

DISTRESS IDENTIFICATION GUIDE

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



U.S. Department of Transportation
Federal Highway Administration

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**CONTINUOUSLY
REINFORCED
CONCRETE
PAVEMENTS**



U.S. Department of Transportation
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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.tfhrc.gov/pavement/ltpp/product.htm>.

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**Recycled
Recyclables**

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS FROM SI UNITS

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
in	inches	0.0254	meters	m	meters	39.37	inches
ft	feet	0.3048	meters	m	meters	3.28	feet
yd	yards	0.9144	meters	m	meters	1.09	yards
mi	miles	1.61	kilometers	km	kilometers	0.621	miles
sq in	SQUARE INCHES	645.2	SQUARES	mm ²	SQUARE MILLIMETERS	0.0016	SQUARE INCHES
sq ft	SQUARE FEET	0.093	SQUARE METERS	m ²	SQUARE METERS	10.764	SQUARE FEET
sq yd	SQUARE YARDS	0.836	SQUARE METERS	m ²	SQUARE METERS	1.196	SQUARE YARDS
sq mi	SQUARE MILES	2.6	SQUARE KILOMETERS	km ²	SQUARE KILOMETERS	2.47	SQUARE MILES
cu in	Solid INCHES	16.39	CUBIC CENTIMETERS	cc	CUBIC CENTIMETERS	0.061	Solid INCHES
cu ft	Solid FEET	0.028	CUBIC METERS	m ³	CUBIC METERS	35.314	Solid FEET
cu yd	Solid YARDS	0.765	CUBIC METERS	m ³	CUBIC METERS	1.357	Solid YARDS
oz	ounces	28.35	grams	g	grams	0.035	ounces
lb	pounds	4.54	kilograms	kg	kilograms	2.205	pounds
ton	SHORT TONS (2000 lb)	0.907	megagrams (or metric ton)	Mg (or T)	megagrams (or metric ton)	1.102	SHORT TONS (2000 lb)
°F	Fahrenheit	(°F - 32) x 5/9	Celsius	°C	Celsius	1.8C - 32	Fahrenheit
ft-candle	foot-candles	3.426	candela	cd	candela	0.093	foot-candles
psi	pounds per square inch	6.895	kilopascals	kPa	kilopascals	0.145	pounds per square inch

*SI is the symbol for the International System of Units. Approximate rounding should be made to comply with Section 4 of ASTM 1020. (Revised March 2000)

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



Local Technical Assistance Program

RESOURCE CENTER

DISTRESSES FOR PAVEMENTS WITH CONTINUOUSLY REINFORCED CONCRETE SURFACES

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2. Longitudinal Cracking
3. Transverse Cracking

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9. Lane-to-Shoulder Dropoff
10. Lane-to-Shoulder Separation
11. Patch/Patch Deterioration
12. Punchouts
13. Spalling of Longitudinal Joints
14. Water Bleeding and Pumping
15. Longitudinal Joint Seal Damage

This section covers continuously reinforced concrete-surface pavements (CRCP), including continuously reinforced concrete overlays on PCC pavements. Each of the distresses has been grouped into one of the following categories:

- A. Cracking**
- B. Surface Defects**
- C. Miscellaneous Distresses**

Table 3 summarizes the various types of distress and unit of measurement. Some distresses also have defined severity levels.

TABLE 3. Continuously Reinforced Concrete-Surfaced Pavement Distress Types

Distress Type	Unit of Measure	Defined Severity Levels?
A. Cracking / page 2		
1. Durability Cracking (“D” Cracking)	Number, m ² (ft ²)	Yes
2. Longitudinal Cracking	Meters (Feet)	Yes
3. Transverse Cracking	Number, m (ft)	Yes
B. Surface Defects / page 11		
4a. Map Cracking	Number, m ² (ft ²)	No
4b. Scaling	Number, m ² (ft ²)	No
5. Polished Aggregate	m ² (ft ²)	No
6. Popouts	Not Measured	N/A
C. Miscellaneous Distresses / page 15		
7. Blowups	Number	No
8. Transverse Construction Joint Deterioration	Number	Yes
9. Lane-to-Shoulder Dropoff	mm (inches)	No
10. Lane-to-Shoulder Separation	mm (inches)	No
11. Patch/Patch Deterioration	Number, m ² (ft ²)	Yes
12. Punchouts	Number	Yes
13. Spalling of Longitudinal Joints	Meters (Feet)	Yes
14. Water Bleeding and Pumping	Number, m (ft)	No
15. Longitudinal Joint Seal Damage	Number, m (ft)	No

A. Cracking: This section includes the following distresses:

1. Durability Cracking (“D” Cracking)
2. Longitudinal Cracking
3. Transverse Cracking

1. DURABILITY CRACKING (“D” CRACKING)

Description

Closely spaced, crescent-shaped hairline cracking pattern. Occurs adjacent to joints, cracks, or free edges. Initiates at the intersection, e.g., cracks and a free edge.

Dark coloring of the cracking pattern and surrounding area.

Severity Levels

LOW

“D” cracks are tight, with no loose or missing pieces, and no patching is in the affected area.

MODERATE

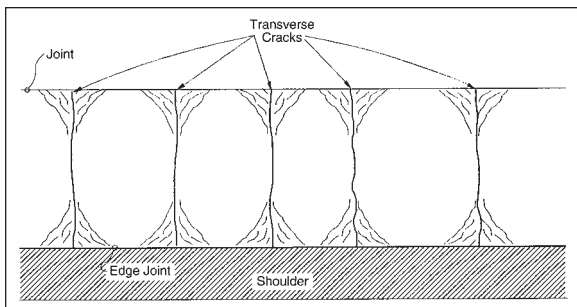
“D” cracks are well-defined, and some small pieces are loose or have been displaced.

HIGH

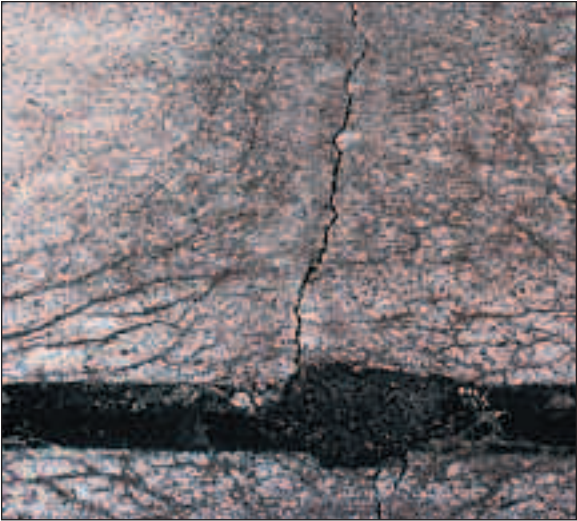
“D” cracking has a well-developed pattern, with a significant amount of loose or missing material. Displaced pieces, up to 0.1 m² (1.0 ft²) may have been patched.

How to Measure

Record number of affected transverse cracks at each severity level and the square meters (square feet) of area affected at each severity level. The transverse crack and affected area severity rating is based on the highest severity level present for at least 10 percent of the area affected.



**Figure 90: Distress Type CRCP 1
Durability Cracking (“D” Cracking)**



**Figure 91: Distress Type CRCP 1
Moderate Severity “D” Cracking at Transverse Crack**



**Figure 92: Distress Type CRCP 1
High Severity “D” Cracking at Longitudinal Joint**

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2. LONGITUDINAL CRACKING

Description

Cracks that are predominantly parallel to the pavement centerline.

Severity Levels

LOW

Crack widths < 3 mm (0.1 in), no spalling, and there is no measurable faulting; or well-sealed and with a width that cannot be determined.

MODERATE

Crack widths ≥ 3 mm (0.1 in) and < 13 mm (0.5 in); or with spalling < 75 mm (3 in); or faulting up to 13 mm (0.5 in).

HIGH

Crack widths ≥ 3 mm (0.1 in); or with spalling ≥ 75 mm (3 in); or faulting ≥ 13 mm (0.5 in).

How to Measure

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

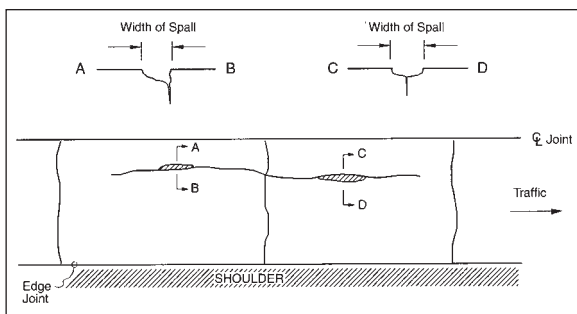


Figure 93: Distress Type CRCP 2 – Longitudinal Cracking



**Figure 94: Distress Type CRCP 2
Low Severity Longitudinal Cracking**



**Figure 95: Distress Type CRCP 2
High Severity Longitudinal Cracking**

3. 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.

Severity Levels

LOW

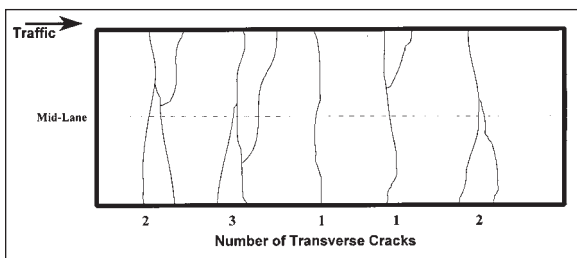
Cracks that are not spalled or with spalling along ≤ 10 percent of the crack length.

MODERATE

Cracks with spalling along > 10 percent and ≤ 50 percent of the crack length.

HIGH

Cracks with spalling along > 50 percent of the crack length.

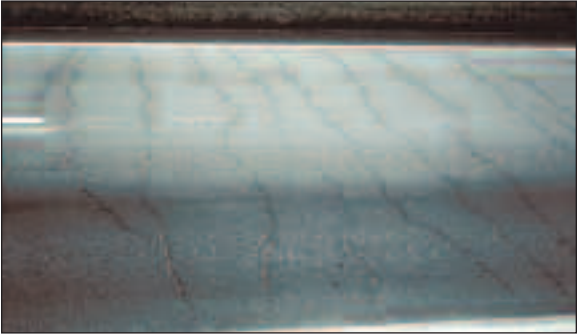


**Figure 96: Distress Type CRCP 3
Transverse Cracking**

How to Measure

Record separately the number and length in meters (feet) of transverse cracking at each severity level. The sum of all the individual crack lengths shall be recorded. Then record the total number of transverse cracks within the survey section.

Note: Cracks that do not cross midlane, although not counted, should be drawn on the map sheets.



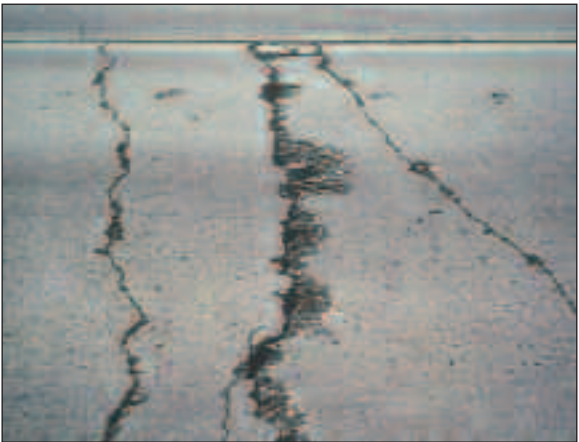
**Figure 97: Distress Type CRCP 3
Transverse Cracking Pattern**



**Figure 98: Distress Type CRCP 3
Low Severity Transverse Cracking**



**Figure 99: Distress Type CRCP 3
Moderate Severity Transverse Cracking**



**Figure 100: Distress Type CRCP 3
High Severity Transverse Cracking**

B. Surface Defects: This section includes the following:

- 4a. Map Cracking
 - 4b. Scaling
 5. Polished Aggregate
 6. Popouts
-

4. MAP CRACKING AND SCALING

4a. MAP CRACKING

Description

A series of cracks that extend only into the upper surface of the slab. Larger cracks frequently are oriented in the longitudinal direction of the pavement and are interconnected by finer transverse or random cracks.

Severity Levels

Not Applicable

How to Measure

Record the number of occurrences and the square meters (square feet) of affected area. When an entire section is affected with map cracking, it should be considered one occurrence.



**Figure 101: Distress Type CRCP 4a
Map Cracking Attributable to Alkali-Silica Reactivity**

4b. SCALING

Description

Scaling is the deterioration of the upper concrete slab surface, normally 3 mm (0.1 in) to 13 mm (0.5 in), and may occur anywhere over the pavement.

Severity Levels

Not Applicable

How to Measure

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



Figure 102: Distress Type CRCP 4b - Scaling

5. POLISHED AGGREGATE

Description

Surface mortar and texturing 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 the square meters (square feet) of affected surface area.

NOTE: Diamond grinding also removes the surface mortar and texturing. However, this condition should not be recorded as polished aggregate but instead should be noted by a comment.



**Figure 103: Distress Type CRCP 5
Polished Aggregate**

6. POPOUTS

Description

Small pieces of pavement broken loose from the surface, normally ranging in diameter from 25 mm (1 in) to 100 mm (4 in) and depth from 13 mm (0.5 in) to 50 mm (2 in).

Severity Levels

Not Applicable

However, severity levels can be defined in relation to the intensity of popouts as measured below.

How to Measure

Not recorded in LTPP surveys.

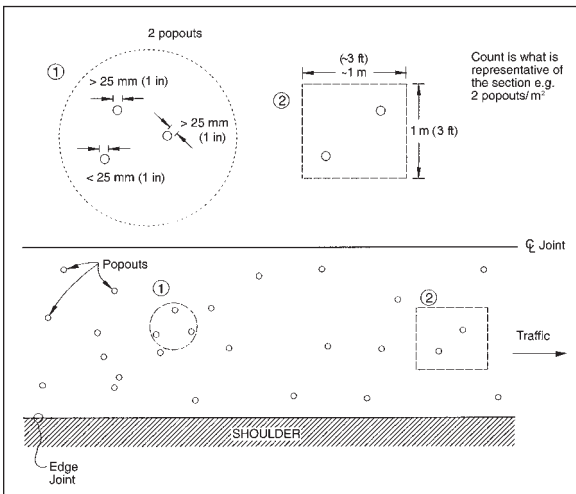


Figure 104: Distress Type CRCP 6 - Popouts



Figure 105: Distress Type CRCP 6 - Popouts

C. Miscellaneous Defects: This section includes the following distresses:

7. Blowups
8. Transverse Construction Joint Deterioration
9. Lane-to-Shoulder Dropoff
10. Lane-to-Shoulder Separation
11. Patch/Patch Deterioration
12. Punchouts
13. Spalling of Longitudinal Joints
14. Water Bleeding and Pumping
15. Longitudinal Joint Seal Damage

7. BLOWUPS

Description

Localized upward movement of the pavement surface at transverse joints or cracks, often accompanied by shattering of the concrete in that area.

Severity Levels

Not Applicable

However, severity levels can be defined by the relative effect of a blowup on ride quality and safety.

How to Measure

Record number of blowups.

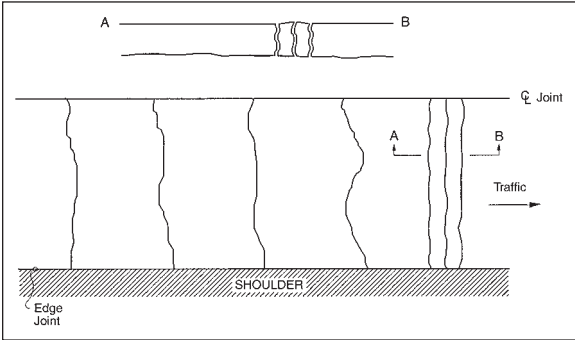
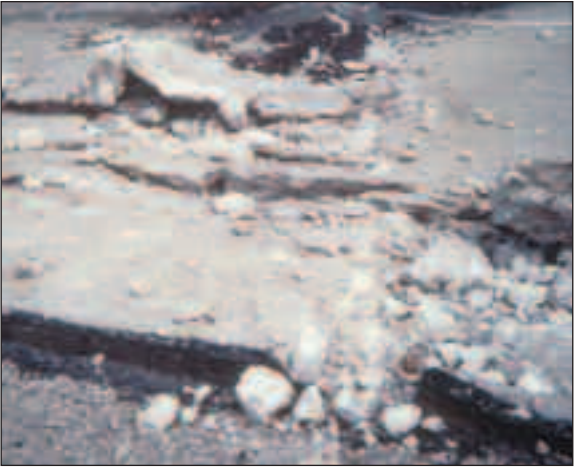


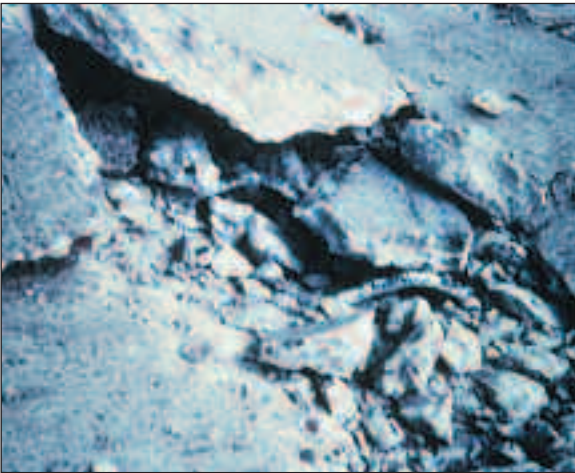
Figure 106: Distress Type CRCP 7 - Blowups



Figure 107: Distress Type CRCP 7 – A Blowup



**Figure 108: Distress Type CRCP 7
Close-up View of a Blowup**



**Figure 109: Distress Type CRCP 7
Exposed Steel in a Blowup**

8. TRANSVERSE CONSTRUCTION JOINT DETERIORATION

Description

Series of closely spaced transverse cracks or a large number of interconnecting cracks occurring near the construction joint.

Severity Levels

LOW

No spalling or faulting within 0.6 m (2.0 ft) of construction joint.

MODERATE

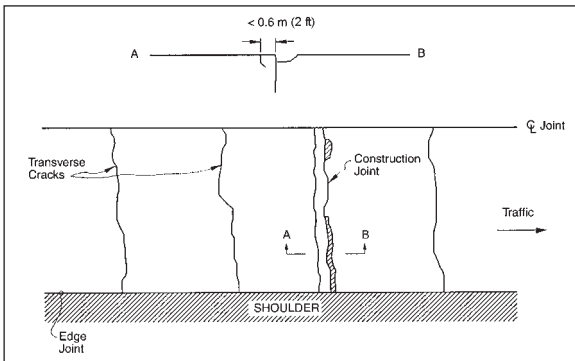
Spalling < 75 mm (3 in) exists within 0.6 m (2.0 ft) of construction joint.

HIGH

Spalling ≥ 75 mm (3 in) and breakup exists within 0.6 m (2.0 ft) of construction joint.

How to Measure

Record number of construction joints at each severity level.



**Figure 110: Distress Type CRCP 8
Transverse Construction Joint Deterioration**



Figure 111: Distress Type CRCP 8 – Low Severity Transverse Construction Joint Deterioration



Figure 112: Distress Type CRCP 8 – Moderate Severity Transverse Construction Joint Deterioration



Figure 113: Distress Type CRCP 8 – Low Severity Transverse Construction Joint Deterioration

9. LANE-TO-SHOULDER DROPOFF

Description

Difference in elevation between the edge of slab and outside shoulder; typically occurs when the outside shoulder settles.

Severity Levels

Not Applicable

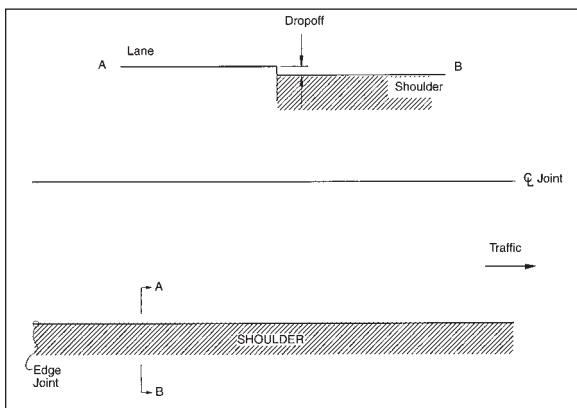
Severity levels could be defined by categorizing the measurements taken. A complete record of the measurements taken is much more desirable, however, because it is more accurate and repeatable than are severity levels.

How to Measure

Measure at the longitudinal construction joint between the lane edge and the shoulder.

Record in millimeters (inches) to the nearest millimeter (inch) at 15.25 m (50 ft) intervals along the lane-to-shoulder joint.

If the traveled surface is lower than the shoulder, record as a negative (-) value.



**Figure 114: Distress Type CRCP 9
Lane-to-Shoulder Dropoff**



**Figure 115: Distress Type CRCP 9
Lane-to-Shoulder Dropoff**

10. LANE-TO-SHOULDER SEPARATION

Description

Widening of the joint between the edge of the slab and the shoulder.

Severity Levels

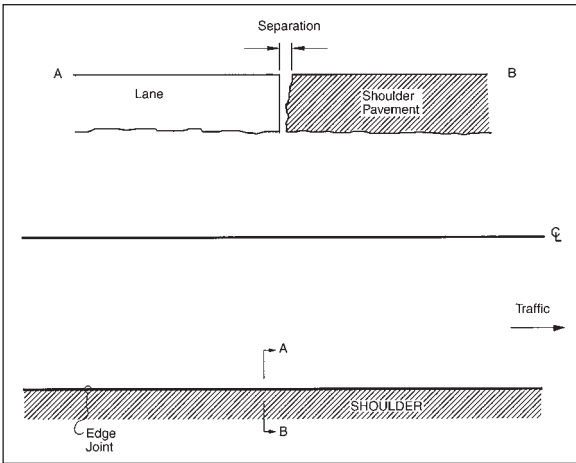
Not Applicable

Severity levels could be defined by categorizing the measurements taken. A complete record of the measurements taken is much more desirable, however, because it is more accurate and repeatable than are severity levels.

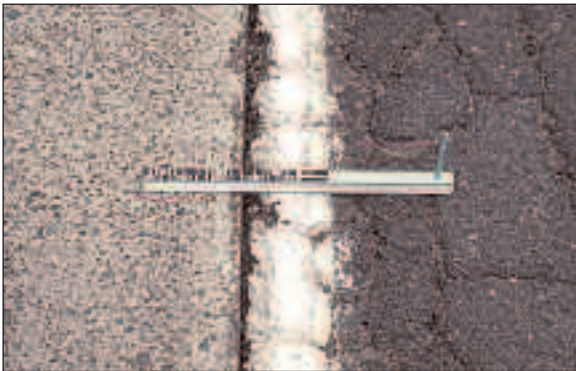
How to Measure

Record in millimeters (inches) to the nearest millimeter (inch) at 15.25 m (50 ft) intervals along the lane-to-shoulder joint and indicate whether the joint is well sealed (yes or no) at each location.

NOTE: A null value (“N”) should be recorded and entered into the database when the surveyor is unable to take a measurement due to an anomaly such as sealant or patch material.



**Figure 116: Distress Type CRCP 10
Lane-to-Shoulder Separation**



**Figure 117: Distress Type CRCP 10
Close-up View of a Lane-to-Shoulder Separation**

11. PATCH/PATCH DETERIORATION

Description

A portion, greater than 0.1 m² (1.0 ft²), or all of the original concrete slab that has been removed and replaced, or additional material applied to the pavement after original construction.

Severity Levels

LOW

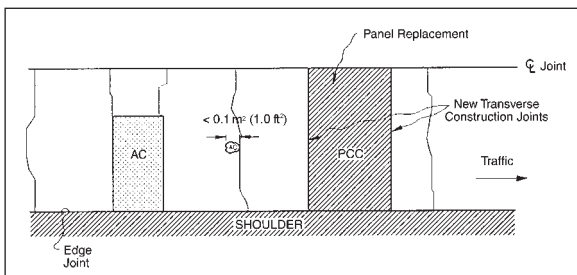
Patch has, at most, low severity distress of any type; and no measurable faulting or settlement; pumping is not evident.

MODERATE

Patch had moderate severity distress of any type; or faulting or settlement up to 6 mm (0.25 in); pumping is not evident.

HIGH

Patch has a high severity distress of any type; or faulting or settlement ≥ 6 mm (0.25 in) pumping may be evident.



**Figure 118: Distress Type CRCP 11
Patch/Patch Deterioration**

How to Measure

Record number of patches and square meters (square feet) of affected surface area at each severity level, recorded separately by material type – rigid versus flexible.

NOTE: Panel replacement shall be rated as a patch. Any sawn joints shall be considered construction joints and rated separately. All patches are rated regardless of location.



Figure 119: Distress Type CRCP 11
Small, Low Severity Asphalt Concrete Patch

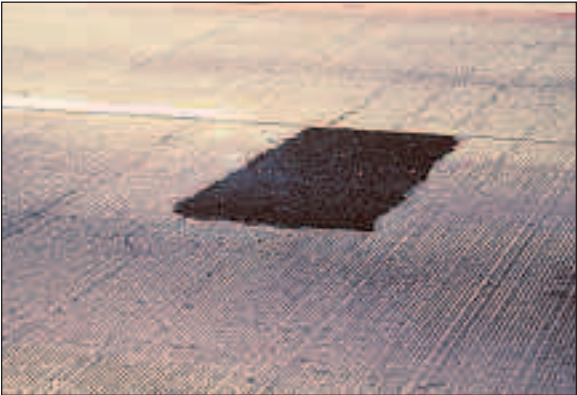


Figure 120: Distress Type CRCP 11
Low Severity Asphalt Concrete Patch



**Figure 121: Distress Type CRCP 11
Moderate Severity Asphalt Concrete Patch**



**Figure 122: Distress Type CRCP 11
Low Severity Portland Cement Concrete Patch**

12. PUNCHOUTS

Description

The area enclosed by two closely spaced (usually < 0.6 m [2.0 ft]) transverse cracks, a short longitudinal crack, and the edge of the pavement or a longitudinal joint. Also includes “Y” cracks that exhibit spalling, breakup, or faulting.

Severity Levels

LOW

Longitudinal and transverse cracks are tight and may have spalling < 75 mm (3 in) or faulting < 6 mm (0.25 in) with no loss of material and no patching. Does not include “Y” cracks.

MODERATE

Spalling ≥ 75 mm (3 in) and < 150 mm (6 in) or faulting ≥ 6 mm (0.25 in) and < 13 mm (0.5 in) exists.

HIGH

Spalling ≥ 150 mm (6 in), or concrete within the punchout is punched down by ≥ 13 mm (0.5 in) or is loose and moves under traffic or is broken into two or more pieces or contains patch material.

How to Measure

Record number of punchouts at each severity level.

The cracks which outline the punchout are also recorded under “longitudinal Cracking” (CRCP 2) and “Transverse Cracking (CRCP 3).

Punchouts that have been repaired by completely removing all broken pieces and replacing them with patching material (rigid or flexible) should be rated as a patch. If the boundaries of the punchout are visible, then also rate as a high severity punchout.

NOTE: Areas between two transverse cracks spaced greater than 0.6 m (2.0 ft) but less than or equal to 1 m (3 ft) apart, and bounded by the edge of pavement (or longitudinal

joint) and a longitudinal crack, are rated as punchouts if the cracks are exhibiting spalling, or the area is breaking up or faulting.

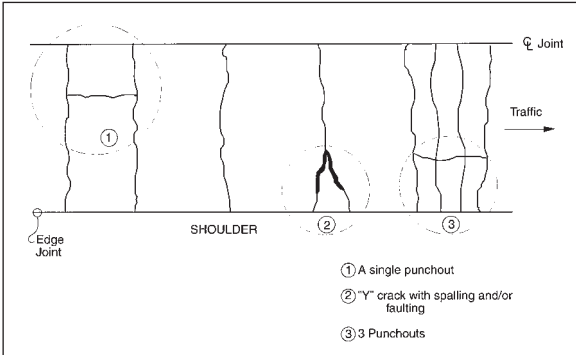
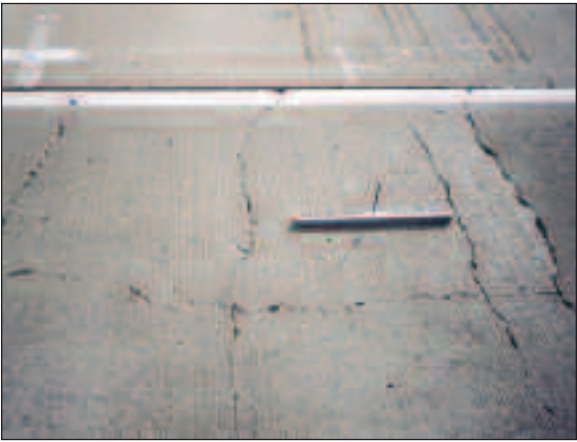


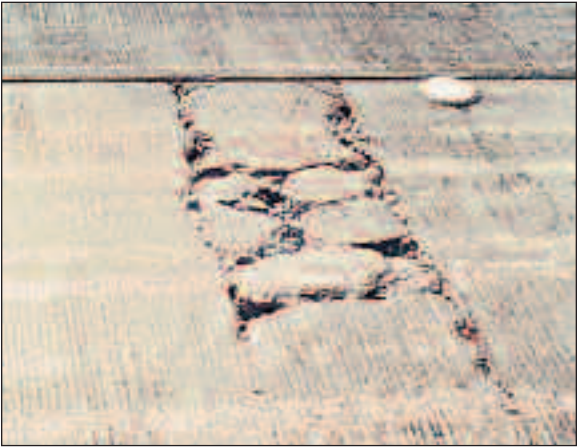
Figure 123: Distress Type CRCP 12 - Punchouts



**Figure 124: Distress Type CRCP 12
Low Severity Punchouts**



**Figure 125: Distress Type CRCP 12
Moderate Severity Punchouts**



**Figure 126: Distress Type CRCP 12
High Severity Punchouts**

13. SPALLING OF LONGITUDINAL JOINTS

Description

Cracking, breaking, chipping, or fraying of slab edges within 0.3 m (1.0 ft) of the longitudinal joint.

Severity Levels

LOW

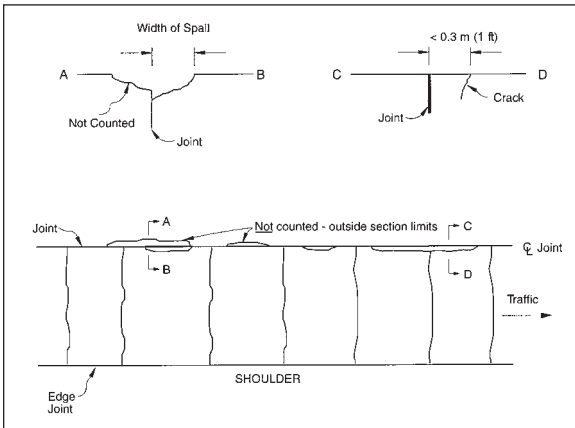
Spalls < 75 mm (3 in) wide, measured to the face of the joint, with loss of material or spalls with no loss of material and no patching.

MODERATE

Spall 75 mm (3 in) to 150 (6 in) wide, measured to the face of the joint, with loss of material.

HIGH

Spall > 150 mm (6 in) wide measured to the face of the joint, with loss of material or is broken into two or more pieces or contains patch material.



**Figure 127: Distress Type CRCP 13
Spalling of Longitudinal Joints**

How to Measure

Record length in meters (feet) of longitudinal joint spalling at each severity level. Only record spalls having a length of 0.1 m (0.3 ft) or more. Spalls that have been repaired by completely removing all broken pieces and replacing them with patching material (rigid or flexible) should be rated as a patch. If the boundaries of the spall are visible, then also rate as a high severity spall.

NOTE: All patches meeting size criteria are rated as patches.



**Figure 128: Distress Type CRCP 13 - Close-up View
Low Severity Spalling of Longitudinal Joints**



**Figure 129: Distress Type CRCP 13
Low Severity Spalling of Longitudinal Joints**



**Figure 130: Distress Type CRCP 13 - Close-up View
Moderate Severity Spalling of Longitudinal Joints**

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14. WATER BLEEDING AND PUMPING

Description

Seeping or ejection of water from beneath the pavement through cracks or joints. 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.

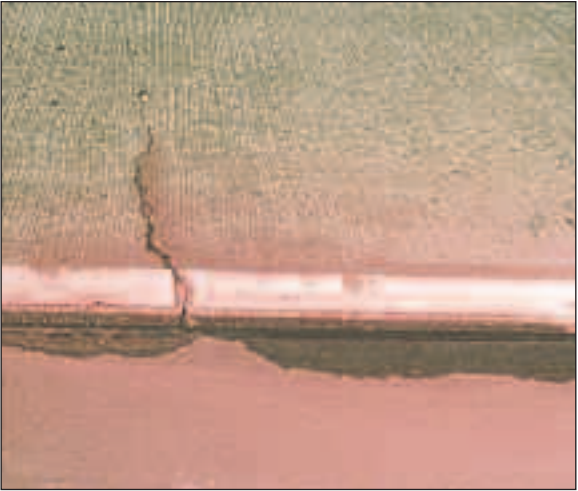
How to Measure

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 quantity of water bleeding and pumping cannot exceed the length of the test section.



**Figure 131: Distress Type CRCP 14
Water Bleeding and Pumping**



**Figure 132: Distress Type CRCP 14
Close-up View of Water Bleeding and Pumping**

15. LONGITUDINAL JOINT SEAL DAMAGE

Description

Joint seal damage is any condition that enables incompressible materials or a significant amount of water to infiltrate into the joint from the surface. Typical types of joint seal damage are:

Extrusion, hardening, adhesive failure (bonding), cohesive failure (splitting), or complete loss of sealant.

Intrusion of foreign material in the joint.

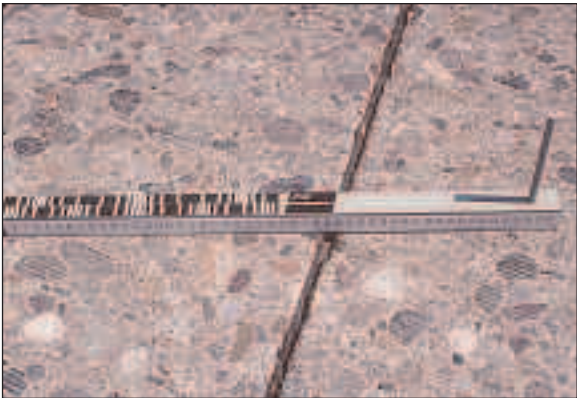
Weed growth in the joint.

Severity Levels

Not Applicable

How to Measure

Record the number of longitudinal joints that are sealed (0, 1, 2). Record length of sealed longitudinal joints with joint seal damage as described above. Individual occurrences are recorded only when at least 1 m (3 ft) in length.



**Figure 133: Distress Type CRCP 15
Longitudinal Joint Seal Damage**

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

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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 Profilometer 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 A2 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. On widened PCC sections, the lateral extent of the test section includes the full width 4.3 m (14.0 ft) of the slab measured from the centerline longitudinal joint to the shoulder joint.

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.

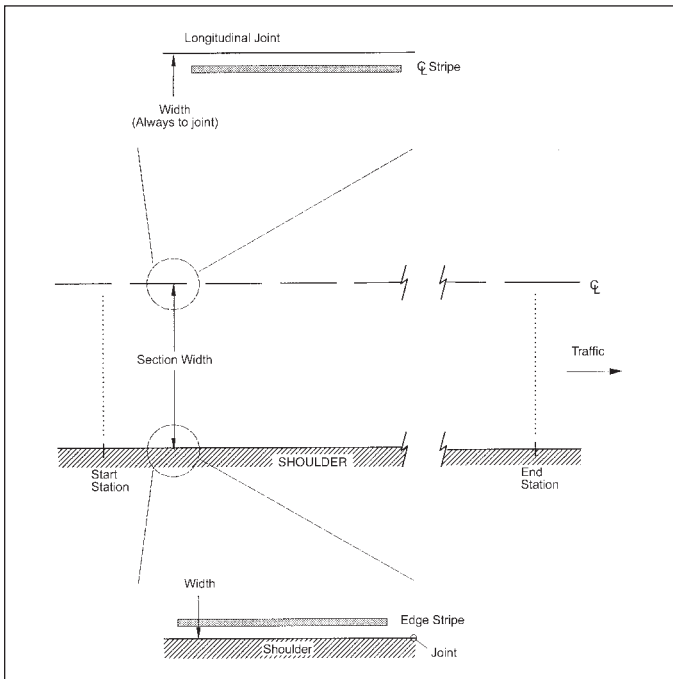


Figure A2: Test Section Limits for Surveys—Concrete Surface

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 predominantly parallel to the centerline of a CRCP would be labeled “2H.” 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 A8 and A9. The specific distress types that are not to be included on the maps are to be recorded as follows:

Jointed Concrete Pavement and Continuously Reinforced Concrete Pavement

If map cracking/scaling, or polished aggregate occur in large areas over the test section, do not map the total extent. Instead, note the location, extent, and severity level, if applicable, 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 CRCP DATA SHEETS

The results of distress surveys on CRCP surfaces are recorded on sheets 8-10. 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 CRCP distresses are contained in figure A8 and an example mapped section is presented in figure A9.

Description of Data Sheet 8

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, except as indicated on the form. Enter “0” for any distress types and/or severity levels not found. The distress types and severity levels should be identified by using the *Distress Identification Manual*.

Description of Data Sheet 9

This sheet is a continuation of the distress survey data recorded on sheet 8 and is completed as described under data sheet 9. In addition, space is provided to list “Other” distress types found on the test section but not listed on data sheets 8 or 9.

Description of Data Sheet 10

This data sheet provides space to record lane-to-shoulder dropoff and lane-to-shoulder separation. Measurements are taken at the beginning of the test section and at 15.25 m (50 ft) intervals (a total of 11 measurements for each distress) at the lane/shoulder interface or joint.

<u>Distress Type</u>	<u>Symbol</u>	<u>Distress Type</u>	<u>Symbol</u>
1. Durability "D" Cracking (Number of Affected Transverse Cracks) (Square Meters) L, M, H*		8. Transverse Construction Joint Deterioration (Number) L, M, H*	
2. Longitudinal Cracking (Meters) L, M, H* S - Sealed		9. Lane - to - Shoulder Dropoff**	
3. Transverse Cracking (Number of Cracks and Length (Meters)) L, M, H*		10. Lane - to - Shoulder Separation**	
4a. Map Cracking 4b. Scaling (Square Meters) No severity levels		11. Patch/Patch Deterioration (Square Meters and Number) L, M, H* F - Flexible R - Rigid	
5. Polished Aggregate (Square Meters) No severity levels		12. Punchouts (Number) L, M, H*	
6. Popouts (Number) No severity levels Not measured in LTPP surveys		13. Spalling of Longitudinal Joints (Meters) L, M, H*	
7. Blowups (Number) No severity levels		14. Water Bleeding and Pumping (Number of Occurrences and Length of Affected Pavement (Meters)) No severity levels	
		15. Longitudinal Joint Seal Damage (Meters)	

*Low, Moderate, and High severity levels.

**Not drawn on distress maps.

FIGURE A8:
Distress Map Symbols for Continuously Reinforced Concrete Pavements

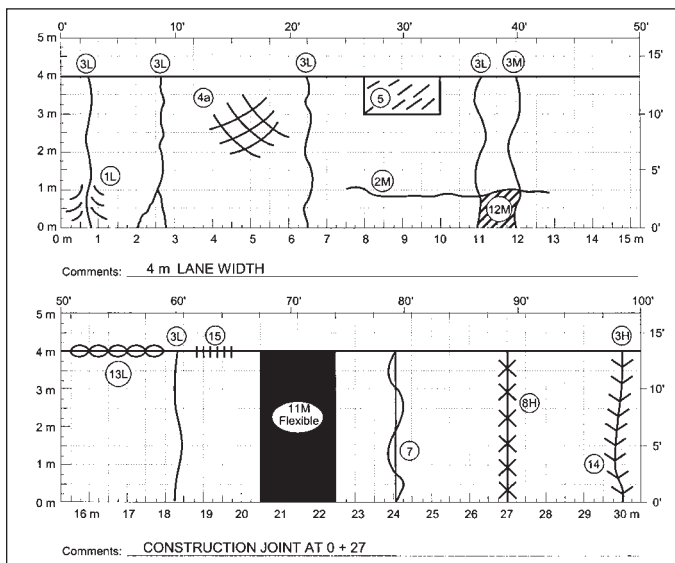


FIGURE A9:

Example Map of First 30.5 meters (100 feet) of a Continuously Reinforced Concrete Pavement Section

Description of Data Sheet 10 (continued)

Lane-to-shoulder dropoff is measured as the difference in elevation, to the nearest 1 mm (0.04 in), between the pavement surface and the adjacent shoulder surface. Lane-to-shoulder dropoff typically occurs when the outside shoulder settles. However, heave of the shoulder may occur due to frost action or swelling soil. If heave of the shoulder is present, it should be recorded as a negative (-) value.

Lane-to-shoulder separation is measured as the width of the joint, to the nearest 1 mm (0.04 in), between the outside lane and the adjacent shoulder surface.

When the surveyor is unable to take a measurement due to an anomaly, such as a sealant or patch material, a null value (“N”) is recorded and entered into the database.

At each point where there is no lane-to-shoulder dropoff or lane-to-shoulder separation, enter "0."

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 December 30, 1992; September 1998

SHEET 8
DISTRESS SURVEY
LTPP PROGRAM

STATE CODE _____
SHRP SECTION ID _____

DISTRESS SURVEY FOR PAVEMENTS WITH CONTINUOUSLY
REINFORCED PORTLAND CEMENT 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. DURABILITY "D" CRACKING (No. of affected Trans Cracks) (Square Meters)	___-___-___	___-___-___	___-___-___
2. LONGITUDINAL CRACKING (Meters) Length Well Sealed (Meters)	___-___-___	___-___-___	___-___-___
3. TRANSVERSE CRACKING (Total Number of Cracks) (Number of Cracks) (Meters)	___-___-___	___-___-___	___-___-___
SURFACE DEFECTS			
4a. MAP CRACKING (Number) (Square Meters)			___-___-___
4b. SCALING (Number) (Square Meters)			___-___-___
5. POLISHED AGGREGATE (Square Meters)			___-___-___
6. POPOUTS Not Recorded			

Data Sheet 8: CRCP Distress Survey

SHEET 9

DISTRESS SURVEY

STATE CODE

LTPP PROGRAM

SHRP SECTION ID

DATE OF DISTRESS SURVEY (MONTH/ DAY/ YEAR)

SURVEYORS:

DISTRESS SURVEY FOR PAVEMENTS WITH CONTINUOUSLY
REINFORCED PORTLAND CEMENT CONCRETE SURFACES
(CONTINUED)

DISTRESS TYPE	SEVERITY LEVEL		
	LOW	MODERATE	HIGH
MISCELLANEOUS DISTRESSES			
7. BLOWUPS (Number)			---
8. TRANSVERSE CONSTRUCTION JOINT DETERIORATION (Number)	---	---	---
9. LANE-TO-SHOULDER DROPOFF - REFER TO SHEET 10			
10. LANE-TO-SHOULDER SEPARATION - REFER TO SHEET 10			
11. PATCH/ PATCH DETERIORATION Flexible (Number) (Square Meters)	---	---	---
Rigid (Number) (Square Meters)	---	---	---
12. PUNCHOUTS (Number)	---	---	---
13. SPALLING OF LONGITUDINAL JOINT (Meters)	---	---	---
14. WATER BLEEDING AND PUMPING (Number of Occurrences) Length Affected (Meters)			---
15. LONGITUDINAL JOINT SEAL DAMAGE Number of Longitudinal Joints that have been sealed (0, 1, or 2) If Sealed Length w/ Damaged Sealant (Meters)			---
16. OTHER (Describe)			

Data Sheet 9: CRCP Distress Survey

SHEET 10

DISTRESS SURVEY

STATE CODE _____

LTPP PROGRAM

SHRP SECTION ID _____

DATE OF DISTRESS SURVEY (MONTH/ DAY/ YEAR) ____/____/____
SURVEYORS: _____, _____DISTRESS SURVEY FOR PAVEMENTS WITH CONTINUOUSLY
REINFORCED PORTLAND CEMENT CONCRETE SURFACES
(CONTINUED)

9. LANE-TO-SHOULDER DROPOFF

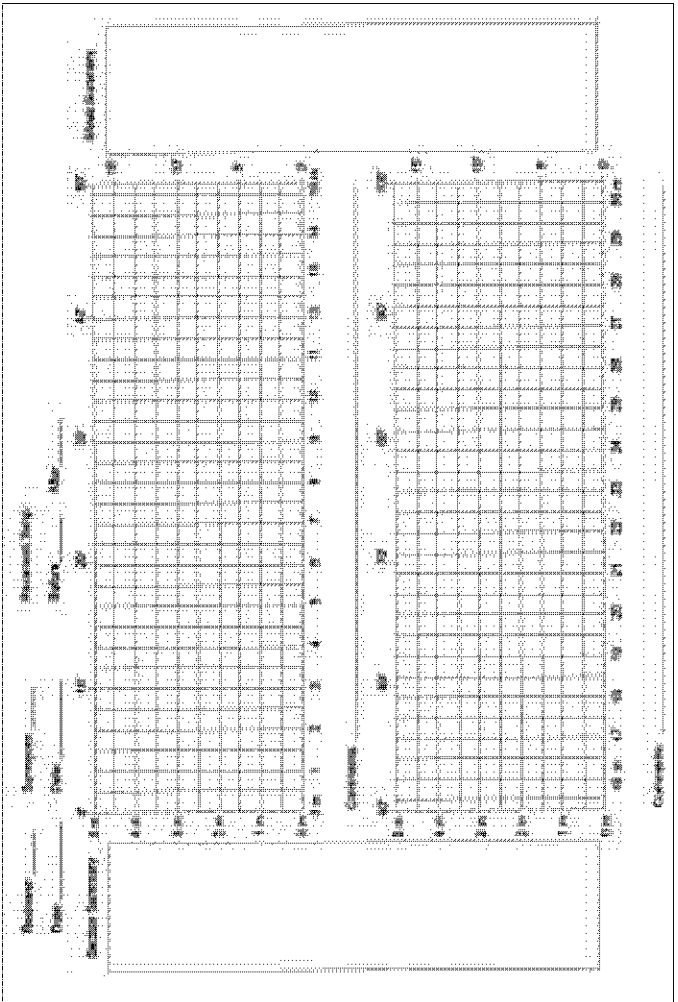
10. LANE-TO-SHOULDER SEPARATION

Point No.	Point ¹ Distance (Meters)	Lane-to-Shoulder ² Dropoff (mm)	Lane-to-Shoulder Separation (mm)	Well Sealed (Y/N)
1.	0.0	— — —	— — — —	—
2.	15.25	— — —	— — — —	—
3.	30.5	— — —	— — — —	—
4.	45.75	— — —	— — — —	—
5.	61.0	— — —	— — — —	—
6.	76.25	— — —	— — — —	—
7.	91.5	— — —	— — — —	—
8.	106.75	— — —	— — — —	—
9.	122.0	— — —	— — — —	—
10.	137.25	— — —	— — — —	—
11.	152.5	— — —	— — — —	—

Note 1. Point Distance is from the start of the test section to the measurement location. The values shown are SI equivalents of the 50 ft spacing used in previous surveys.

Note 2. If heave of the shoulder occurs (upward movement), record as a negative (-) value. Do not record (+) sign, positive values are assumed.

Data Sheet 10: CRCP Distress Survey



Map Form: CRCP Distress