of transverse cracking the crack is very faint with little or no pavement separation.

Gap up to 1/32 inch and no spalling
Gap up to 1/16 inch or slight spalling

Moderate

More pronounced transverse cracking is visible. There is more separation, and the cracks appear to travel deeper into the pavement.

Gap up to 1/8 inch
Gap up to 3/16 inch

Severe

Transverse cracks that are wide and deep. The crack may travel across an entire lane, and usually has areas of spalling or potholing around the crack.

Gap > 3/16 inch

Figure 13a. Longitudinal Crack (Slight)

Figure 13a. Longitudinal Crack (Moderate)

Figure 13a. Longitudinal Crack (Severe)

Durability Cracking (D Cracking)

Description

Half moon or D shaped cracks that form along the edge of longitudinal and transverse joints. This is how many of the spalls you see begin. The D shape forms, and over time the D shaped piece pops out leaving a spall.

Severity Levels

Slight

The D crack is tight, with no spalling present. They are often hard to detect.

D Cracks < 1/32 inch and no spalling
D cracks > 1/16 inch or spalled width < 3 inch

Moderate

The D crack will be opened a bit more possibly displaying signs of spalling or faulting. Patching may be present.

Severe

There is heavy cracking with spalling and possibly faulting present. These typically are patched or need to be patched.

Figure 14a. D Cracking (Slight)

Figure 14b. D Cracking (Moderate)

Figure 14c. D Cracking (Severe)

OTHER DISTRESS
FOR
PORTLAND CEMENT CONCRETE

Faulting of Longitudinal Joints

Description

One side of a joint or crack will be lower than the other. This offset will cause a disturbance to motorist when changing lanes.

Severity Levels

Slight

A small drop in elevation across a crack or joint is present.

Barely perceptible while driving
< 1/4 inch drop

Moderate

A more noticeable drop in elevation across a crack or joint is visible.

> 1/4 inch and < 3/8 inch
> 3/8 inch and < 1/2 inch

Severe

A considerable drop in elevation across a crack or joint is seen and felt by the motorist.

> 1/2

Figure 15a. Longitudinal Faulting (Slight)

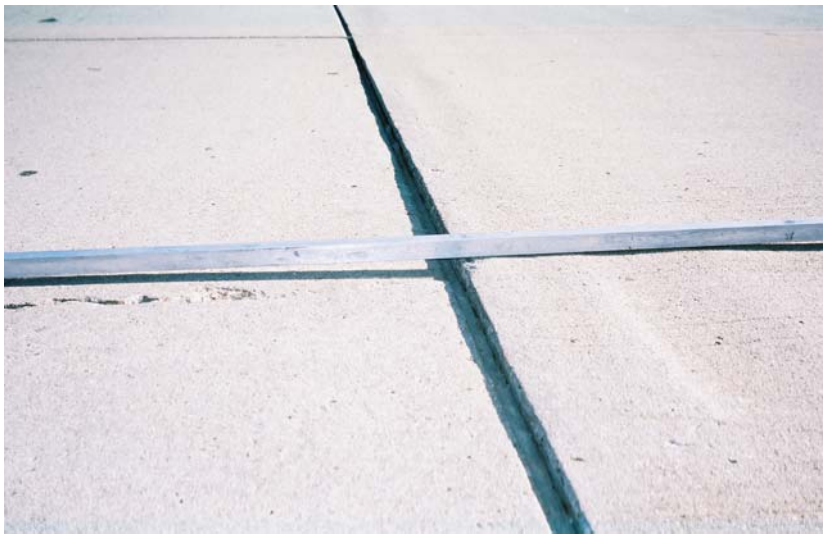

Figure 15b. Longitudinal Faulting (Moderate)

Figure 15c. Longitudinal Faulting (Severe)

Faulting of Transverse Joints

Description

One side of a joint or crack will be lower than the other. This offset will cause a disturbance to motorist when traveling across faulted pavements.

Severity Levels

Slight

A small drop in elevation across a crack or joint is present.

Barely perceptible while driving
< 1/4 inch drop

Moderate

A more noticeable drop in elevation across a crack or joint is visible.

> 1/4 inch and < 3/8 inch
> 3/8 inch and < 1/2 inch

Severe

A considerable drop in elevation across a crack or joint is seen and felt by the motorist.

> 1/2

Figure 16a. Transverse Faulting (Slight)

Figure 16b. Transverse Faulting (Moderate)

Figure 16c. Transverse Faulting (Severe)

Pop Out

Description

Pop outs occur when aggregate literally pop out of the pavement. This often happens when a piece of aggregate floats to the top during the finishing process, and later pops out. Once this has happened, the hole that is left from the pop out will fill with debris and when freezing and thawing occurs, it will expand the size of the hole.

Severity Levels

Slight

When a very small holes in the pavement is present.

Moderate

When the hole in the pavement is more visible and is easier to detect.

Severe

When the hole in the pavement has become rather large and could become a bigger problem.

Figure 17a. Pop Out (Slight)

Figure 17b. Pop Out (Moderate)

Figure 17c. Pop Out (Severe)

Spall

Description

Spalls usually occur around the joints of concrete pavements, and often begin as D cracks. Once the D crack has developed, the broken aggregate will spall out away from the joint. Spalls can worsen just like the pop out. As a spall fills with debris, and goes through freezing and thawing, the area will deteriorate.

Severity Levels

Slight

Small pieces of pavement start to break away leaving holes in the pavement.

Moderate

Small to medium size pieces of pavement are spalling out, causing bigger voids to appear.

Severe

Large pieces of aggregate are missing, and at this time it is usually time for repairs.

Figure 18a. Spall (Slight)

Figure 18b. Spall (Moderate)

Figure 18c. Spall (Severe)

Joint Seal Failure

Description

Joint seal failure occurs when the seal is displaced. This usually occurs because the joints were not sawed deep enough or can occur when the slabs move back and forth. Either way, this is a serious problem. Once the seal is out of the joint, the joint will fill with debris and begin to spall.

Severity Levels

Slight

A small piece of the seal may be visible on the surface of the pavement.

Moderate

A larger piece of seal is laying on the pavement and the joint is beginning to fill with debris.

Severe

The seal may be gone completely and the joint will be full of debris.

Figure 18 a. Joint Seal Failure (Slight)

Figure 18b. Joint Seal Failure (Moderate)

Figure 18c. Joint Seal Failure (Severe)

For more information or a complete publication list, contact us at:

KENTUCKY TRANSPORTATION CENTER

176 Raymond Building
University of Kentucky
Lexington, Kentucky 40506-0281

(859) 257-4513
(859) 257-1815 (FAX)
1-800-432-0719
www.ktc.uky.edu
ktc@engr.uky.edu