

DISTRESS IDENTIFICATION GUIDE

**from the Long-Term
Pavement Performance
Program**



U.S. Department of Transportation
Federal Highway Administration

PUBLICATION NO.
FHWA-RC-05-001
AUGUST 2005

**ASPHALT
CONCRETE
PAVEMENTS**



U.S. Department of Transportation **Federal Highway Administration**

Publication No. FHWA-RC-05-001

This pocket guide is derived from the Long-Term Pavement Performance (LTPP) program's Distress Identification Manual, Fourth Revised Edition, Publication No. FHWA-RD-03-031, published in June 2003 as part of the Strategic Highway Research Program.

Additional copies of this pocket guide can be obtained by contacting the LTPP Product Development and Delivery Team at 410-962-5623 or by visiting the LTPP Products website at <http://www.tfhr.gov/pavement/ltpv/product.htm>.

NOTICE: This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government and the State of North Dakota assume no liability for its contents or use thereof. This guide does not constitute a standard, specification, or regulation.

The U.S. Government and the State of North Dakota do not endorse products or manufacturers. Trade and manufacturers' names appear in this guide only because they are considered essential to the object of the document.



**Recycled
Recyclables**

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol	When You Know	Multiply By	To Find	Symbol
in	inches	25.4	millimeters	mm	millimeters	0.039	inches	in
ft	feet	0.305	meters	m	meters	3.28	feet	ft
yd	yards	0.914	meters	m	meters	1.09	yards	yd
mi	miles	1.61	kilometers	km	kilometers	0.621	miles	mi
sq in	square inches	645.2	square millimeters	mm ²	square millimeters	0.0016	square inches	in ²
sq ft	square feet	0.093	square meters	m ²	square meters	10.764	square feet	ft ²
sq yd	square yards	0.836	square meters	m ²	square meters	1.196	square yards	yd ²
sq mi	square miles	2.6	square kilometers	km ²	square kilometers	2.47	square miles	mi ²
oz	fluid ounces	29.57	milliliters	mL	milliliters	0.034	fluid ounces	fl oz
gal	gallons	3.785	liters	L	liters	0.264	gallons	gal
cu ft	cubic feet	0.028	cubic meters	m ³	cubic meters	35.314	cubic feet	ft ³
cu yd	cubic yards	0.765	cubic meters	m ³	cubic meters	1.357	cubic yards	yd ³
oz	ounces	28.35	grams	g	grams	0.035	ounces	oz
lb	pounds	4.54	kilograms	kg	kilograms	2.205	pounds	lb
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")	megagrams (or "metric ton")	1.102	short tons (2000 lb)	T
°F	Fahrenheit	5/9 (°F-32)/9 or (°F-32)/1.8	Celsius	°C	Celsius	1.8C+32	Fahrenheit	°F
°F	Fahrenheit	5/9 (°F-32)/9 or (°F-32)/1.8	Celsius	°C	Celsius	1.8C+32	Fahrenheit	°F
ft	feet-candles	10.76	lux	lx	lux	0.0929	feet-candles	fc
ft	foot-lamberts	3.426	candelmas ²	cd/m ²	candelmas ²	0.2916	foot-lamberts	ft-l
ksi	pounds per square inch	6.895	megapascals	MPa	megapascals	0.225	pounds per square inch	psi
ksi	pounds per square inch	6.895	megapascals	MPa	megapascals	6.145	pounds per square inch	psi

NOTE: volumes greater than 1,000 L, shall be shown in m³

*SI is the symbol for the International System of Units. Approximate rounding should be made to comply with Section 4 of ASTM E280.

[Revised March 2002]

This pocket guide was commissioned by the North Dakota Department of Transportation and produced by the North Dakota Local Technical Assistance Program (LTAP) Center in conjunction with the FHWA Resource Center. Funding for this project was provided by the FHWA Resource Center's Pavement and Materials Team through the North Dakota Division Office, North Dakota Department of Transportation, North Dakota Insurance Reserve Fund, North Dakota State University, and North Dakota LTAP Center.



U.S. Department
of Transportation
**Federal Highway
Administration**



DISTRESSES FOR ASPHALT CONCRETE PAVEMENTS

A. Cracking / 2

1. Fatigue Cracking
2. Block Cracking
3. Edge Cracking
4. Longitudinal Cracking
5. Reflection Cracking at Joints
6. Transverse Cracking

B. Patching and Potholes / 20

7. Patch Deterioration
8. Potholes

C. Surface Deformation / 26

9. Rutting
10. Shoving

D. Surface Defects / 29

11. Bleeding
12. Polished Aggregate
13. Raveling

E. Miscellaneous Distresses / 35

14. Lane-to-Shoulder Dropoff
15. Water Bleeding and Pumping

This section covers asphalt concrete-surfaced pavements (ACP), including ACP overlays on either asphalt concrete (AC) or portland cement concrete (PCC) pavements.

Each of the distresses has been grouped into one of the following categories:

- A.** Cracking
- B.** Patching and Potholes
- C.** Surface Deformation
- D.** Surface Defects
- E.** Miscellaneous Distresses

Table 1. Summarizes the various types of distress and unit of measurement. Some distresses also have defined severity levels.

TABLE 1. Asphalt Concrete Surfaced Pavement Distress Types		
Distress Type	Unit of Measure	Defined Severity Levels?
A. Cracking / page 2		
1. Fatigue Cracking	m ² (ft ²)	Yes
2. Block Cracking	m ² (ft ²)	Yes
3. Edge Cracking	Meters (Feet)	Yes
4a. Wheel Path Longitudinal Cracking	Meters (Feet)	Yes
4b. Non-Wheel Path Longitudinal Cracking	Meters (Feet)	Yes
5. Reflection Cracking at Joints		
Transverse Reflection Cracking	Not Measured	N/A
Longitudinal Reflection Cracking	Not Measured	N/A
6. Transverse Cracking	Number, m (ft)	Yes
B. Patching and Potholes / page 20		
7. Patch/Patch Deterioration	Number, m ² (ft ²)	Yes
8. Potholes	Number, m ² (ft ²)	Yes
C. Surface Deformation / page 26		
9. Rutting	mm (inches)	No
10. Shoving	Number, m ² (ft ²)	No
D. Surface Defects / page 29		
11. Bleeding	m ² (ft ²)	No
12. Polished Aggregate	m ² (ft ²)	No
13. Raveling	m ² (ft ²)	No
E. Miscellaneous Distress / page 35		
14. Lane-to-Shoulder Dropoff	Not Measured	N/A
15. Water Bleeding	Number, m (ft)	No

A. Cracking: This section includes the following distresses:

- | | |
|---------------------|---|
| 1. Fatigue Cracking | 4a. Longitudinal Cracking
Wheel Path |
| 2. Block Cracking | |
| 3. Edge Cracking | 4b. Longitudinal Cracking
Non-Wheel Path |

5. Reflection Cracking
at Joints

6. Transverse Cracking

Measurement of crack width is illustrated in Figure 1.

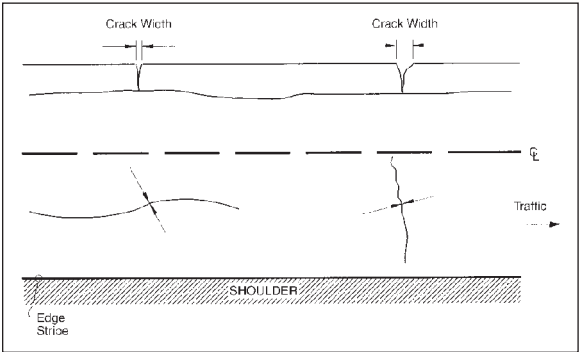


Figure 1: Measuring Crack Width in Asphalt Concrete Surfaced Pavements

Figure 2. depicts the effect on severity level of a crack, in this case block cracking, due to associated random cracking.

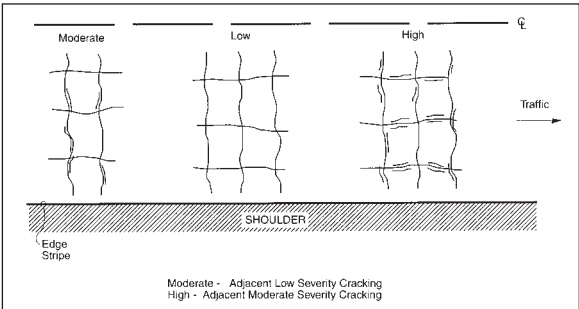


Figure 2: Effect on Severity Level of Block Cracking due to Associated Random Cracking

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 m (1 ft) on the longest side, characteristically with a chicken wire/alligator pattern, in later stages. Must have a quantifiable area.

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.

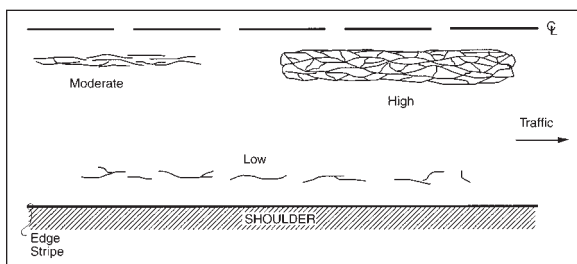
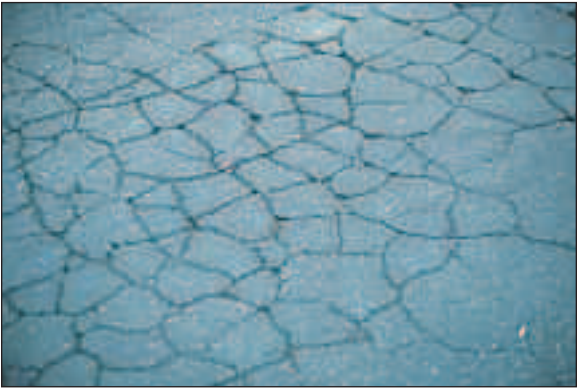


Figure 3: Distress Type ACP 1—Fatigue Cracking

How to Measure

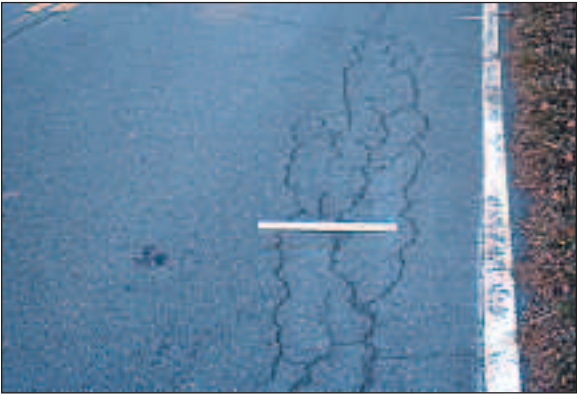
Record square meters (square feet) of affected area at each severity level. If different severity levels existing within an area cannot be distinguished, rate the entire area at the highest severity present.



**Figure 4: Distress Type ACP 1
Chicken Wire/Alligator Pattern Cracking
Typical in Fatigue Cracking**



**Figure 5: Distress Type ACP 1 - Low Severity
Fatigue Cracking**



**Figure 6: Distress Type ACP 1
Moderate Severity Fatigue Cracking**



**Figure 7: Distress Type ACP 1
High Severity Fatigue Cracking with Spalled
Interconnected Cracks**

This page intentionally left blank.

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 m² (1 ft²) to 10 m² (100 ft²).

Severity Levels

LOW

Cracks with a mean width ≤ 6 mm (0.25 in); 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 (0.25 in) and ≤ 19 mm (0.75 in); or any crack with a mean width ≤ 19 mm (0.75 in) and adjacent low severity random cracking.

HIGH

Cracks with a mean width > 19 mm (0.75 in); or any crack with a mean width ≤ 19 mm (0.75 in) and adjacent moderate to high severity random cracking.

How to Measure

Record square meters (square feet) of affected area at each severity level. If fatigue cracking exists within the block cracking area, the area of block cracking is reduced by the area of fatigue cracking.

Note: An occurrence should be at least 15 m (50 ft) long before rating as block cracking.

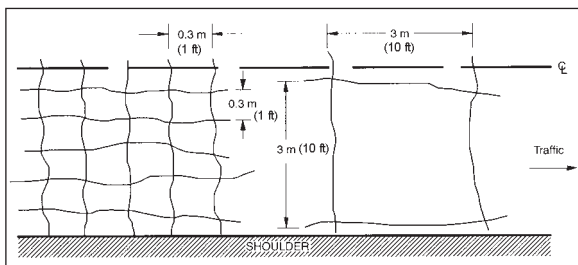


Figure 8: Distress Type ACP 2—Block Cracking



Figure 9: Distress Type ACP 2
Block Cracking with Fatigue Cracking in the Wheel
Paths



Figure 10: Distress Type ACP 2
High Severity Block Cracking

3. EDGE CRACKING

Description

Applies only to pavements with unpaved shoulders.

Crescent-shaped cracks or fairly continuous cracks which intersect the pavement edge and are located within 0.6 m (2 ft) of the pavement edge, adjacent to the shoulder.

Includes longitudinal cracks outside of the wheel path and within 0.6 m (2 ft) of the pavement edge.

Severity Levels

LOW

Cracks with no breakup or loss of material.

MODERATE

Cracks with some breakup and loss of material for up to 10 percent of the length of the affected portion of the pavement.

HIGH

Cracks with considerable breakup and loss of material for more than 10 percent of the length of the affected portion of the pavement.

How to Measure

Record length in meters (feet) of pavement edge affected at each severity level. The combined quantity of edge cracking cannot exceed the length of the section.

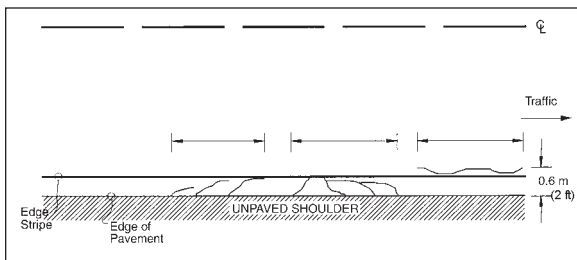


Figure 11: Distress Type ACP 3—Edge Cracking



Figure 12: Distress Type ACP 3
Low Severity Edge Cracking

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

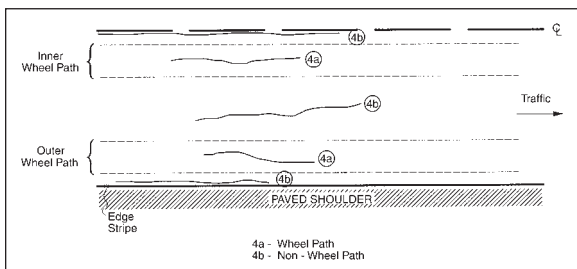
A crack with a mean width ≤ 6 mm (0.25 in); or a sealed crack with sealant material in good condition and with a width that cannot be determined.

MODERATE

Any crack with a mean width > 6 mm (0.25 in) and ≤ 19 mm (0.75 in); or any crack with a mean width ≤ 19 mm (0.75 in) and adjacent low severity random cracking.

HIGH

Any crack with a mean width > 19 mm (0.75 in); or any crack with a mean width ≤ 19 mm (0.75 in) and adjacent moderate to high severity random cracking.



**Figure 13: Distress Type ACP 4
Longitudinal Cracking**

How to Measure

Record separately:

4A. WHEEL PATH LONGITUDINAL CRACKING

Record the length in meters (feet) of longitudinal cracking within the defined wheel paths at each severity level.

Record the length in meters (feet) of longitudinal cracking with sealant in good condition at each severity level.

Note: Any wheel path longitudinal crack that has associated random cracking is rated as fatigue cracking. Any wheel path longitudinal crack that meanders and has a quantifiable area is rated as fatigue cracking.

4B. NON-WHEEL PATH LONGITUDINAL CRACKING

Record the length in meters (feet) of longitudinal cracking not located in the defined wheel paths at each severity level. Record the length in meters (feet) of longitudinal cracking with sealant in good condition at each severity level.



Figure 14: Distress Type ACP 4a
Moderate Severity Longitudinal Cracking in the Wheel Path



Figure 15: Distress Type ACP 4b
High Severity Longitudinal Cracking not in the Wheel Path

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.

Severity Levels

LOW

An unsealed crack with a mean width ≤ 6 mm (0.25 in); 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 (0.25 in) and ≤ 19 mm (0.75 in); or any crack with a mean width ≤ 19 mm (0.75 in) and adjacent low severity random cracking.

HIGH

Any crack with a mean width > 19 mm (0.75 in); or any crack with a mean width ≤ 19 mm (0.75 in) and adjacent moderate to high severity random cracking.

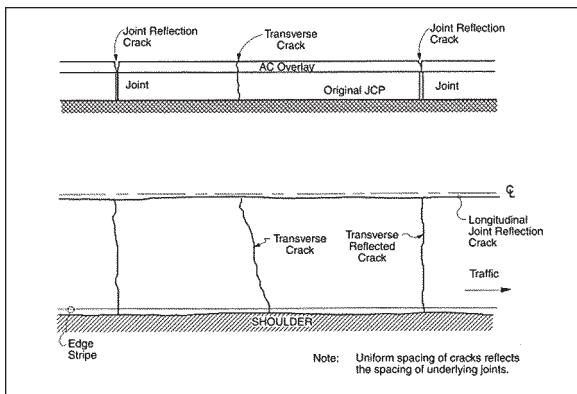


Figure 16: Distress Type ACP 5
Reflection Cracking at Joints

How to Measure

Recorded as longitudinal cracking (ACP4) or transverse cracking (ACP6) on LTPP surveys.



Figure 17: Distress Type ACP 5
High Severity Reflection Cracking at Joints

6. TRANSVERSE CRACKING

Description

Cracks that are predominantly perpendicular to pavement centerline.

Severity Levels

LOW

An unsealed crack with a mean width ≤ 6 mm (0.25 in); 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 (0.25 in) and ≤ 19 mm (0.75 in); or any crack with a mean width ≤ 19 mm (0.75 in) and adjacent low severity random cracking.

HIGH

Any crack with a mean width $> 19 \text{ mm}$ (0.75 in); or any crack with a mean width $\leq 19 \text{ mm}$ (0.75 in) and adjacent moderate to high severity random cracking.

How to Measure

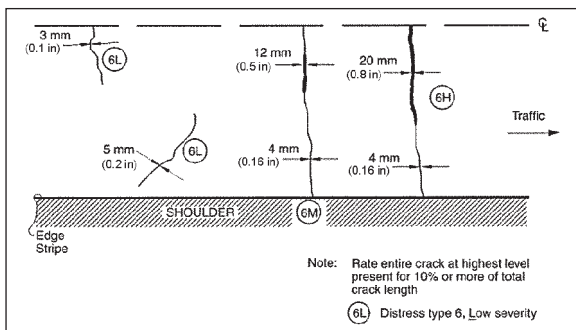
Record number and length of transverse cracks at each severity level. Rate the entire transverse crack at the highest severity level present for at least 10 percent of the total length of the crack. Length recorded, in meters (feet), is the total length of the crack and is assigned to the highest severity level present for at least 10 percent of the total length of the crack.

Also record length in meters (feet) of transverse cracks with sealant in good condition at each severity level.

Note: The length recorded is the total length of the well-sealed crack and is assigned to the severity level of the crack. Record only when the sealant is in good condition for at least 90 percent of the length of the crack.

If the transverse crack extends through an area of fatigue cracking, the length of the crack within the fatigue area is not counted. The crack is treated as a single transverse crack, but at a reduced length.

Cracks less than 0.3 m (1 ft) in length are not recorded.



**Figure 18: Distress Type ACP 6
Transverse Cracking Asphalt Concrete Surfaces**



**Figure 19: Distress Type ACP 6
Low Severity Transverse Cracking**



Figure 20: Distress Type ACP 6
Moderate Severity Transverse Cracking



Figure 21: Distress Type ACP 6
High Severity Transverse Cracking

This page intentionally left blank.

B. Patching and Potholes: This section includes the following distresses.

7. Patch/Patch Deterioration
 8. Potholes
-

7 PATCH/PATCH DETERIORATION

Description

Portion of pavement surface, greater than 0.1 m², (1 ft²) that has been removed and replaced or additional material applied to the pavement after original construction.

Severity Levels

LOW

Patch has, at most, low severity distress of any type including rutting < 6 mm (0.25 in); pumping is not evident.

MODERATE

Patch has moderate severity distress of any type or rutting from 6 mm (0.25 in) to 12 mm (0.5 in); pumping is not evident.

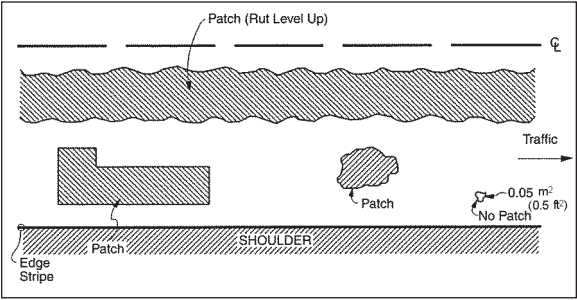
HIGH

Patch has high severity distress of any type including rutting > 12 mm (0.5 in), or the patch has additional different patch material within it; pumping may be evident.

How to Measure

Record number of patches and square meters (square feet) of affected surface area at each severity level.

Note: Any distress in the boundary of the patch is included in rating the patch. Rutting (settlement) may be at the perimeter or interior of the patch.



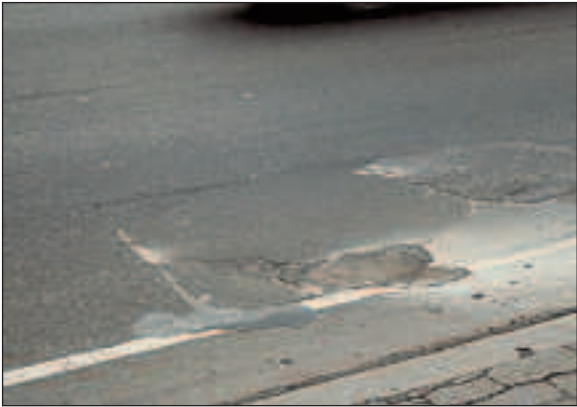
**Figure 22: Distress Type ACP 7
Patch/Patch Deterioration**



**Figure 23: Distress Type ACP 7
Low Severity Patch**



**Figure 24: Distress Type ACP 7
Moderate Severity Patch**



**Figure 25: Distress Type ACP 7
High Severity Patch**

8. POTHOLES

Description

Bowl-shaped holes of various sizes in the pavement surface. Minimum plan dimension is 150 mm (0.5 ft).

Severity Levels

LOW

< 25 mm (1 in) deep.

MODERATE

25 mm (1 in) to 50 mm (2 in) deep.

HIGH

> 50 mm (2 in) deep.

How to Measure

Record number of potholes and square meters (square feet) of affected area at each severity level. Pothole depth is the maximum depth below pavement surface. If pothole occurs within an area of fatigue cracking the area of fatigue cracking is reduced by the area of the pothole.

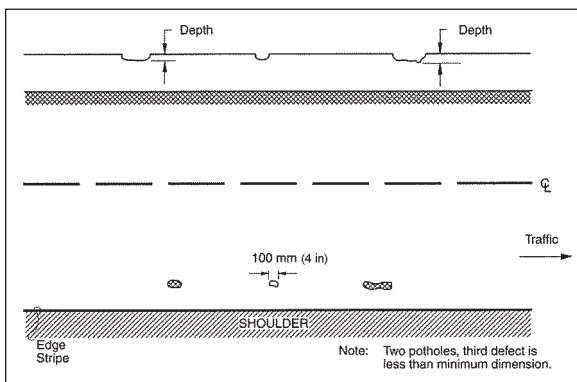


Figure 26: Distress Type ACP 8—Potholes



Figure 27: Distress Type ACP 8 Low Severity Pothole



**Figure 28: Distress Type ACP 8
Moderate Severity Pothole**



**Figure 29: Distress Type ACP 8
Moderate Severity Pothole, Close-up View**



**Figure 30: Distress Type ACP 8
High Severity Pothole, Close-up View**

C. Surface Deformation: This section includes the following types of surface deformations:

9. Rutting
10. Shoving

9. RUTTING

Description

A rut is a longitudinal surface depression in the wheel path. It may have associated transverse displacement.

Severity Levels

Not applicable. Severity levels could be defined by categorizing the measurements taken. A record of the measurements taken is much more desirable, because it is more accurate and repeatable than are severity levels.

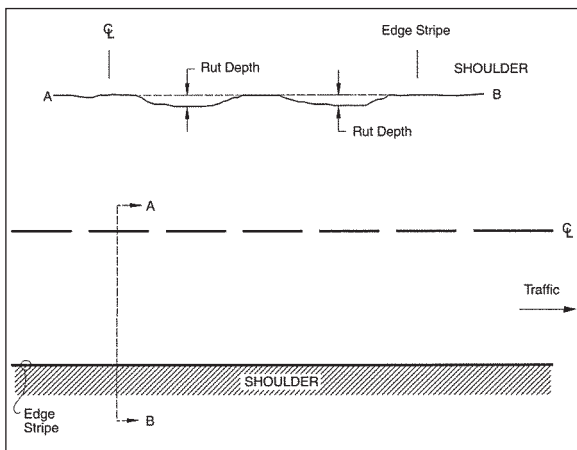


Figure 31: Distress Type ACP 9—Rutting

How to Measure

Specific Pavement Studies (SPS)-3 ONLY. Record maximum rut depth to the nearest millimeter (inches) at 15.25 m (50 ft) intervals for each wheel path, as measured with a 1.2 m (4 ft) straight edge.

All other LTPP sections: Transverse profile is measured with a Dipstick® profiler at 15.25 m (50 ft) intervals.



Figure 32: Distress Type ACP 9 - Rutting



**Figure 33: Distress Type ACP 9
Standing Water in Ruts**

10. SHOVING

Description

Shoving is a longitudinal displacement of a localized area of the pavement surface. It is generally caused by braking or accelerating vehicles, and is usually located on hills or curves, or at intersections. It also may have associated vertical displacement.

Severity Levels

Not applicable. However, severity levels can be defined by the relative effect of shoving on ride quality.

How to Measure

Record number of occurrences and square meters (square feet) of affected surface area.

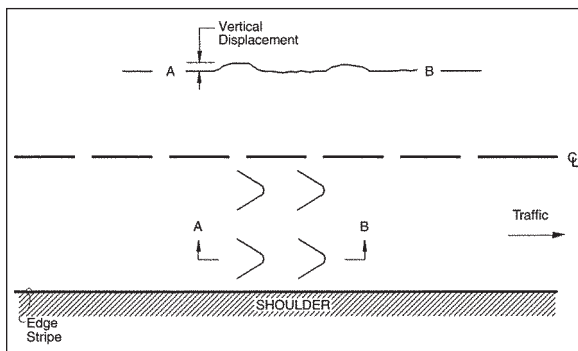


Figure 34: Distress Type ACP 10—Shoving



**Figure 35: Distress Type ACP 10
Shoving in Pavement Surface**

D. Surface Defects: This section includes the following types of surface defects:

- 11. Bleeding
- 12. Polished Aggregate
- 13. Raveling

11. BLEEDING (FLUSHING)

Description

Excess bituminous binder occurring on the pavement surface, usually found in the wheel paths. May range from a surface discolored relative to the remainder of the pavement, to a surface that is losing surface texture because of excess asphalt, to a condition where the aggregate may be obscured by excess asphalt possibly with a shiny, glass-like, reflective surface that may be tacky to the touch.

Severity Levels

LOW

An area of pavement surface discolored relative to the remainder of the pavement by excess asphalt.

MODERATE

An area of pavement surface that is losing surface texture due to excess asphalt.

HIGH

Excess asphalt gives the pavement surface a shiny appearance; the aggregate may be obscured by excess asphalt; tire marks may be evident in warm weather.

How to Measure

Record square meters (square feet) of surface area affected.

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

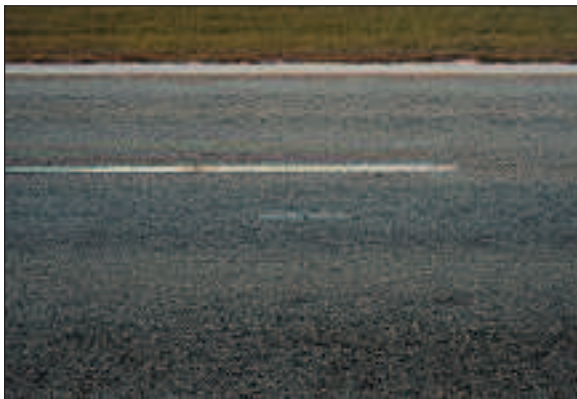


Figure 36: Distress Type ACP 11 Low Severity - Discoloration



Figure 37: Distress Type ACP 11
Moderate Severity - Loss of Texture



Figure 38: Distress Type ACP 11
High Severity - Aggregate Obscured

12. POLISHED AGGREGATE

Description

Surface binder worn away to expose coarse aggregate.

Severity Levels

Not applicable. However, the degree of polishing may be reflected in a reduction of surface friction.

How to Measure

Record square meters (square feet) of affected surface area. Polished aggregate should not be rated on test sections that have received a preventive maintenance treatment that has covered the original pavement surface.



Figure 39: Distress Type ACP 12 - Polished Aggregate

13. RAVELING

Description

Wearing away of the pavement surface caused by the dislodging of aggregate particles and loss of asphalt binder. Raveling ranges from loss of fines to loss of some coarse aggregate and ultimately to a very rough and pitted surface with obvious loss of aggregate.

Severity Levels

LOW

The aggregate or binder has begun to wear away but has not progressed significantly. Some loss of fine aggregate.

MODERATE

Aggregate and/or binder has worn away and the surface texture is becoming rough and pitted; loose particles generally exist; loss of fine aggregate and some loss of coarse aggregate.

HIGH

Aggregate and/or binder has worn away and the surface texture is very rough and pitted; loss of coarse aggregate.

How to Measure

Record square meters (square feet) of affected surface. Raveling should not be rated on chip seals.



Figure 40: Distress Type ACP 13 Low Severity - Loss of Fine Aggregate



Figure 41: Distress Type ACP 13 – Moderate Severity Loss of Fine and Some Coarse Aggregate



**Figure 42: Distress Type ACP 13
Loss of Coarse Aggregate**

E. Miscellaneous Distress: This section includes the following distresses:

14. Lane-to-Shoulder Dropoff
15. Water Bleeding and Pumping

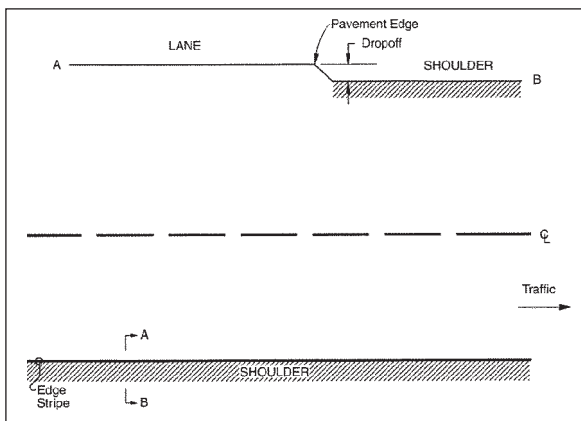
14. LANE-TO-SHOULDER DROPOFF

Description

Difference in elevation between the traveled surface and the outside shoulder. Typically occurs when the outside shoulder settles as a result of pavement layer material differences.

Severity Level

Not applicable. Severity levels could be defined by categorizing the measurements taken. A record of the measurements taken is much more desirable, however, because it is more accurate and repeatable than are severity levels.



**Figure 43: Distress Type ACP 14
Lane-to-Shoulder Dropoff**

How to Measure

Not recorded in LTPP surveys.



**Figure 44: Distress Type ACP 14
Lane-to-Shoulder Dropoff**

15. WATER BLEEDING AND PUMPING

Description

Seeping or ejection of water from beneath the pavement through cracks. In some cases, detectable by deposits of fine material left on the pavement surface, which were eroded (pumped) from the support layers and have stained the surface.

Severity Levels

Not applicable. Severity levels are not used because the amount and degree of water bleeding and pumping changes with varying moisture conditions.

How to Measure

Record the number of occurrences of water bleeding and pumping and the length in meters (feet) of affected pavement with a minimum length of 1 m (3 ft).

Note. The combined length of water bleeding and pumping cannot exceed the length of the test section.



**Figure 45: Distress Type ACP 15
Water Bleeding and Pumping**



Figure 46: Distress Type ACP 15
Fine Material Left on Surface by Water Bleeding
and Pumping

ADHESIVE FAILURE

loss of bond (e.g., between the joint sealant and the joint reservoir; between the aggregate and the binder)

AGGREGATE INTERLOCK

interaction of aggregate particles across cracks and joints to transfer load

APPROACH SLAB

section of pavement just prior to joint, crack, or other significant roadway feature relative to the direction of traffic (see also leave slab)

BINDER

brown or black adhesive material used to hold stones together for paving

BITUMINOUS

like or from asphalt

BLEEDING

identified by a film of bituminous material on the pavement surface that creates a shiny, glass-like, reflective surface that may be tacky to the touch in warm weather

BLOCK CRACKING

the occurrence of cracks that divide the asphalt surface into approximately rectangular pieces, typically 0.1 m² or more in size

BLOWUP

the result of localized upward movement or shattering of a slab along a transverse joint or crack

CENTERLINE

the painted line separating traffic lanes

CHIPPING

breaking or cutting off small pieces from the surface

COHESIVE FAILURE

the loss of a material's ability to bond to itself. Results in the material splitting or tearing apart from itself (i.e., joint sealant splitting)

CONSTRUCTION JOINT

the point at which work is concluded and reinitiated when building a pavement

CORNER BREAK

a portion of a jointed concrete pavement separated from the slab by a diagonal crack intersecting the transverse and longitudinal joint, which extends down through the slab, allowing the corner to move independently from the rest of the slab

DURABILITY CRACKING

the breakup of concrete due to freeze-thaw expansive pressures within certain aggregates. Also called "D" cracking

EDGE CRACKING

fracture and materials loss in pavements without paved shoulders that occurs along the pavement perimeter. Caused by soil movement beneath the pavement

EXTRUSION

to be forced out (i.e., joint sealant from joint)

FATIGUE CRACKING

a series of small, jagged, inter-connecting cracks caused by failure of the AC surface under repeated traffic loading (also called alligator cracking)

FAULT

difference in elevation between opposing sides of a joint or crack

FREE EDGE

pavement border that is able to move freely

HAIRLINE CRACK

a fracture that is very narrow in width, less than 3 mm (0.1 in)

JOINT SEAL DAMAGE

any distress associated with the joint sealant, or lack of joint sealant

LANE LINE

boundary between travel lanes, usually a painted stripe

LANE-TO-SHOULDER DROPOFF

the difference in elevation between the traffic lane and shoulder

LANE-TO-SHOULDER SEPARATION

widening of the joint between the traffic lane and the shoulder

LEAVE SLAB

section of pavement just past a joint, crack, or other significant roadway feature relative to the direction of traffic

LONGITUDINAL

parallel to the centerline of the pavement

MAP CRACKING

a series of interconnected hairline cracks in PCC pavements that extend only into the upper surface of the concrete. Includes cracking typically associated with alkali-silica reactivity

PATCH

an area where the pavement has been removed and replaced with a new material

PATCH DETERIORATION

distress occurring within a previously repaired area

POLISHED AGGREGATE

surface mortar and texturing worn away to expose coarse aggregate in the concrete

POPOUTS

small pieces of pavement broken loose from the surface

POTHOLE

a bowl-shaped depression in the pavement surface

PUMPING

the ejection of water and fine materials through cracks in the pavement under moving loads

PUNCHOUT

a localized area of a CRCP bounded by two transverse cracks and a longitudinal crack. Aggregate interlock decreases over time and eventually is lost, leading to steel rupture and allowing the pieces to be punched down into the subbase and subgrade

RAVELING

the wearing away of the pavement surface caused by the dislodging of aggregate particles

REFLECTION CRACKING

the fracture of AC above joints in the underlying jointed concrete pavement layer(s)

RUTTING

longitudinal surface depressions in the wheel paths

SCALING

the deterioration of the upper 3–12 mm (0.1 in–0.5 in) of the concrete surface, resulting in the loss of surface mortar

SHOVING

permanent, longitudinal displacement of a localized area of the pavement surface caused by traffic pushing against the pavement

SPALLING

cracking, breaking, chipping, or fraying of the concrete slab surface within 0.6 m (2 ft) of a joint or crack

TRANSVERSE

perpendicular to the pavement centerline

WATER BLEEDING

seepage of water from joints or cracks

WEATHERING

the wearing away of the pavement surface caused by the loss of asphalt binder

MANUAL FOR DISTRESS SURVEYS

Table of Contents

Introduction / A1

Equipment for Distress Surveys / A2

Instructions for Completing Distress Maps / A2

Asphalt Concrete-Surfaced Pavement

Survey Sheets' Data Elements / A4

Instructions for Completing ACP Distress Survey Sheets / A5

Description of Data Sheet 1

Description of Data Sheet 2

Description of Data Sheet 3

Example Survey Map / A7

Blank Distress Map Forms and Data Sheets / A11

INTRODUCTION

This appendix provides instructions, data sheets, and distress maps for use in visual surveys for the collection of distress information for ACP surfaces. Visual distress survey procedures have been used in the LTPP program as the primary distress data collection method since 1995. The *Distress Identification Manual for the Long-Term Pavement Performance Program* is the basis for all distress surveys performed for the LTPP.

During the visual distress survey, safety is the first consideration, as with all field data collection activities. All raters must adhere to the practices and authority of the State or Canadian Province.

EQUIPMENT FOR DISTRESS SURVEYS

The following equipment is necessary for performing field distress surveys of any pavement surface type.

- Copy of map sheets and survey forms from most recent prior survey.
- Pavement thermometer.
- Extra blank data sheets and maps.
- Pencils.
- Latest version of the *Distress Identification Manual*.
- Clipboard.
- Two tape measures, one at least 30 m (100 ft) long and a scale or ruler graduated in millimeters (0.04 in).
- Calculator.
- Hard hat or safety cap and safety vest.
- Faultmeter, calibration stand and manual for PCC test sections.
- Digital camera, video camera, tapes.
- Transverse profile equipment required for AC test sections.
- Longitudinal profile equipment is required on sites where the LTPP Profiler is unable to test.

INSTRUCTIONS FOR COMPLETING DISTRESS MAPS

The distress maps show the exact location of each distress type existing on the test section. The distress types and severity levels should be identified by using the *Distress Identification Manual*. A total of five sheets are used to map; each sheet contains two 15.25 m (50 ft) maps that represent 30.5 m (100 ft) of the test section, with the exception of SPS-6 sections 2 and 5, which are 305 m (1000 ft). Each test section must be laid out consistently each time a survey is conducted. Sections begin and end at the stations marked on the pavement. Lateral extent of the section, for survey purposes, will vary depending on the existence of longitudinal joints and cracks and the relative position of the lane markings.

Figure A1 illustrates the rules to follow when determining the lateral extent of the section for a distress survey. The lateral extent of the

test sections should be consistent with prior distress surveys. The lateral extent of AC test sections with double yellow lines on the centerline are determined by using the inside yellow line.

To map the test section, place the tape measure on the shoulder adjacent to the test section from Station 0+00 to Station 1+00. It may be necessary to secure the tape onto the pavement with adhesive tape or a heavy object. After the tape is in place, the distresses can be mapped with the longitudinal placement of the distresses read from the tape. The transverse placement and extent of the distresses can be recorded using the additional tape measure. After the first 30.5 m (100 ft) subsection is mapped, the tape measure should be moved to map the second 30.5 m (100 ft) subsection. The process is repeated throughout the test section.

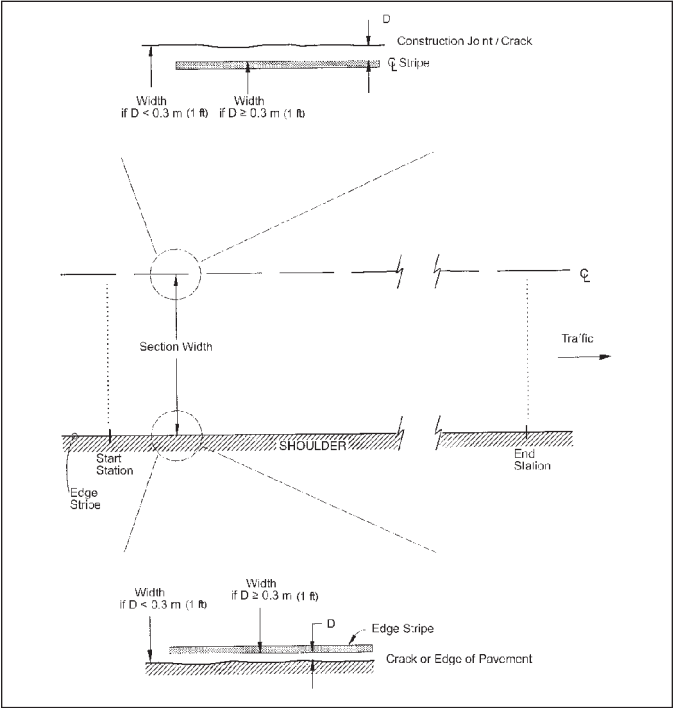


Figure A1: Test Section Limits for Surveys—Asphalt Surface

The distresses are drawn on the map at the scaled location using the symbols appropriate to the pavement type. In general, the distress is drawn and is labeled using the distress type number and the severity level (L, M, or H) if applicable.

For example, a high severity longitudinal crack in the wheel path of an ACP would be labeled “4aH.” An additional symbol is added beside the distress type and severity symbol in cases where the crack or joint is well-sealed. Figures specifying the symbols to be used for each pavement type are presented in the following chapters. In addition, example maps are provided to illustrate properly completed maps.

Any observed distresses that are not described in the *Distress Identification Manual* should be photographed and described on the comments line of the map sheet. The location and extent of the distress should be shown and labeled on the map. Crack sealant and joint sealant condition is to be mapped only for those distresses indicated in figures A4, A5, and A8. The specific distress types that are not to be included on the maps are to be recorded as follows:

Asphalt Concrete-Surfaced Pavement

If raveling, polished aggregate, or bleeding occurs in large areas over the test section, do not map the total extent. Instead, note the location and extent in the space for comments underneath the appropriate map(s). These distresses should be mapped only if they occur in localized areas. The extent of these distresses must be summarized on the data summary sheets.

SURVEY SHEETS' DATA ELEMENTS

In the common data section appearing in the upper right-hand corner of each of the distress survey data sheets the six-digit SHRP ID (two-digit State code plus four-digit SHRP Section ID) is entered. The date the survey was conducted, the initials of up to three raters, before and after pavement surface temperature readings, and the code indicating whether photographs and/or video tape were obtained at the time of the survey are entered in the appropriate spaces.

INSTRUCTIONS FOR COMPLETING ACP DISTRESS SURVEY SHEETS

Location of the vehicle wheel paths is critical for distinguishing between types of longitudinal cracking in ACP. Figure A3 illustrates the procedure for establishing the location and extent of the wheel paths. Both wheel paths must be drawn and identified on the distress maps. The distresses observed are recorded to scale on map sheets. The individual distresses and severity levels depicted on the map are carefully scaled and summed to arrive at the appropriate quantities (e.g., square meters [square feet] or number of occurrences) and are then recorded on sheets 1-3. It is important to carefully evaluate the distress map for certain distress types which have multiple

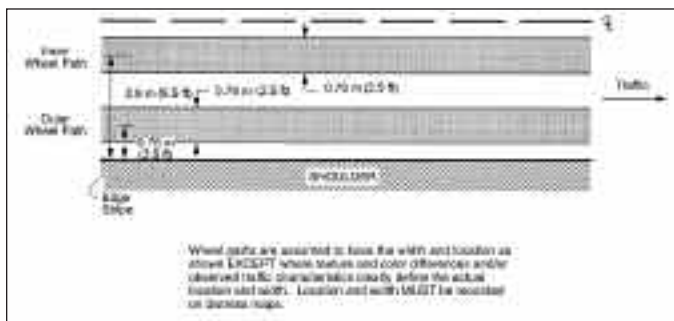
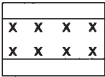
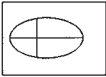
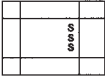
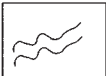
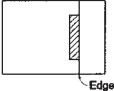
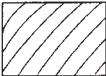
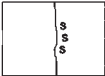
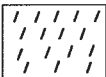
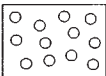
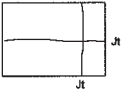
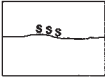
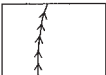


Figure A3: Locating Wheel Paths in Asphalt Concrete-Surfaced Pavements

methods of measurement because of orientation or location within the section. Longitudinal cracking, in the wheel path or elsewhere, are examples of these. Except where indicated otherwise, entries are made for all distress data elements. If a particular type of distress does not exist on the pavement, enter “0” as a positive indication that the distress was not overlooked in summarizing the map sheets. All data sheets are to be completed in the field prior to departing the site. Symbols to be used for mapping ACP sections are contained in figure A4, and an example mapped section is shown in figure A5.

<u>Distress Type</u>	<u>Symbol</u>	<u>Distress Type</u>	<u>Symbol</u>
1. Fatigue Cracking (Square Meters [Square Feet]) L, M, H*		8. Potholes (Square Meters [Square Feet]) L, M, H*	
2. Block Cracking (Square Meters [Square Feet]) L, M, H*		9. Rutting**	
S - Sealed		10. Shoving (Square Meters [Square Feet]) No severity levels	
3. Edge Cracking (Meters [Feet]) L, M, H*		11. Bleeding (Square Meters [Square Feet]) No Severity Levels	
4. Longitudinal Cracking (Meters [Feet]) L, M, H*		12. Polished Aggregate (Square Meters [Square Feet]) No severity levels	
S - Sealed		13. Raveling (Square Meters [Square Feet]) No Severity Levels	
5. Reflection Cracking at Joints Not measured in LTPP Surveys		14. Lane - to - Shoulder Dropoff** Not measured in LTPP Surveys	
6. Transverse Cracking (Number of Cracks and Length [Meters (Feet)]) L, M, H*		15. Water Bleeding and Pumping (Number of Occurrences and Length of Affected Pavement [Meters (Feet)]) No severity levels	
S - Sealed			
7. Patch/Patch Deterioration (Square Meters [Square Feet] and Number) L, M, H*			

*Low, Moderate, and High severity levels.

**Not drawn on distress maps.

Figure A4: Distress Map Symbols for Asphalt Concrete-Surfaced Pavements

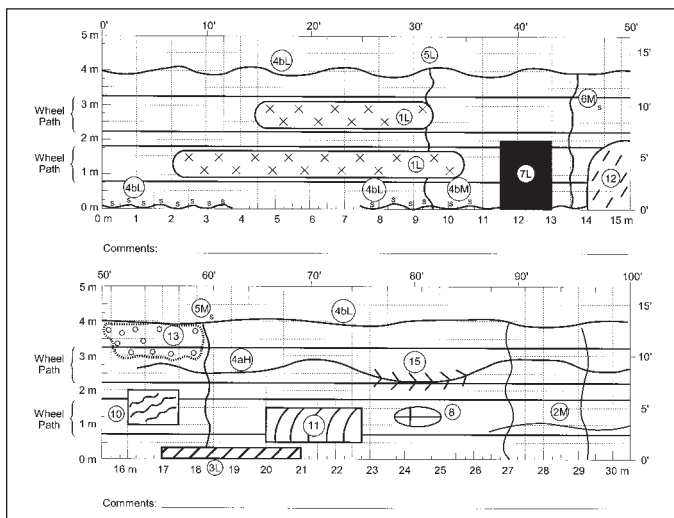


Figure A5: Example Map of First 30.5 meters (100 feet) of Asphalt Concrete Pavement Section

Description of Data Sheet 1

This data sheet provides space for recording measured values for the distress types identified in the left column. The units of measurement for each of the distress types are also identified in the left column. The extent of the measured distress for each particular level of severity is entered in the severity level columns identified as low, moderate, or high. Enter “0” for any distress types and/or severity levels not found.

Description of Data Sheet 2

This sheet is a continuation of the distress survey data recorded on sheet 1 and is completed as described under data sheet 1. In addition, space is provided to list “Other” distress types found on the test section but not listed on data sheets 1 or 2.

Description of Data Sheet 3

This data sheet provides space to record rutting, using a straight edge 1.2 m (4.0 ft) long. Manual rutting measurements using a straight

edge are only taken for visual surveys conducted on SPS-3 experiment sections. Measurements are taken at the beginning of the test section and at 15.25 m (50 ft) intervals. There should be a total of 11 measurements in each wheel path, for a total of 22 measurements on each test section.

Blank Distress Map Forms and Data Sheets

These map forms and data sheets may be photocopied from the *Distress Identification Manual* for field use. Note that each type of pavement has its own data sheets.

Revised Dec 1992; Jan 1999; Feb 2002

SHEET 1

DISTRESS SURVEY

STATE CODE _____

LTPP PROGRAM

SHRP SECTION ID _____

DISTRESS SURVEY FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) _____/_____/_____

SURVEYORS: _____, _____ PHOTOS, VIDEO, OR BOTH WITH SURVEY (P,V,B) _____

PAVEMENT SURFACE TEMP - BEFORE _____°C; AFTER _____°C

DISTRESS TYPE	SEVERITY LEVEL		
	LOW	MODERATE	HIGH
CRACKING			
1. FATIGUE CRACKING (SQUARE METERS)	_____.____	_____.____	_____.____
2. BLOCK CRACKING (SQUARE METERS)	_____.____	_____.____	_____.____
3. EDGE CRACKING (METERS)	_____.____	_____.____	_____.____
4. LONGITUDINAL CRACKING			
4a. Wheelpath (Meters)	_____.____	_____.____	_____.____
Length Sealed (Meters)	_____.____	_____.____	_____.____
4b. Non-Wheelpath (Meters)	_____.____	_____.____	_____.____
Length Sealed (Meters)	_____.____	_____.____	_____.____
5. REFLECTION CRACKING AT JOINTS	Not Recorded		
6. TRANSVERSE CRACKING			
Number of Cracks	____.____	____.____	____.____
Length (Meters)	_____.____	_____.____	_____.____
Length Sealed	_____.____	_____.____	_____.____
PATCHING AND POTHOLES			
7. PATCH/ PATCH DETERIORATION (Number) (Square Meters)	____.____ _____.____	____.____ _____.____	____.____ _____.____
8. POTHOLES (Number) (Square Meters)	____.____ _____.____	____.____ _____.____	____.____ _____.____

Data Sheet 1: ACP Distress Survey

SHEET 2

DISTRESS SURVEY

STATE CODE

LTPP PROGRAM

SHRP ID

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) ____/____/____

SURVEYORS: ____'____

DISTRESS SURVEY FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES
(CONTINUED)

DISTRESS TYPE	SEVERITY LEVEL		
	LOW	MODERATE	HIGH
SURFACE DEFORMATION			
9. RUTTING - REFER TO SHEET 3 FOR SPS - 3 FOR FORM S1 SEE DIPSTICK MANUAL			
10. SHOving (Number) (Square Meters)			____
SURFACE DEFECTS			
11. BLEEDING (Square Meters)			____
12. POLISHED AGGREGATE (Square Meters)			____
13. RAVELING (Square Meters)			____
MISCELLANEOUS DISTRESSES			
14. LANE-TO-SHOULDER DROPOFF - NOT RECORDED			
15. WATER BLEEDING AND PUMPING (Number) Length of Affected Pavement (Meters)			____
16. OTHER (Describe)			____

Data Sheet 2: ACP Distress Survey

SHEET 3
DISTRESS SURVEY
LTPP PROGRAM

STATE CODE — —

SHRP ID — — — — —

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) — — / — — / — —

SURVEYORS: — — — — —

DISTRESS SURVEY FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES
(CONTINUED)

9. RUTTING (FOR SPS-3 SURVEYS)

INNER WHEEL PATH			OUTER WHEEL PATH		
Point No.	Point Distance ¹ (Meters)	Rut Depth (mm)	Point No.	Point Distance ¹ (Meters)	Rut Depth (mm)
1	0.0	— — — —	1	0.0	— — — —
2	15.25	— — — —	2	15.25	— — — —
3	30.5	— — — —	3	30.5	— — — —
4	45.75	— — — —	4	45.75	— — — —
5	61.0	— — — —	5	61.0	— — — —
6	76.25	— — — —	6	76.25	— — — —
7	91.5	— — — —	7	91.5	— — — —
8	106.75	— — — —	8	106.75	— — — —
9	122.0	— — — —	9	122.0	— — — —
10	137.25	— — — —	10	137.25	— — — —
11	152.5	— — — —	11	152.5	— — — —

14. LANE-TO-SHOULDER DROPOFF -- Not Recorded

Note 1: "Point Distance" is the distance in meters for the start of the test section to the point where the measurement was made. The values shown are approximate S1 equivalents of the 50 ft spacing used in previous surveys.

Data Sheet 3: ACP Distress Survey

Reviewer: _____

Surveyors: _____

Pavement Temp: _____

Date: _____

Before _____

After _____

Section Summary

5 m

4 m

3 m

2 m

1 m

0 m

0'

10'

20'

30'

40'

50'

0 m

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15 m

15'

10'

5'

0'

Sheet Summary

5 m

4 m

3 m

2 m

1 m

0 m

0'

10'

20'

30'

40'

50'

0 m

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30 m

15'

10'

5'

0'

Comments: _____

Comments: _____

Map Form: ACP Distress