



AUTOMATED PAVEMENT CONDITION SURVEY FIELD MANUAL



**COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION**

**AUTOMATED
PAVEMENT CONDITION SURVEY
FIELD MANUAL**

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TABLE OF CONTENTS

INTRODUCTION.....	1
PENNSYLVANIA LOCATION REFERENCE SYSTEM.....	1
SURVEY TECHNIQUE AND PROCEDURES	14
DEFINITIONS	15
GENERAL:	15
WHEEL PATH LOCATIONS:	15
EDGE OF PAVEMENT:	16
LANE WIDTH:	17
CONDITION IDENTIFICATION GUIDE.....	19
PROFILE DATA COLLECTION AND PROCESSING.....	20
RUT DEPTH	21
ASPHALT SURFACE PAVEMENTS	23
Fatigue Cracking Description	24
Transverse Cracking	27
Miscellaneous Cracking.....	31
Edge Deterioration	35
Bituminous Patching.....	39
Raveling / Weathering	41
Left Edge Joint.....	43
RIGID PAVEMENTS.....	48
Faulted Joints	49
Broken Slab.....	52
Transverse Joint Spalling.....	56
Transverse Cracking	60
Longitudinal Cracking	63
Longitudinal Joint Spalling.....	65
Bituminous Patching.....	67
Portland Cement Concrete Patching	69

Introduction

This manual is for use with the Pennsylvania Department of Transportation's Pavement Condition Survey. The Pavement Condition Survey is a distress survey, with the purpose of providing quantified, location-specific condition data on Pennsylvania's network of about 40,000 centerline miles of state highways.

The data collected is used for the following purposes:

1. To provide a uniform statewide condition evaluation that would improve decision making.
2. To provide management with the information and tools to monitor condition of the network, assess future needs, establish county condition rankings and optimize investments.
3. To provide condition information to fulfill the requirements of Act 68 (1980) which requires the allocating of maintenance funds to the individual counties based on needs.
4. To provide information for monitoring the performance of various pavement designs, rehabilitation and maintenance techniques.
5. To provide information for identifying candidate projects for maintenance and betterment programs.

Pennsylvania Location Reference System

Introduction:

The Location Reference System (LRS) is designed to bring Pennsylvania's roadway designations into a verifiable, flexible, and constant Engineering standard. It is the key to the collection, storage, and integration of roadway information within the Department.

CO/SR/SEG/OFFSET is the KEY series of numbers given to the location of a point or feature on a state route. This fourteen digit number (CO/SR/SEG/OFFSET) is an integral part of the computerized Roadway Management System (RMS) where key roadway data are stored.

Pennsylvania is divided into 67 counties. Each county (CO) has a number which represents the first two digits of the LRS number. In each county there are state routes. The State Route (SR) is subdivided into approximate one-half mile segments (SEG). Finally, the OFFSET is an even smaller subdivision of the segment. The offset is the distance (in feet) to a particular roadway feature from the beginning of the segment.

The Location Reference System is not complicated and anyone can easily take advantage of the benefits it has to offer. It adds permanence, accuracy, and stability to our marker system. It is easy to understand, costs less to maintain, and generates a computerized representation of the state highway network.

The following material will provide some insight into how the LRS was developed and the type of information that can be inferred utilizing the 14 digit KEY.

County (CO):

A. County Names, Numbers, and Maintenance District No.:

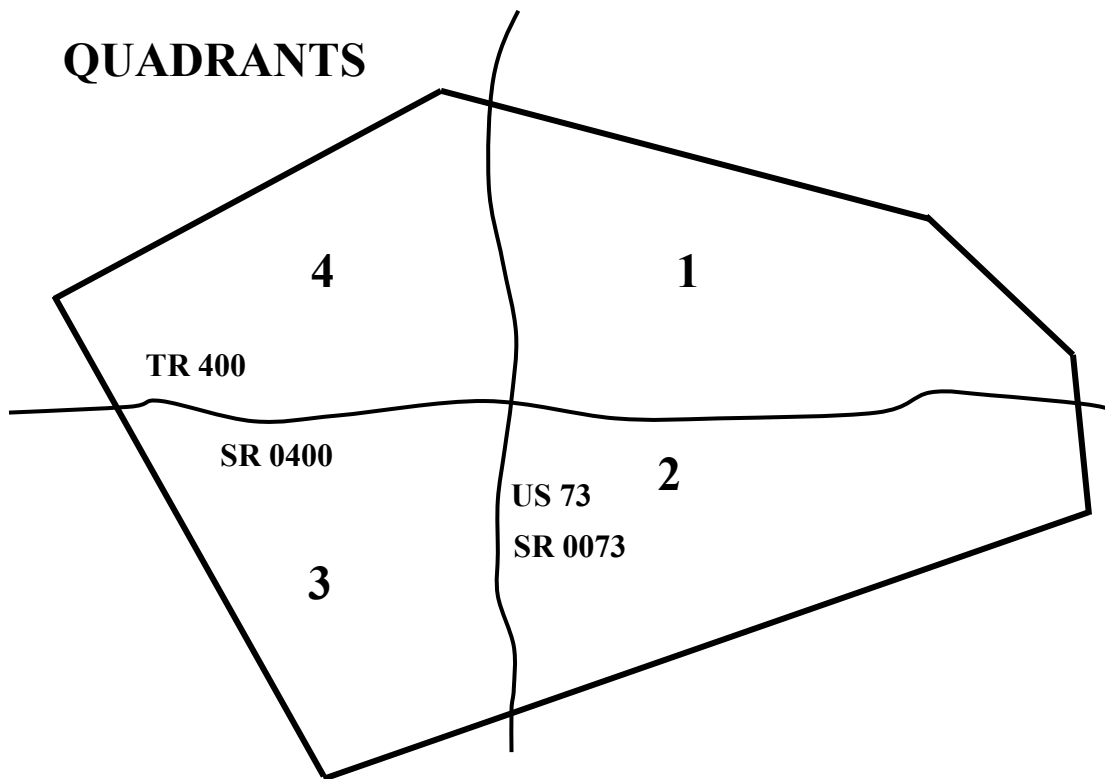
<u>County Name</u>	<u>County No. (CO)</u>	<u>Maint. Dist. No.</u>
Adams	1	8-1
Allegheny	2	11-1
Armstrong	3	10-1
Beaver	4	11-2
Bedford	5	9-1
Berks	6	5-1
Blair	7	9-2
Bradford	8	3-9
Bucks	9	6-1
Butler	10	10-2
Cambria	11	9-3
Cameron	12	2-4
Carbon	13	5-2
Centre	14	2-1
Chester	15	6-2
Clarion	16	10-3
Clearfield	17	2-2
Clinton	18	2-3
Columbia	19	3-1
Crawford	20	1-1
Cumberland	21	8-2
Dauphin	22	8-5
Delaware	23	6-3
Elk	24	2-8
Erie	25	1-2
Fayette	26	12-1
Forest	27	1-3
Franklin	28	8-3
Fulton	29	9-4
Greene	30	12-2
Huntingdon	31	9-5

<u>County Name</u>	<u>County No. (CO)</u>	<u>Maint. Dist. No.</u>
Indiana	32	10-4
Jefferson	33	10-5
Juniata	34	2-9
Lackawanna	35	4-2
Lancaster	36	8-7
Lawrence	37	11-4
Lebanon	38	8-8
Lehigh	39	5-3
Luzerne	40	4-3
Lycoming	41	3-2
McKean	42	2-5
Mercer	43	1-4
Mifflin	44	2-7
Monroe	45	5-4
Montgomery	46	6-4
Montour	47	3-3
Northampton	48	5-5
Northumberland	49	3-4
Perry	50	8-9
Pike	51	4-4
Potter	52	2-6
Schuylkill	53	5-6
Snyder	54	3-5
Somerset	55	9-7
Sullivan	56	3-6
Susquehanna	57	4-5
Tioga	58	3-7
Union	59	3-8
Venango	60	1-5
Warren	61	1-6
Washington	62	12-4
Wayne	63	4-6
Westmoreland	64	12-5
Wyoming	65	4-7
York	66	8-4
Philadelphia	67	6-5

State Routes (SR):

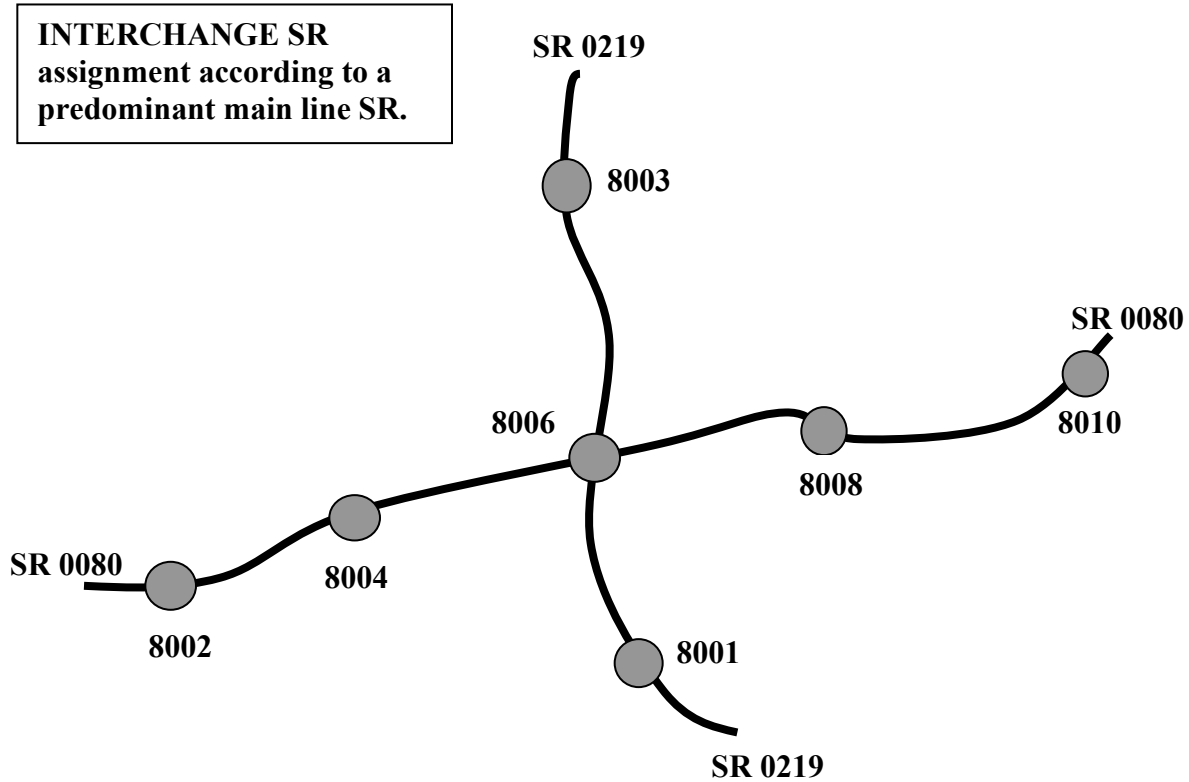
A. SR Numbering Convention:

	<u>SR Value</u>
1. Interstates, US Routes, and PA Routes.....	0001-0999
2. Quadrant Routes.....	1001-4999
Note: By quadrants 1, 2, 3, or 4	



- | | |
|-------------------------------------|-----------|
| 3. Non-Toll PA Turnpike Routes..... | 5001-5999 |
| 4. Relocated Traffic Routes..... | 6000-6999 |

5. Interchanges.....8001-8999



6. WYEs.....9101-9199

7. Rest Areas.....9201-9299

8. Truck Escape Ramps.....9301-9399

9. Others.....9401-9499

10. Park and Ride.....9501-9599

B. Odd/Even Convention:

1. Odd numbered SRs are assigned to north/south direction.
2. Even numbered SRs are assigned to east/west direction.
3. The Odd/Even convention MAY NOT apply to PA or US traffic routes.

C. Traffic Routes - Routes which have been assigned an Interstate, U.S., or PA traffic route designation.

D. Quadrant Routes (Non-traffic routes)

1. Four Quadrants
 - refer to quadrant diagram
 - refer to SR numbering convention
2. Directional Convention:
 - Odd number State Routes are N/S direction
 - Even number State Routes are E/W direction

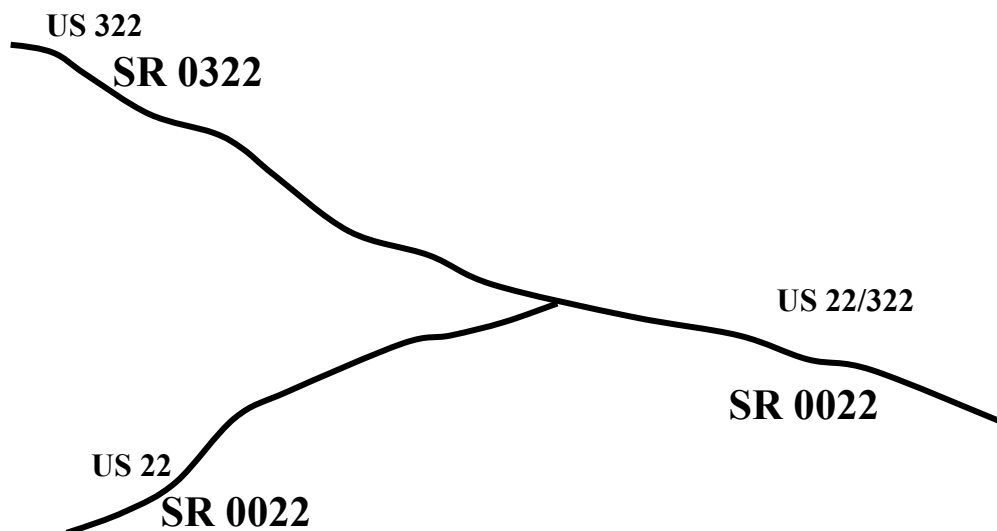
E. Hierarchy -

If 2 or more traffic routes occupy the same section of roadway, the following hierarchy applies.

1. Interstate
2. U.S. Routes
3. PA Routes
4. Quadrant Routes

If the traffic routes are the same hierarchy class, then the SR number is assigned the lower numbered traffic route.

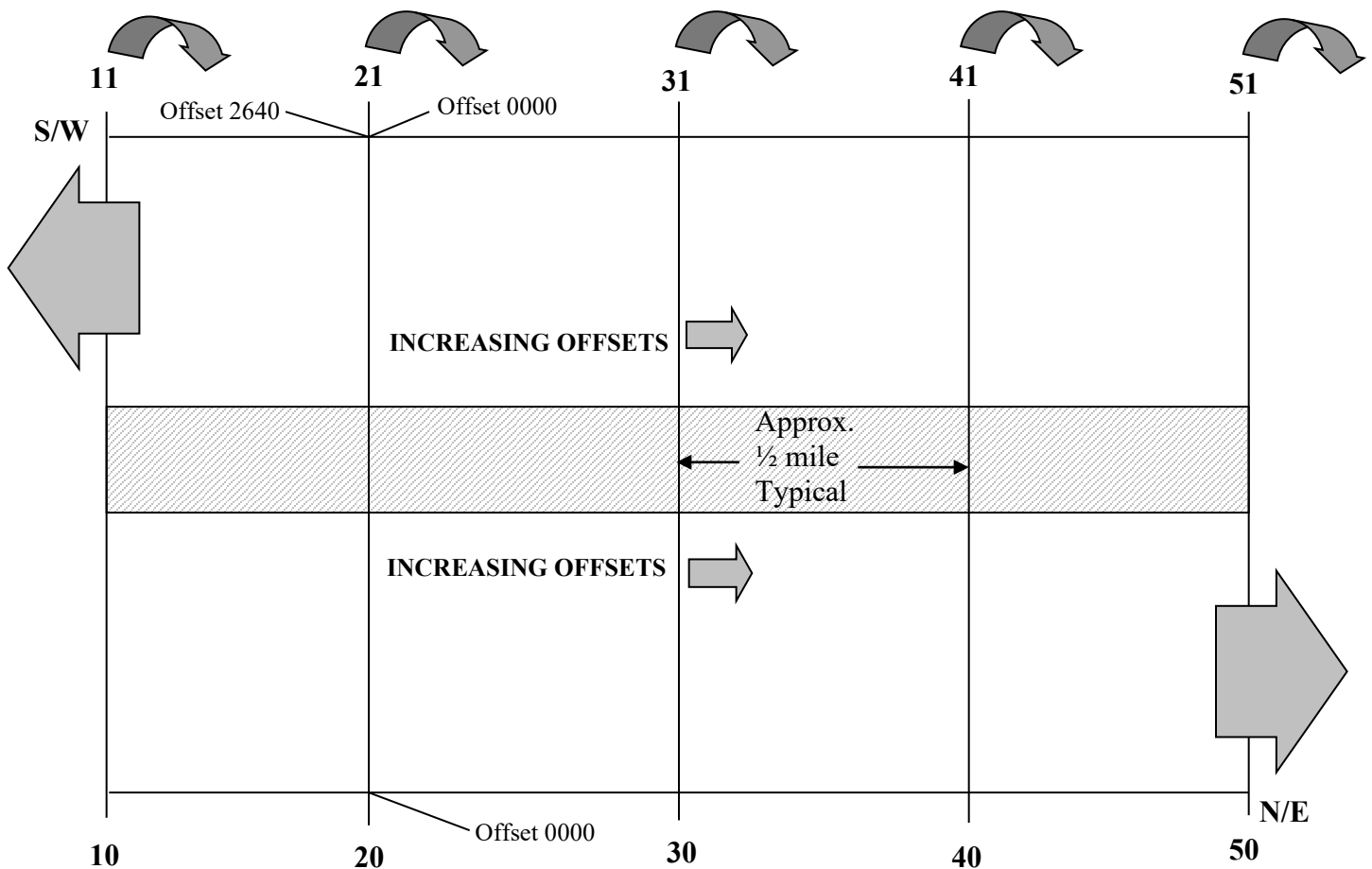
SR DESIGNATION OF SHARED ROADWAY



Segments (SEG)

- A. Segment = approximately one-half mile sections of SRs that are usually numbered by 10s.
- B. The beginning and ending points of Segments are placed at physical features where possible.
- C. Direction
 - Divided roads have directional segments
 - North or East are even numbers
 - South or West are odd numbers

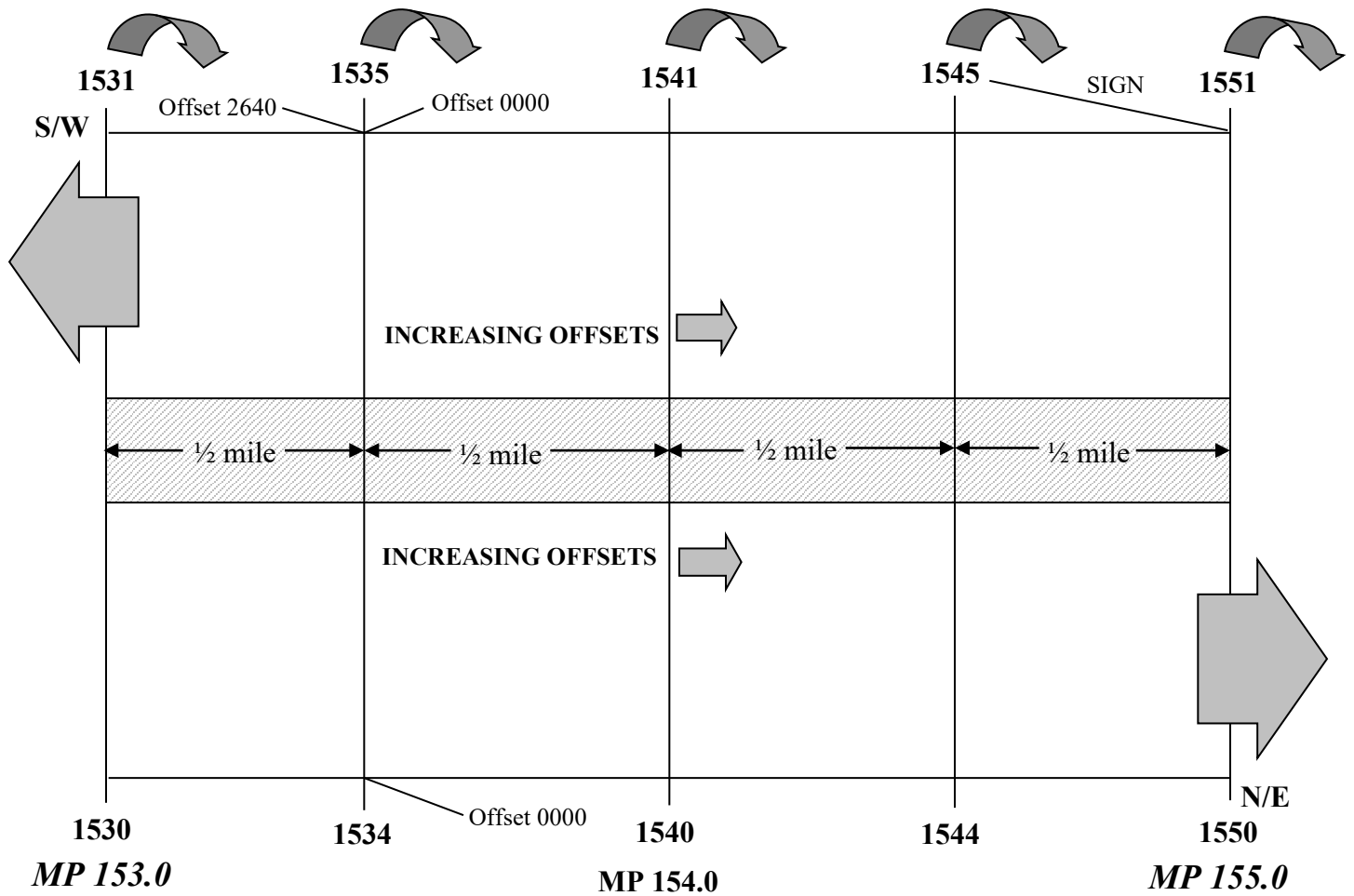
DIRECTIONAL SEGMENTING ON DIVIDED HIGHWAYS



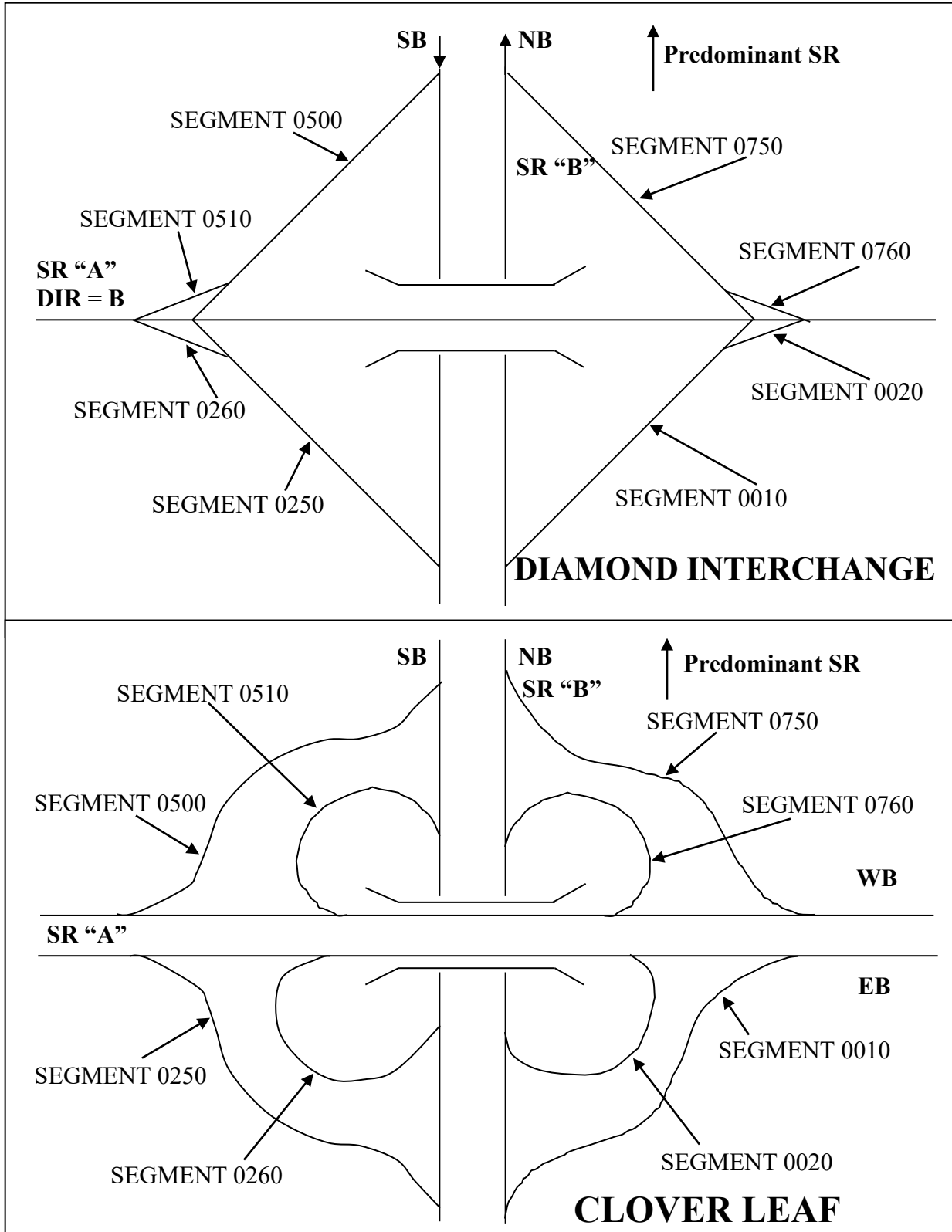
D. Interstate

- Interstate Segmenting is associated with the milepost.

SEGMENTING ON INTERSTATE HIGHWAYS

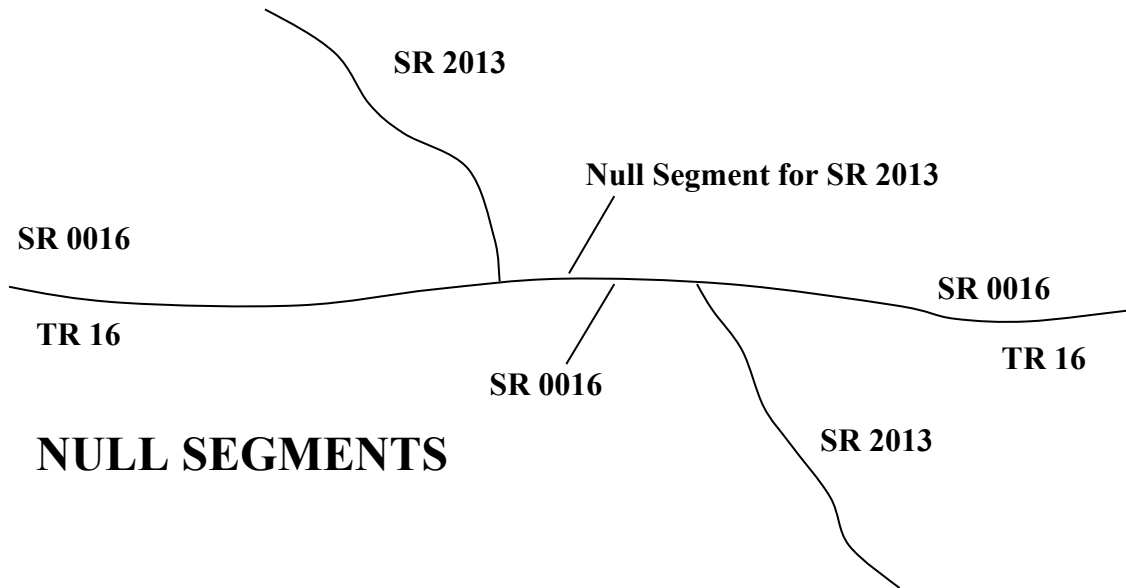


E. Common Interchange Configurations and Segmentation

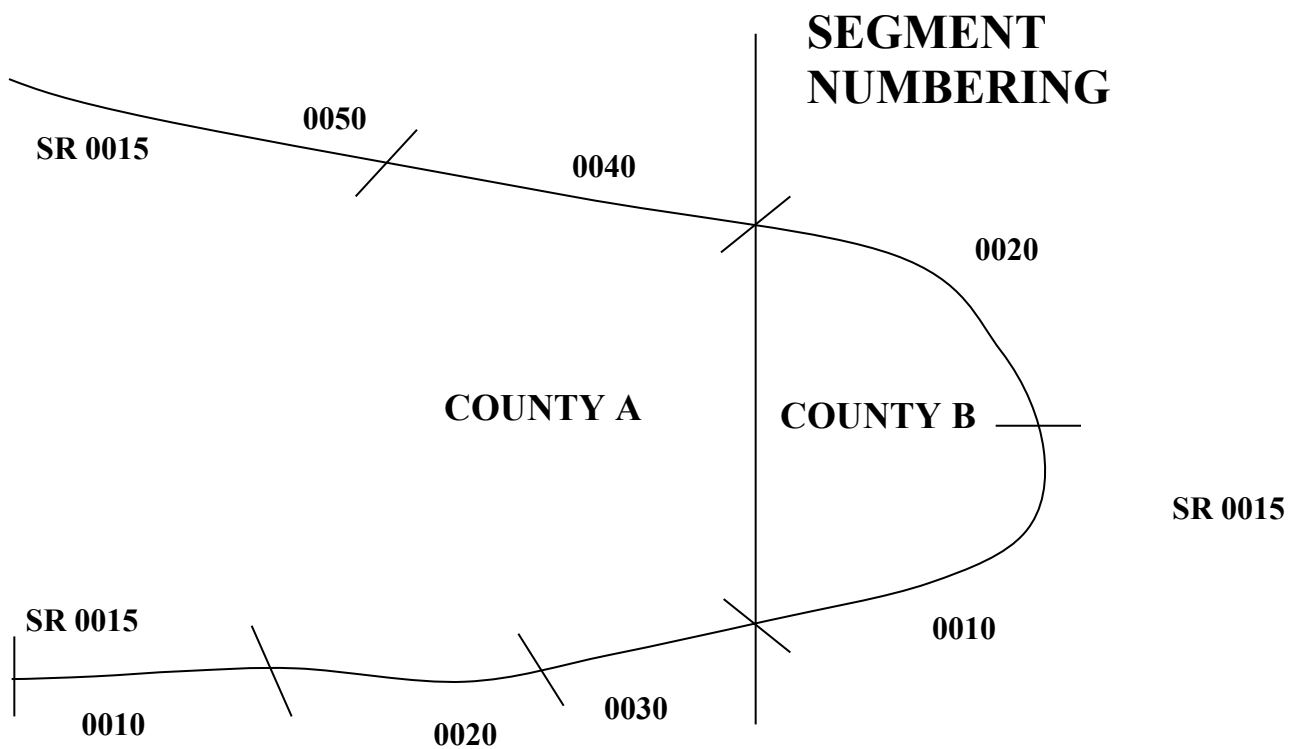


F. 7000 Series Segments: 7000 - 7999

- Turnbacks
- Abandonment
- Nulls

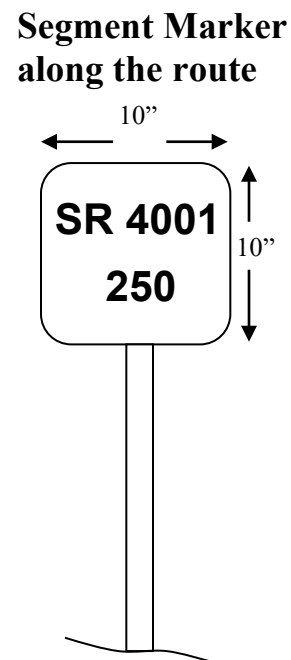
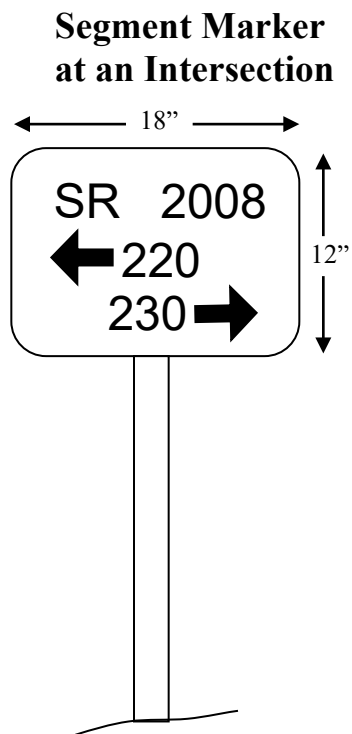


G. Segment Numbering of Traffic Routes at County Boundaries:



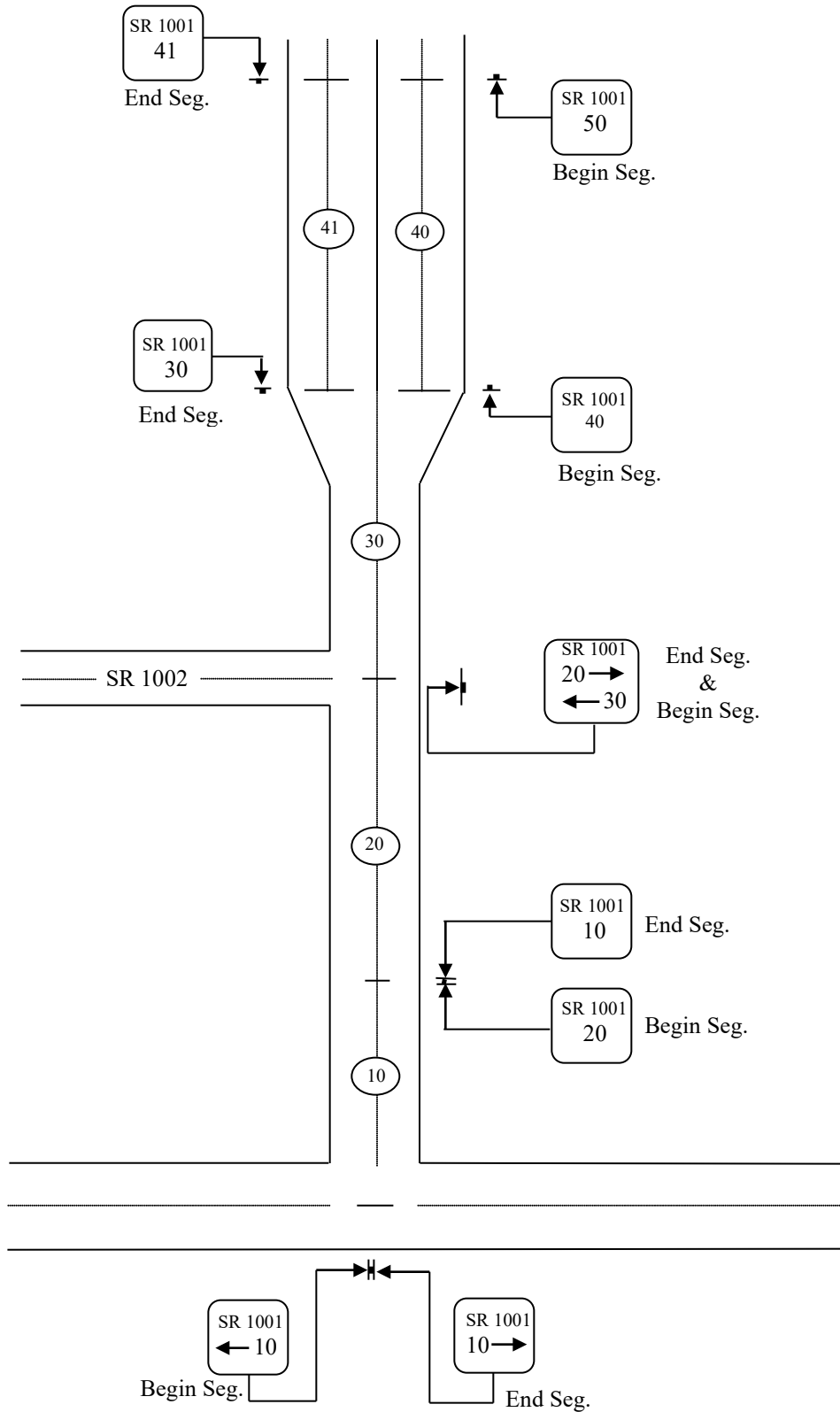
H. Signs

- Identifiable in field, easy for identification of maintenance/work areas on the State Highway System.
1. Segment Marker - indicates SR and segment number at the beginning and end of each segment. If the beginning or end of a segment occurs at a physical feature, then the point of reference is at the physical feature and NOT the sign.
 2. Intersection - indicates segmentation at the intersection of 2 or more state owned highways.



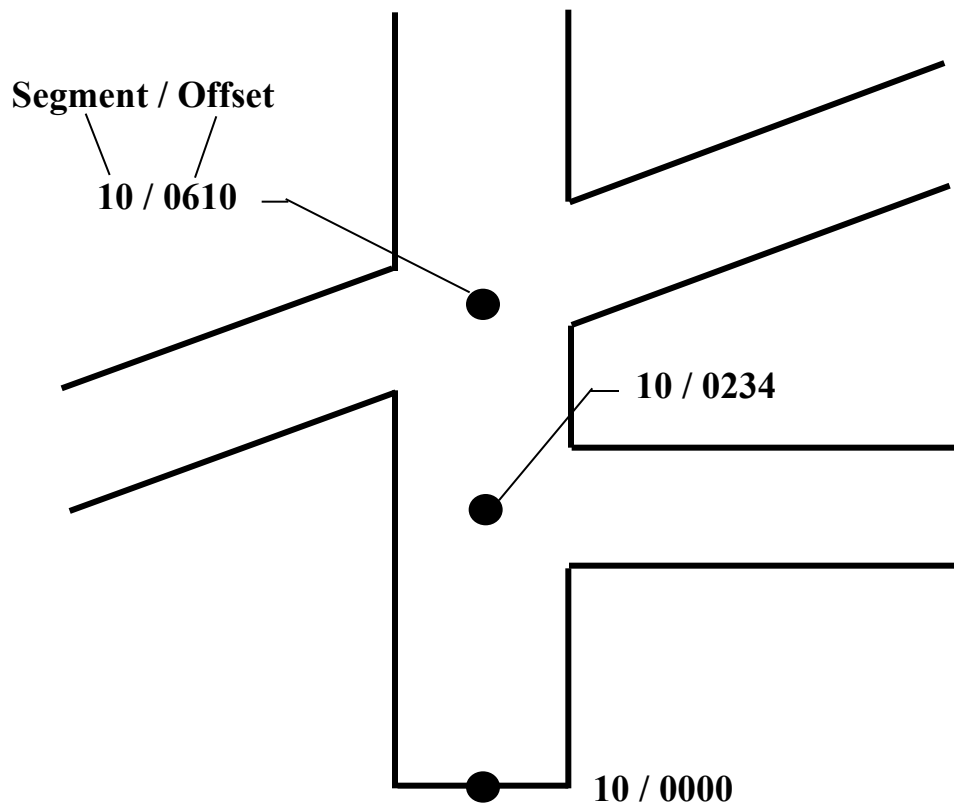
3. SR/Segment Sign Placement

SAMPLE STATE ROUTE SIGNING



Offset (Offset)

Distance in linear feet from the beginning of a segment to a point of interest measured in the INCREASING segment direction.



Survey Technique And Procedures

General:

Many instances will be encountered in the performance of the Pavement Condition Survey which do not exactly conform to the general descriptions and instructions in this manual. Some of these are listed below, along with recommended procedures for evaluating. For other unusual circumstances, good judgment should be exercised and notes added to the data file.

Multi-lane Roadways:

All roadway segments will be evaluated in one pass. Because the lane being surveyed will represent the entire roadway width, best judgment must be used to select which lane to survey. For purposes of pavement maintenance the surveyor should select the lane exhibiting the most distresses. In most cases this will be the right lane on multi-lane roadways.

Ramps:

At this time, no separate evaluation will be made of ramps, as any maintenance and rehabilitation of ramps will usually be performed in conjunction with work on the main line. Ramp acceleration and deceleration lanes will be ignored when evaluating the main line pavement and shoulders. Do not survey acceleration or deceleration lanes, but collect information up to where the shoulder continues on the other side of the ramp (gore area).

Bridges:

Pavement condition data will **not** be reported for the bridge portion of a segment. The bridge length, determined by the limits of the bridge superstructure, will be excluded from the length of pavement being evaluated when determining lengths of extents. Bridge approach slabs are included in the pavement condition evaluation. **No** pavement condition data will be reported for segments with bridges 50% of the segment length or greater.

All bridges **will** be included in roughness measurements.

Brick or block pavement:

Brick or block surfaces are rated as Flexible Surface Pavements. Only collect roughness and bituminous patching.

Definitions

General:

The following terms used in this manual are defined as follows:

Pavement: The portion of the roadway intended for regular vehicular traffic.

Asphalt Surface Pavement: A pavement with a bituminous riding surface on any type of base.

Rigid Pavement: A pavement with a Portland Cement Concrete riding surface. Rigid pavement includes Plain Cement Concrete Pavement (PCCP) or Reinforced Cement Concrete Pavement (RCCP). (70 series pavements)

Wheel Path Locations:

To properly locate where various distress measurements are made, the following descriptions of spacing between wheel paths, offset from pavement edge and locations and widths of various parts of the pavement surface are defined. It is very difficult to operate pavement data collection equipment on all pavements under all conditions and meet the definitions. In these instances, the judgment of the operator/driver concerning the safe operation of the vehicle and the safety of the traveling public takes precedence over data collection.

Distance Between Wheel Paths: For the purposes of profile data collection the centerline distance between the outside and inside wheel paths and the sensors mounted to collect data shall be 69 inches.

Width of Outside Wheel Path: The outside wheel path shall be 39 inches wide with the center of the wheel path referenced along the same centerline location as the sensor mounted for the outside wheel path profile measurement.

Width of Inside Wheel Path: The theoretical maximum inside wheel path width shall be 39 inches. There may be some instances on very narrow, secondary pavements where the inside wheel path must be less than 39 inches due to operational constraints.

Width of Lane Center: The width of the center of the travel lane shall be 30 inches. The right most edge of the area bounding the lane center shall be immediately adjacent to the left most side of the area that is bounded by the outside wheel path.

Location of the Center of Outside Wheel Path on the Lane: The center of the outside wheel path is nominally located at the following distances from the right pavement edge for the following lane widths. The center of the outside wheel path located as described below allow for edge deterioration coverage on Pennsylvania's many narrow, secondary roads.

Width	Distance from Edge to Centerline of Outside Wheel Path	Distance from Edge to Centerline of Inside Wheel Path
9.0 feet	26 inches	7.9 feet (95 inches)
10.0 feet	26 inches	7.9 feet (95 inches)
11.0 feet	31 inches	8.3 feet (100 inches)
12.0 feet	37 inches	8.8 feet (106 inches)

It is often difficult for the driver to follow perfectly in the wheel paths as defined above and it is not expected that the vehicle will always be able to collect data exactly as shown. It is the intention of the above descriptions to:

- 1) Define where the sensors, outside wheel path, and pavement center are located with respect to the vehicle, and
- 2) Provide guidance to the vehicle operator concerning the appropriate location for operating the vehicle the majority of the time.

Vehicle Operation in the Outside Wheel Path: Vehicle is to be operated in the wheel path where the majority of the traffic routinely drives. The wheel path is often easily recognized as a discoloration or contrasting color of the pavement surface. The vehicle operator is expected to drive the vehicle with the right wheel path sensors in the middle of the apparent right wheel path used by vehicles. This will ensure that the profile, rut depth, faulting, and high resolution cameras are collecting information where the majority of the traffic is driving on the lane.

Edge of Pavement:

The pavement edge has various definitions depending upon the pavement type and functional classification. For the purpose of this specification the following pavement edge definitions apply.

Asphalt pavements - unpaved shoulder: The pavement edge is defined as the rightmost transverse location where the bituminous paved surface ends and the unpaved surface of the shoulder begins. There may or may not be a paint lane stripe along these pavement types.

Asphalt pavements - paved shoulder: The pavement edge is defined as the side construction joint formed between the bituminous paved surface and the bituminous paved surface of the shoulder. In those locations where there is no construction joint or it cannot be readily identified, the pavement edge shall be the outside edge of the outside lane stripe.

Jointed concrete pavements - asphalt shoulder: The pavement edge is defined as the construction joint formed by the portland cement concrete slab and the bituminous paved shoulder.

Jointed concrete pavements - concrete shoulder: The pavement edge is defined as the rightmost construction joint between the travel lane and the shoulder.

Note: These definitions assume that the data collection vehicle will be operated in the outside lane on multi-lane roads. In those situations where the vehicle operates in a lane other than the outside lane, the construction joint shall be used to identify the right side of the lane. If a construction joint cannot be readily identified, then the right side pavement lane stripe shall be used. These definitions are expected to apply on most conditions found in Pennsylvania. In those situations where the definitions do not apply, PENNDOT will define the pavement edge.

Lane Width:

The lane width will have various definitions depending upon the paving material.

Asphalt pavements: The lane width is defined as the transverse distance from the right side pavement edge to the left construction joint. If the construction joint is not readily discernible, the left side of the lane shall be defined by the lane paint stripe. Collect and report bituminous distresses according to the placement on the lane as detailed in the Condition Identification section of this manual. All bituminous distresses are to be evaluated on every segment, on a segment by segment basis.

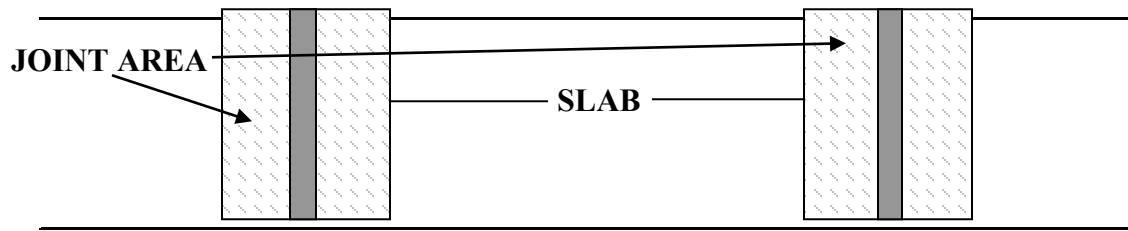
Jointed Concrete Pavements: The lane width is defined as the transverse distance from the right side of the pavement edge to the left construction joint forming the slab. In those situations where the construction joint is not readily discernible, the left pavement edge shall be defined by the lane stripe.

Jointed concrete pavements require additional definitions to define the location of joint and slab related conditions.

Joints: Joints are straight transverse or longitudinal discontinuities in the pavement surface caused by original construction or maintenance activities. A transverse joint should only be counted and evaluated if it is an original construction joint or a joint caused by a full width concrete pavement patch. Longitudinal joints should only be evaluated if it is the result of original construction or concrete patches that are large enough to be included in the patch area rating definitions in the Condition Identification Section of this manual. There will be a few cases where the longitudinal joint falls within the lane. In this case, count and rate both slabs created by the longitudinal joint.

Joint area for evaluation: The procedure for identifying joint conditions is: Identify the joint. Evaluate the pavement for the full lane width on either side of the joint for 1.0 ft each side of the joint. Assign the joint condition to the appropriate classification and severity rating. Collect and report all distress on a joint (the distresses are cumulative).

Slab Conditions: Slab interior from 1.0 ft of joint area as defined above to the next 1.0 ft area of the next joint. Collect and report all distress on a slab (the distresses are cumulative) with the exception of Broken Slab. Rating a slab as Broken supersedes all other slab distresses.



CONDITION IDENTIFICATION GUIDE

Profile Data Collection and Processing

Description:

Roughness on a traveled surface is the deviations of a surface from a true planar surface with characteristic dimensions that affect vehicle dynamics and ride quality (ASTM E950). It will be estimated by IRI which is calculated from longitudinal profile measurements. A longitudinal profile is the perpendicular deviations of the pavement surface from an established reference parallel to the lane direction.

Measurement:

Longitudinal profile is measured at least every 2.0 inches or preferably 1.0 inch in the designated data collection lane for both the outside and inside wheel paths located 69 inches apart.

Computation:

The International Roughness Index (IRI) is used to indicate the amount of roughness. IRI is an index computed from the longitudinal profile using a quarter-car simulation. The summary statistic to be reported to PENNDOT is the average of both wheel paths. The IRI is summarized and reported every 528 feet.

Note: The profile must also be evaluated on Jointed Concrete Pavements over each slab. The profile is evaluated using a 20-foot moving window. When the distress data indicates a broken slab, the 20-foot summary IRI must be computed to assist in the broken slab severity rating. Refer to the Broken Slab definitions.

Measurement Units: IRI is reported in units of inches/mile (in/mi).

Rut Depth

Description:

This condition, which occurs longitudinally along the roadway, is characterized by the distortion of the pavement cross-section, with the wheel paths being lower than the centerline, pavement edge, or the center of the lane.

Possible Causes:

Rutting on flexible pavements can be caused by base or subgrade failure, which is usually indicated by the presence of fatigue cracking, by shoving of unstable asphalt mixes, or by wear.

Wear is the cause of rutting on rigid pavements. Rutting may be prevalent where studded snow tires are heavily used.

Rating Procedure:

For all pavement types, rutting consists of longitudinal depressions in one or both wheel paths. Rut depth is measured by laying a string line or straight edge (or software simulation) between the middle of the lane and either lane edge, depending on the wheel path measured. The distance from the bottom of the string line or straight edge to the pavement surface is the measured rut depth for that wheel path. The definition and measurement techniques are the same for all severity levels.

Rutting is collected in both wheel paths independently and reported for each wheel path. For automated equipment, the maximum allowable spacing between rut depth sampling intervals is 30 feet. Sampling performed and reported more often is acceptable. Each sample is assigned to one of the three severity levels described below.

Severity:

Low	Average Rut Depth ≥ 0.25 in and < 0.5 in
Medium	Average Rut Depth ≥ 0.5 in and < 1.0 in
High	Average Rut Depth ≥ 1.0 in

Extent:

Record the length for each severity level. Each wheel path will be recorded separately giving a total possible length of reported rut depth equal to twice the STAMPP segment length.

Example Reporting:

An 800-foot long STAMPP segment (total: 1600 feet of wheel path) has 300 feet of outside wheel path, medium severity rutting, 200 feet of inside wheel path, medium severity rutting and 350 feet of outside wheel path high severity rutting. The rating for this section is: Outside Wheel Path: 150 ft. none, 300 ft. medium severity, 350 ft. high severity; Inside Wheel Path: 600 ft. none; 200 ft. medium severity.

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ASPHALT SURFACE PAVEMENTS

Fatigue Cracking Description

Description:

Fatigue cracking is characterized by a series of longitudinal or interconnecting cracks that divide the asphalt pavement surface into many sided, sharp angled pieces resembling chicken wire or an alligator's hide. The pieces are less than 1 foot in any dimension. Fatigue cracking usually occurs in wheel paths or other areas subjected to loading. Fatigue cracking is an indication of a structural problem.

Possible Causes:

Fatigue cracking can be caused by weaknesses in the base or subgrade, which result in the fatigue failure of the asphalt pavement surface under repeated loading.

Rating Procedure:

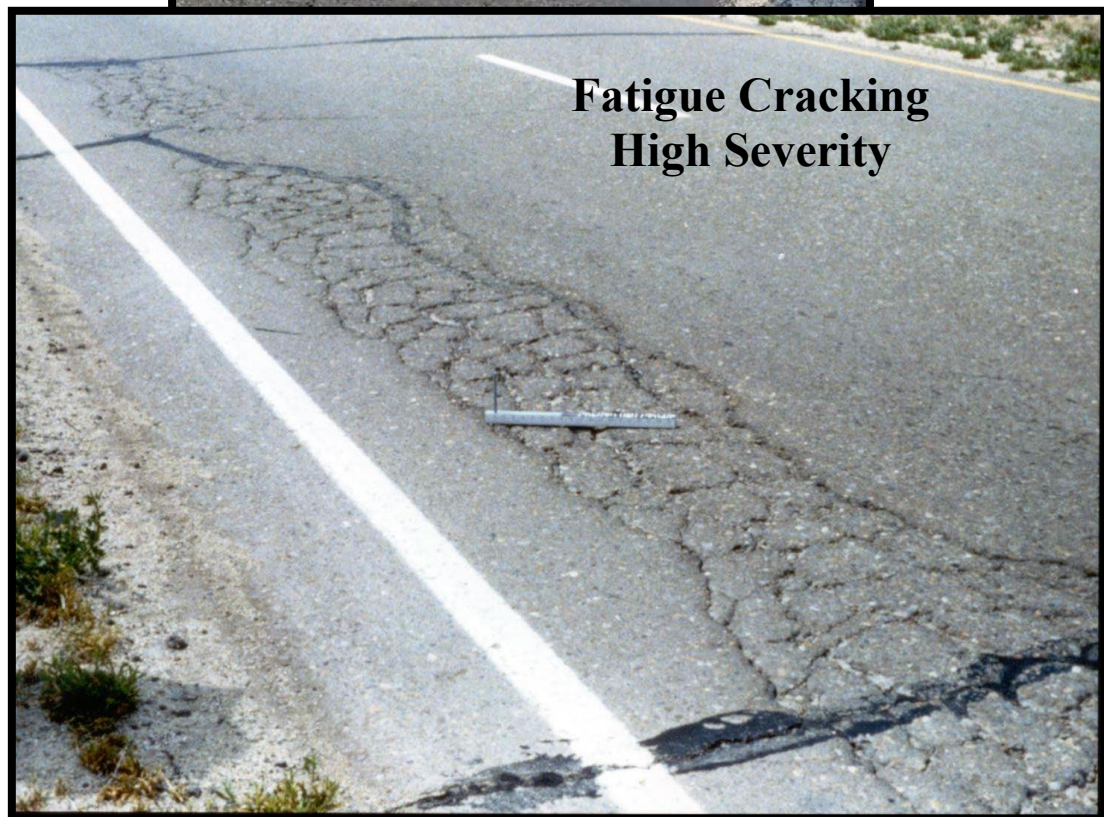
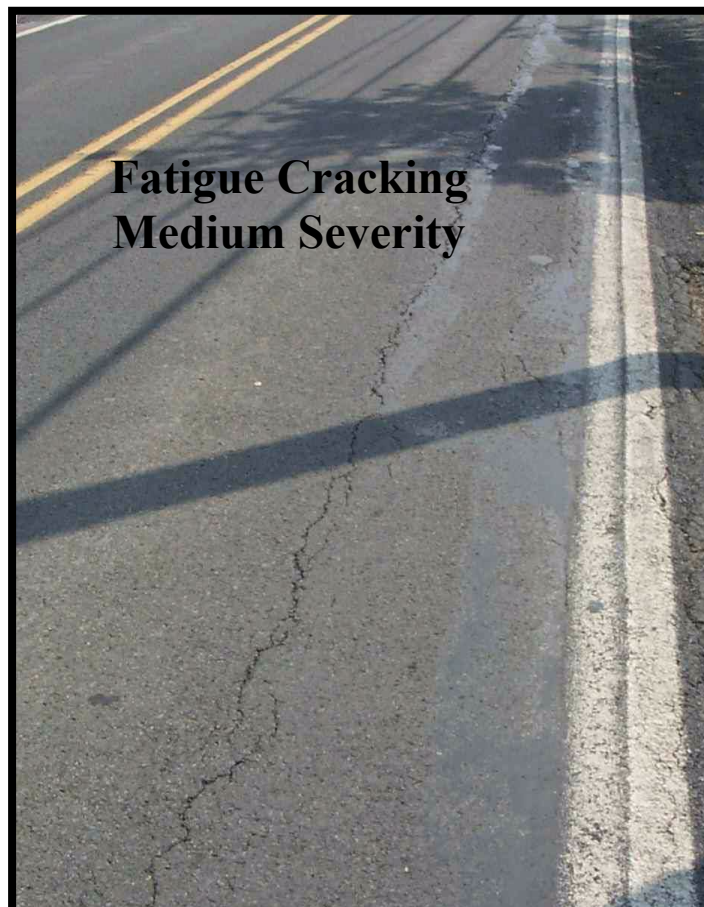
Fatigue cracking is collected in both wheel paths on asphalt surfaces. The left wheel path data will only be used for MAP-21 reporting requirements. Both wheel paths are evaluated continuously along the STAMPP segment. If the cracks are sealed, the severity level is always low. If the cracks have opened up (missing sealant), rate at the appropriate severity level for the crack width.

Severity:

- Low: Average Crack Width \leq hairline
Fatigue cracking consisting of only longitudinal cracks in the wheel path. The size of the crack opening is often referred to as hairline since it is the width of a hair; just barely discernable. This severity rating indicates a pavement is beginning to suffer from structural loading but the cracks do not yet allow water to enter the pavement structure.
- Medium: Average Crack Width $>$ hairline and ≤ 0.25 in
Fatigue cracking consisting of longitudinal and interconnecting cracks typically forming a diamond shaped, chicken wire or alligator's hide pattern. The crack width ranges from fine, just over hairline cracking to widths that allow water to penetrate the surface as well as loss of some material from the surface or spalling.
- High: Average Crack Width > 0.25 in
Fatigue cracking consisting of longitudinal and interconnecting cracks typically forming a diamond shaped, chicken wire or alligator's hide pattern. The cracks are sufficiently wide to allow water to enter the pavement surface. The width measurement includes loss of surface material or crack spalling.

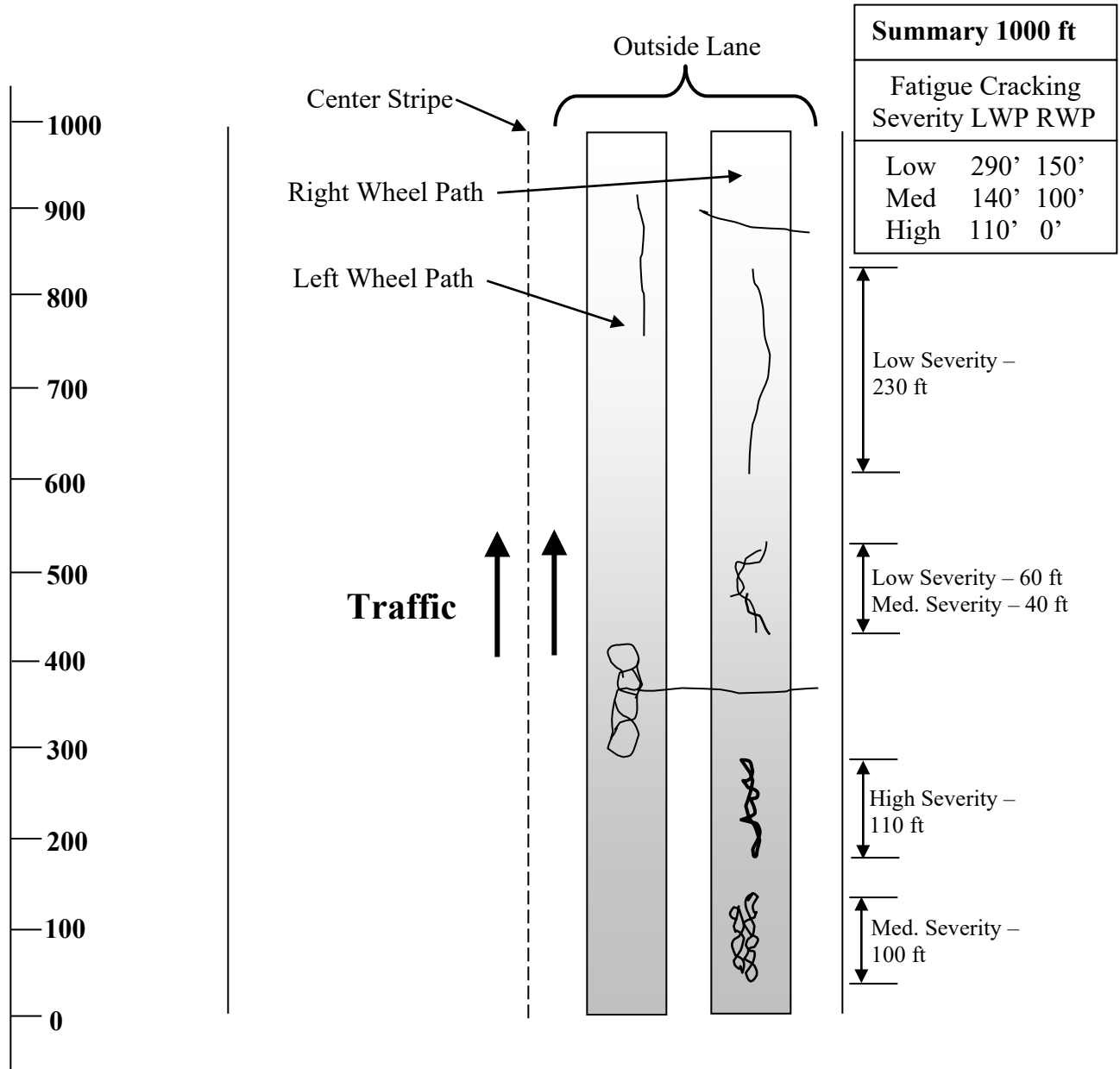
Extent:

Record the length of the segment for each severity level.



Example Reporting:

On a 1000-foot STAMPP segment, in the right wheel path (RWP), there are 2 occurrences of low severity fatigue cracking of 230 and 60 feet, there are 2 occurrences of medium severity fatigue cracking of 40 and 100 feet and 1 occurrence of high severity fatigue cracking of 110 feet. In the left wheel path (LWP) there is 1 occurrence of low severity fatigue cracking (150') and 1 occurrence of medium severity fatigue cracking (100'). The rating for the STAMPP segment would be: LWP - 290 ft low severity fatigue cracking, 140 ft medium severity fatigue cracking, and 110 ft high severity fatigue cracking. RWP – 150' low severity and 100' medium severity fatigue cracking.



Fatigue Cracking Example

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Transverse Cracking

Description:

This condition is characterized by visible fractures or separations of the asphalt pavement surface occurring transversely across the roadway. Cracks are rated as transverse cracks if the angle formed by the crack and the pavement is between 45° and 90° to the direction of travel.

Possible Cause:

Transverse cracking may be caused by a poorly constructed paving joint, shrinkage of the surface due to low temperature, asphalt hardening, or a reflection crack from an underlying rigid base.

Rating Procedure:

The entire pavement lane width is analyzed for transverse cracking for the full STAMPP segment. Only transverse cracks that are ≥ 1 foot long are evaluated. If the cracks are sealed, the severity level is always low; this includes saw-and-seal joints in asphalt overlays on concrete pavement. If the cracks have opened up (missing sealant), rate at the appropriate severity level for the crack width.

Severity:

Estimate the average crack width for each crack and record number and length for each severity level. Each crack can have only one severity level. The average crack width can include spalls.

Low: Average Crack Width > hairline and ≤ 0.25 in

Medium: Average Crack Width > 0.25 in and ≤ 0.5 in

High: Average Crack Width > 0.5 in

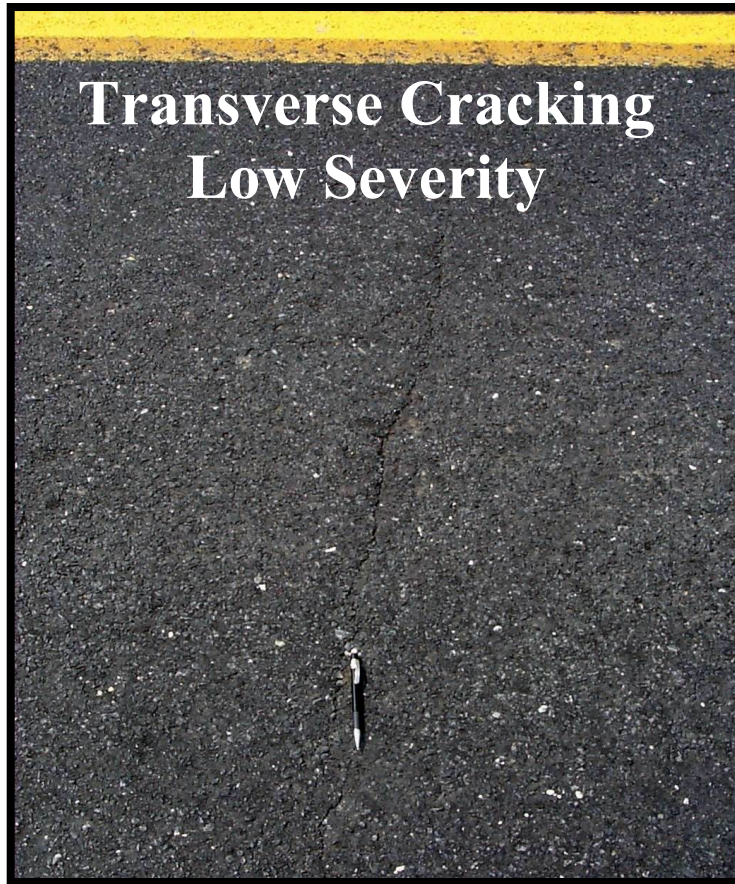
Extent:

Record the number and length of Transverse Cracks in a segment for each severity level. Count all Transverse Cracks ≥ 1 ft long.

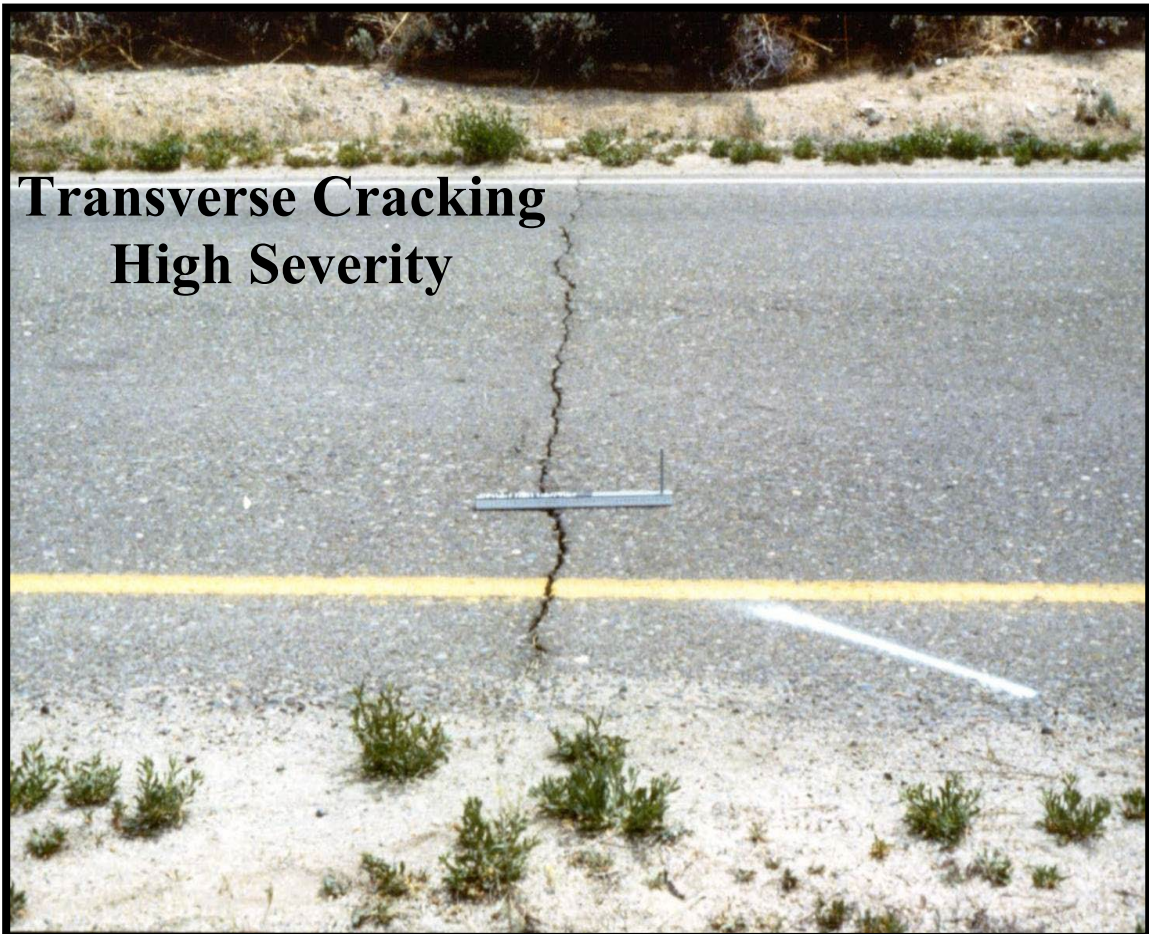
Example Reporting:

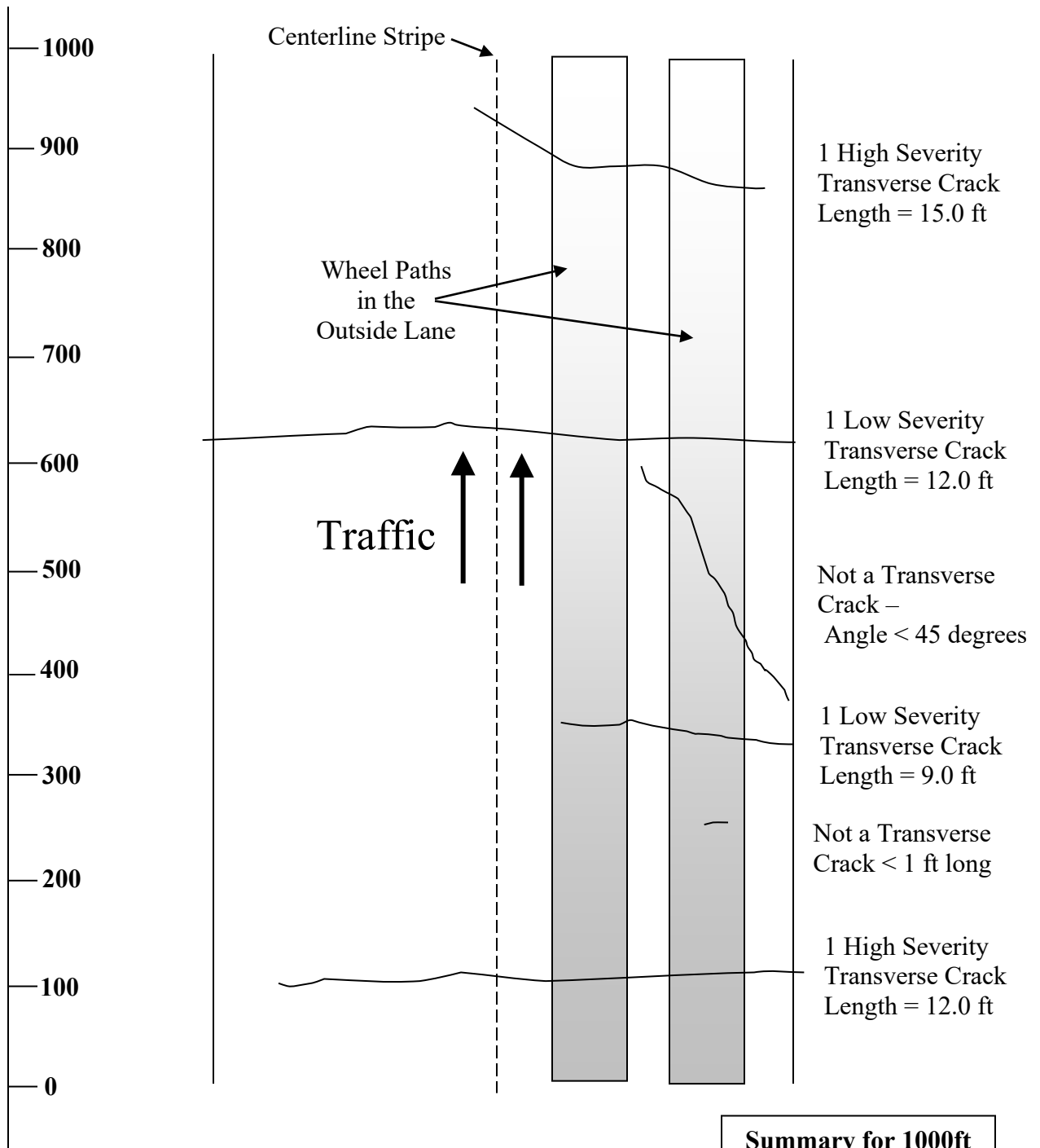
A 1000-foot STAMPP segment has four Transverse Cracks that are identified to be rated. Two of the cracks are low severity and two are high. The total length of the two low severity cracks is 21 feet. The total length of the high severity cracks is 27 feet.

**Transverse Cracking
Low Severity**



**Transverse Cracking
High Severity**





Transverse Cracking Example

Summary for 1000ft		
Transverse Cracking Severity	Num.	Len.
Low	2	21
Medium	0	0
High	2	27

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Miscellaneous Cracking

Description:

This condition is characterized by visible fractures or separations of the asphalt pavement surface occurring longitudinally or randomly along the roadway.

Possible Cause:

This cracking may be caused by a poorly constructed paving joint, shrinkage of the surface due to low temperature, asphalt hardening, a reflection crack from an underlying rigid base, or movement of subgrade material. This distress is characterized by longitudinal and transverse cracking occurring simultaneously with the resulting block pattern less than approximately 10 ft x 10 ft. Miscellaneous cracking tends to occur over large areas but generally on low traffic roads.

Rating Procedure:

This distress is recorded for the middle 30-inch strip of pavement defined earlier as the lane center. This pavement strip is evaluated continuously along the STAMPP segment. Report the length of the STAMPP Segment with miscellaneous cracking. If the cracks are sealed, the severity level is always low. If the cracks have opened up (missing sealant), rate at the appropriate severity level for the crack width.

Severity:

Estimate the average crack width and record in severity categories. Crack width can include width of spalling.

Low: Average Crack Width > hairline and ≤ 0.25 in

Medium: Average Crack Width > 0.25 in and ≤ 0.5 in

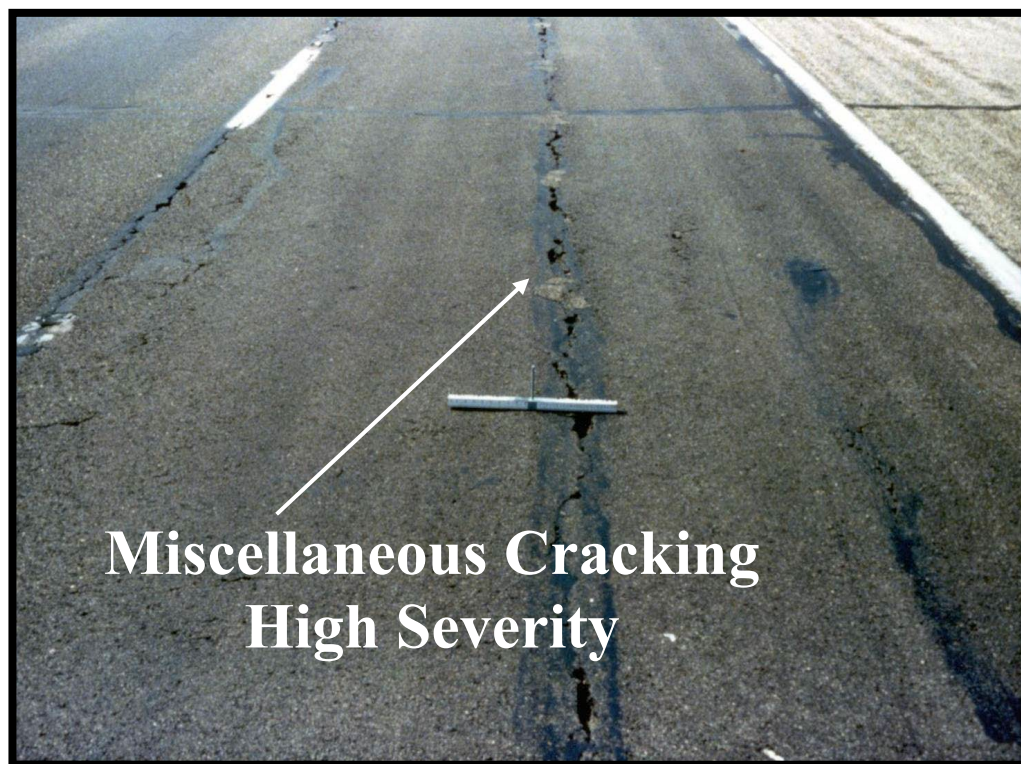
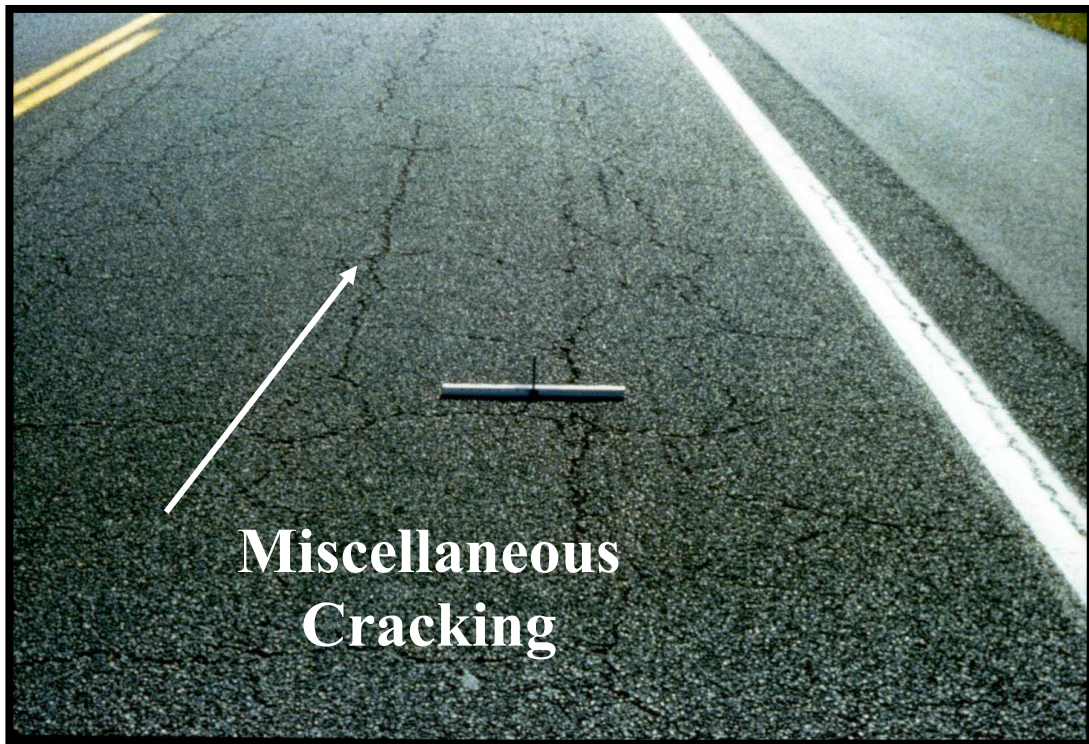
High: Average Crack Width > 0.5 in

Extent:

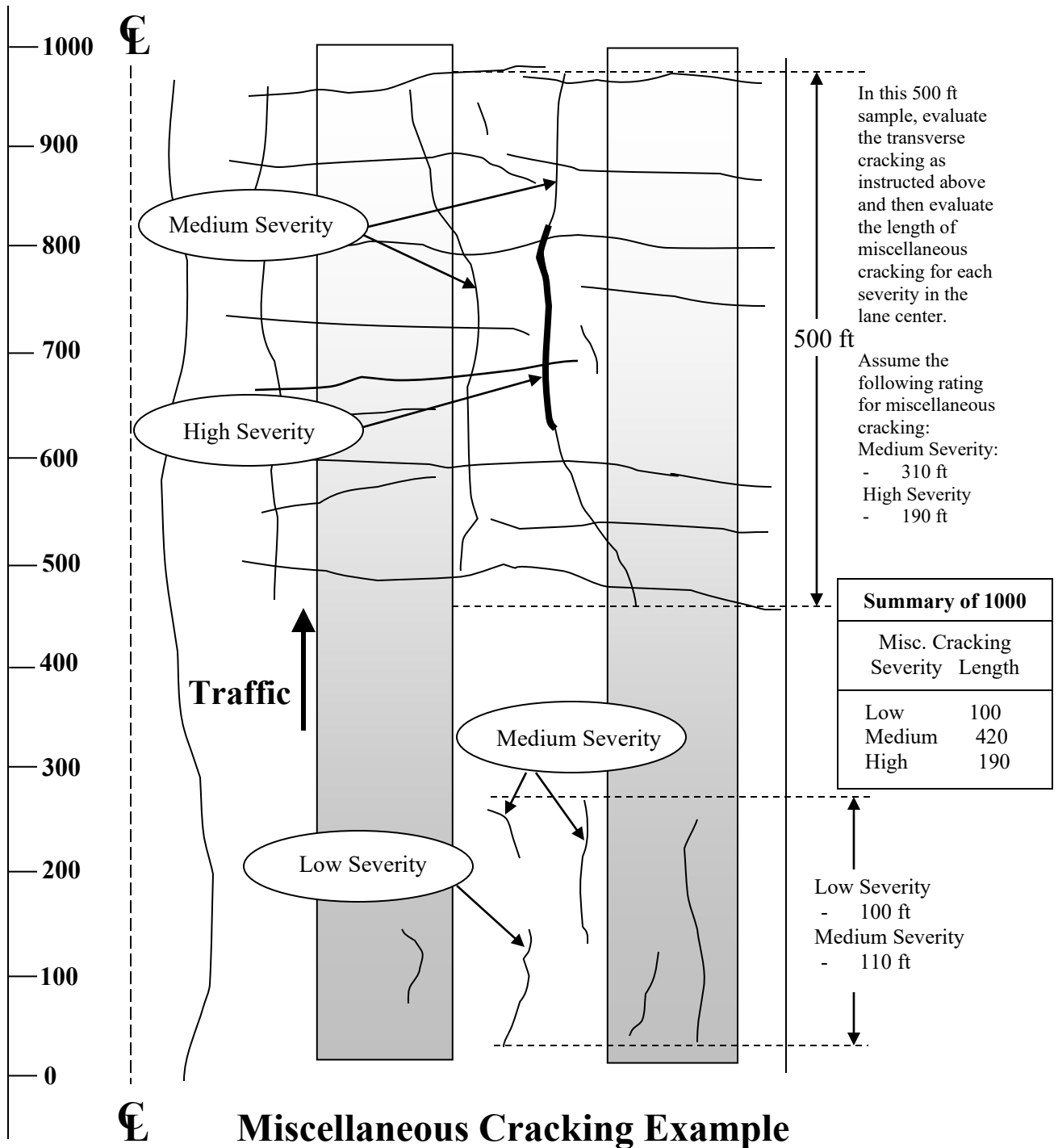
Record the length of segment for each severity level. The total length of miscellaneous cracking cannot exceed the STAMPP segment length.

Example Reporting:

A 1000-foot STAMPP segment has two locations where miscellaneous cracking occurs. The first is longitudinal cracking in the lane center. This location is evaluated for the severity and length of miscellaneous cracking. The second is an occurrence of block cracking. This location is evaluated for transverse cracking first. Once the number and length of transverse cracks are recorded,



the length of the miscellaneous cracking is evaluated. In the example that follows: the section has 100 feet of low severity miscellaneous cracking, 420 feet of medium severity miscellaneous cracking and 190 feet of high severity miscellaneous cracking.



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Edge Deterioration

Description:

This condition is characterized by the progressive breakup of the asphalt pavement, beginning at the pavement edge and proceeding toward the centerline, confined within 1.0 foot of the pavement edge. (Anything within the first 1.0 ft of the pavement edge is called edge deterioration.)

Possible Causes:

Edge deterioration is usually caused by loading over an unsupported pavement edge. Unpaved or deteriorated shoulders contribute to this condition since they do not offer the support needed.

Rating Procedure:

Edge Deterioration is only collected along the 1.0 ft outside edge of the pavement in the direction of travel. Edge deterioration consists of generally crescent shaped or continuous cracks within 1.0 ft of and intersecting with the pavement edge. It also includes longitudinal cracks within the 1.0 ft edge band that do not intersect with the pavement edge.

Severity:

Estimate the average crack width and record in severity categories. The crack width can include width of spalling.

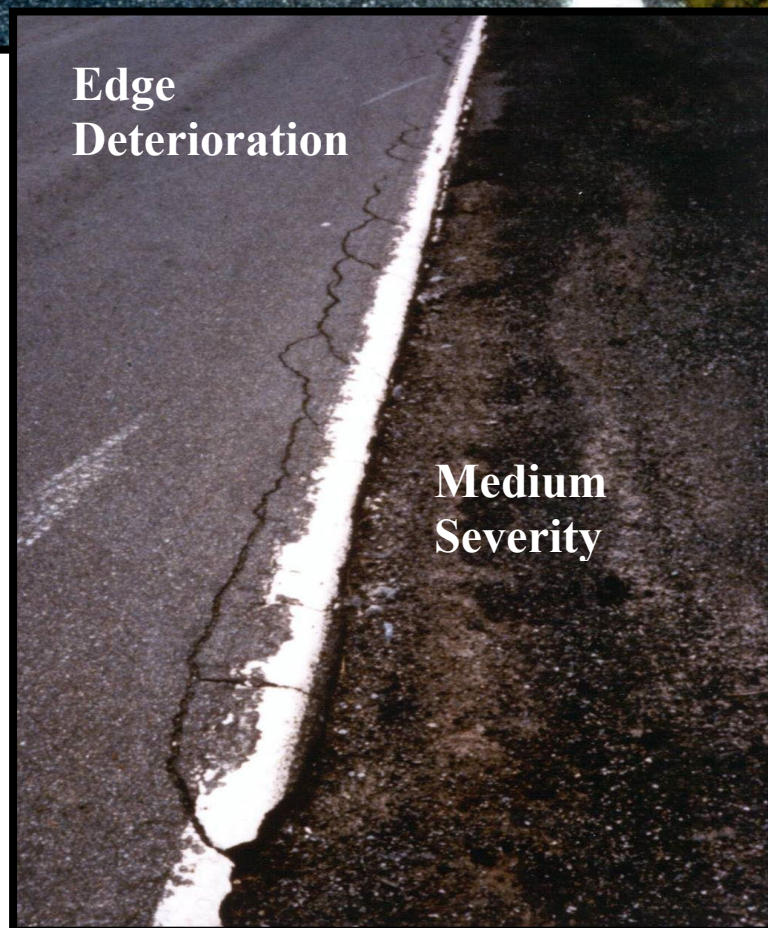
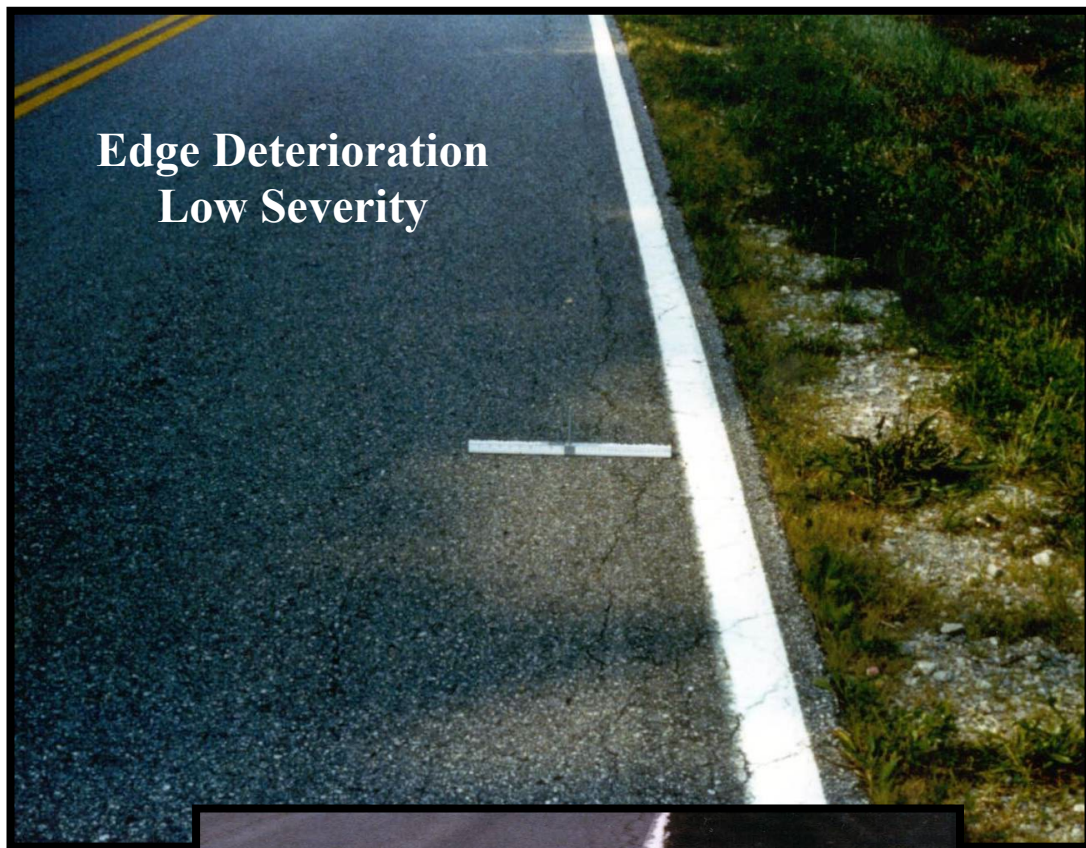
- | | |
|---------|--|
| Low: | Average Crack Width > hairline and ≤ 0.25 in
The width measurement may include crack spalling. No loss of pavement material is allowed in this category. |
| Medium: | Average Crack Width > 0.25 in and ≤ 0.50 in. The edge of the pavement is becoming jagged. |
| High: | Average Crack Width > 0.50 in. The edge of the pavement is deteriorated and pieces of the pavement edge are broken loose or missing. |

Extent:

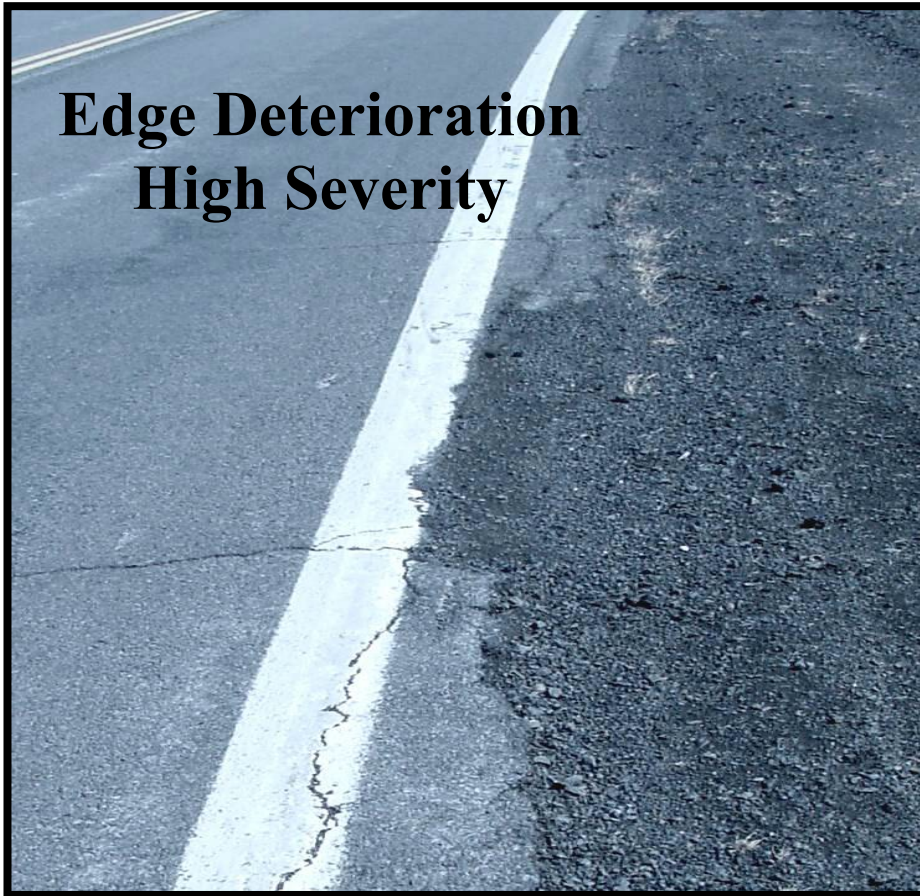
Record the length of segment for each severity level.

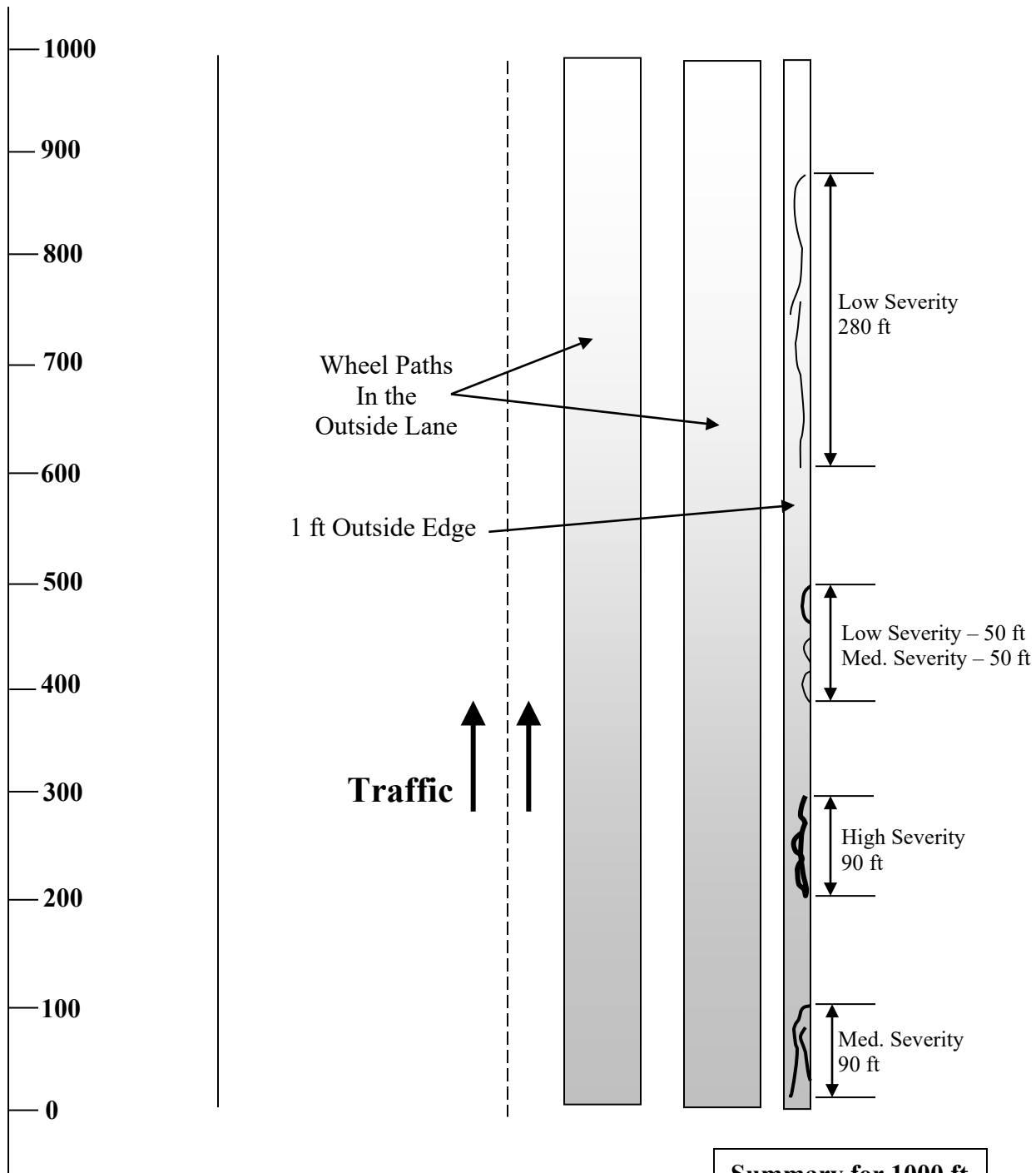
Example Reporting:

A 1000-foot STAMPP segment has 2 occurrences of low severity edge deterioration of 280 and 50 feet, 2 occurrences of medium severity edge deterioration of 50 and 90 feet and 1 occurrence of high severity edge deterioration of 90 feet. The rating for this STAMPP segment is: 330 ft low severity edge deterioration, 140 ft medium severity edge deterioration and 90 ft high severity edge deterioration.



Edge Deterioration High Severity





Edge Deterioration Example

Summary for 1000 ft	
Edge Deterioration Severity	Length
Low	330
Medium	140
High	90

Bituminous Patching

Description:

This condition is characterized by an area of the original asphalt pavement, which has been replaced by bituminous material. Patches are easily recognized because they will generally be darker than the surrounding pavement since they are newer. The patch must have a surface area of at least 1.0 sq ft to be counted. If a full-width patch is more than 400 ft long, do not rate as a patch - it is considered an overlay or surface seal.

Possible Cause:

Bituminous patching is usually the result of maintenance activities such as pothole patching.

Rating Procedure:

The entire lane surface is evaluated for patching.

Severity:

None. Rate the individual distresses present in a patch separate from the patch; rate the distresses in the appropriate distress category. The condition rating of a distressed patch will be reflected in the pavement rating for both the patch and the distress.

Extent:

Record the total number and area of patches.

Example Rating:

A 1000-foot long, 9-foot wide STAMPP segment has two patches that are within the correct size limitations for rating as patches. After evaluating the patches for distress, the area and number are recorded. The first patch is 100 feet long and 4.6 feet wide. The second patch is 30 feet long and 9.0 feet wide. The rating for patches on this segment is: 2 patches at 730 sq ft.

Bituminous Patching



Raveling / Weathering

Description:

This condition is characterized by wearing away of the asphalt pavement surface caused by the dislodging of aggregate particles (raveling) and loss of asphalt binder (weathering).

Possible Cause:

Raveling and weathering are normally caused by oxidation of the asphalt binder of the mix, resulting in loss of flexibility and ability to hold the aggregate, which is dislodged by traffic.

Rating Procedure:

The entire lane surface is evaluated for raveling and weathering. Rate only one severity level for each contiguous occurrence of raveling and weathering.

Severity:

Medium: Surface is rough and pitted, may have loose particles.

High: Surface is very rough and highly pitted.

Extent:

Record the length of the segment for each severity level.

Example Rating:

On a 1000-foot long, 9-foot wide STAMPP Segment there are two localized areas of raveling and weathering. The first contains a length of 125 feet of medium severity raveling and weathering. The second contains a length of 65 feet of high severity raveling and weathering. The rating for this section is: 125 feet medium severity raveling and weathering and 65 feet high severity raveling and weathering.

**Raveling/Weathering
Medium Severity**



**Raveling/Weathering
High Severity**



**Raveling/Weathering
High Severity**



Left Edge Joint

Description:

This condition is characterized by an open longitudinal construction joint (paving seam) sometimes accompanied by parallel, interconnected cracks that form jagged pieces. Severe cases of this distress result in spalling of the asphalt pavement and may require patching of the construction joint.

Possible Cause:

Undetermined.

Rating Procedure:

The longitudinal construction joint (paving seam) defining the left edge of the survey lane is evaluated for distress. The joint will be rated whenever it lies within one foot to the left or right of the pavement markings (paint stripes or reflectors) separating the surveyed lane from adjacent lanes. If the joint is sealed, with the sealant in good condition, no severity level is rated. If the joint has opened up (missing sealant), rate at the appropriate severity level for the crack width.

Severity:

- Low:
- Construction joint open $< \frac{1}{4}$ ".
 - If any cracks parallel to the joint are present, they are hairline width.
 - No loss of material in this category and no patching.
- Medium:
- Construction joint open $\frac{1}{4}$ " to $\frac{1}{2}$ ".
 - Random adjacent cracks are $\leq \frac{1}{4}$ " wide and interconnected forming jagged pieces.
 - Some minor loss of material (spalling) visible but no patching present.
- High:
- Construction joint open $> \frac{1}{2}$ ".
 - Random adjacent cracks are $> \frac{1}{4}$ " wide and interconnected forming jagged pieces.
 - Visibly severe loss or breaking of material (spalling) or patching of construction joint present.

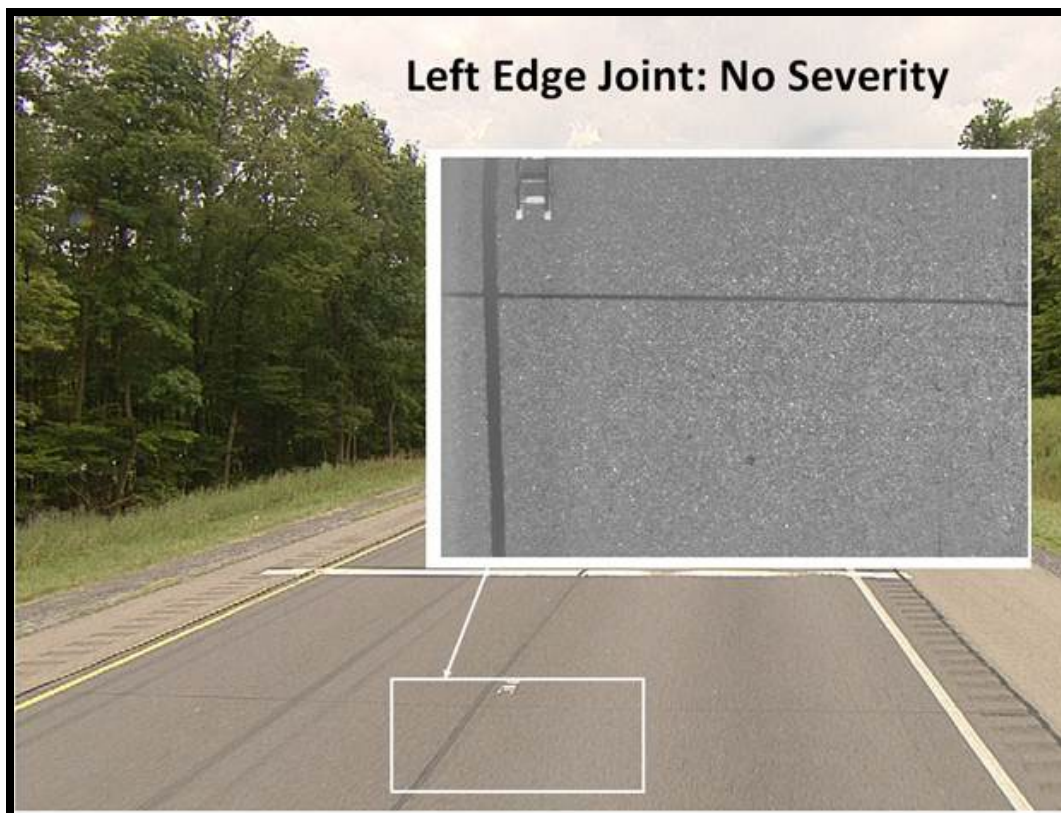
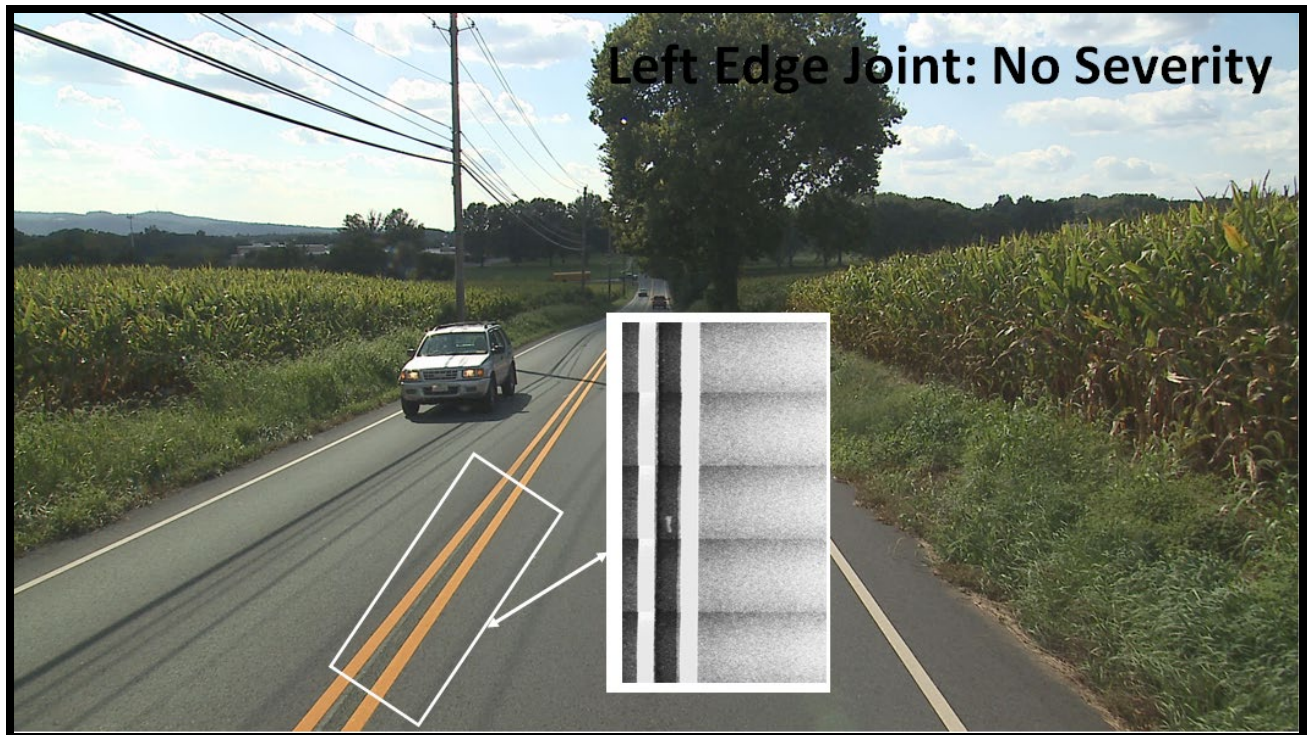
Extent:

Record the length of the segment for each severity level.

Example Rating:

On a 2640-foot long, 12-foot wide STAMPP Segment there are two localized areas of left edge joint distress. The first contains a length of 1250 feet of low severity distress. The second contains a length of 650 feet of medium severity distress. The rating for this section is: 1250 feet low severity and 650 feet medium severity left edge joint distress.

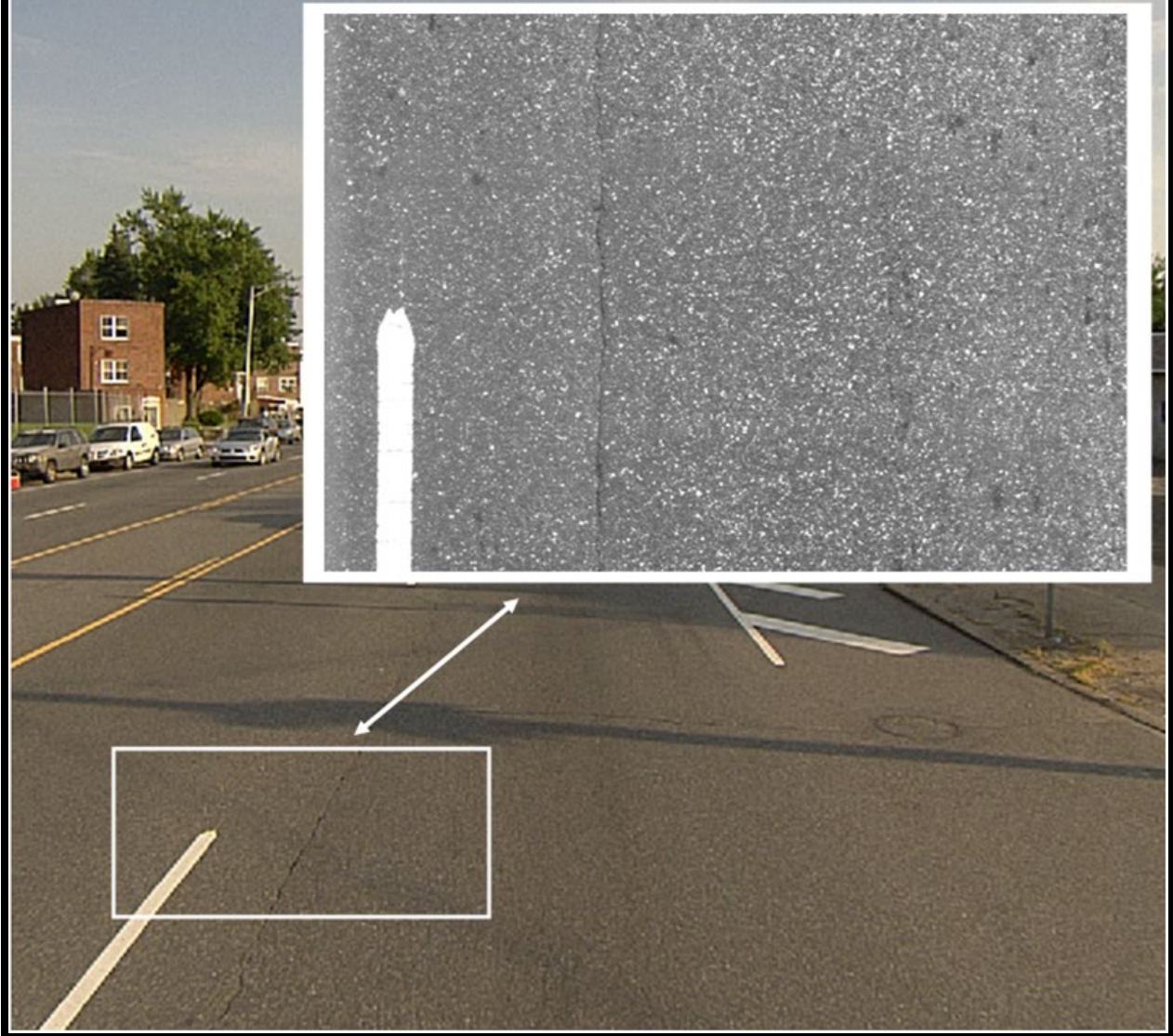
Left Edge Joint Examples



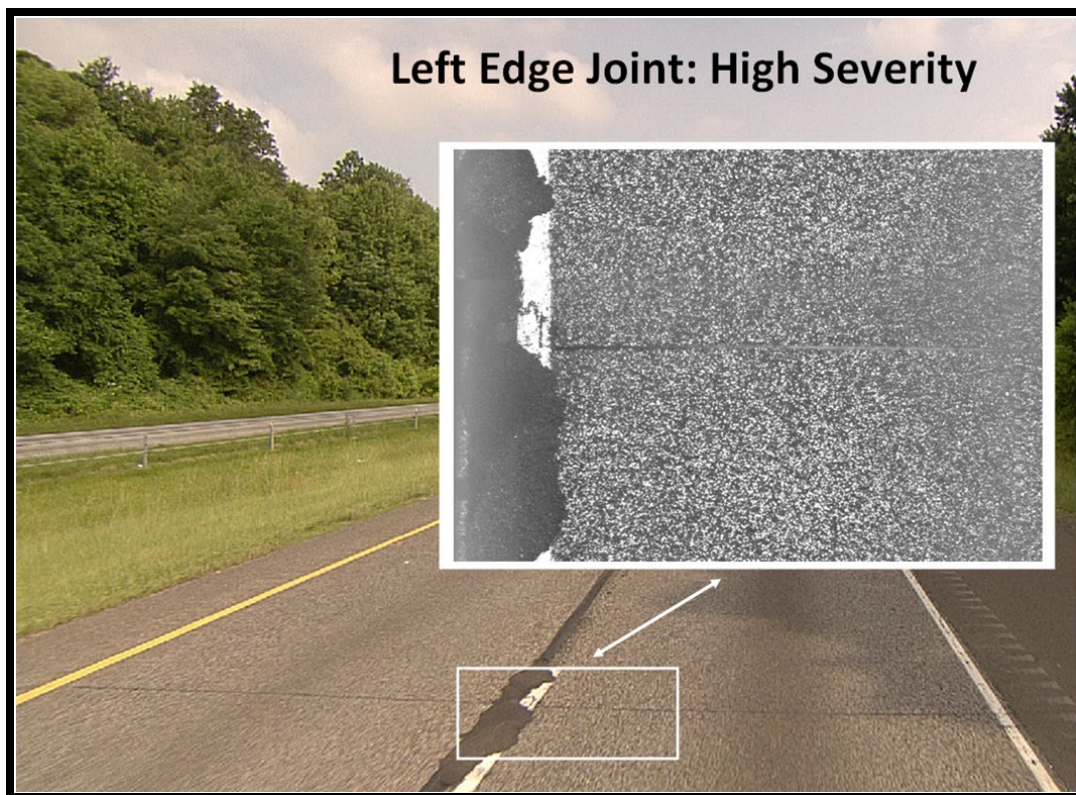
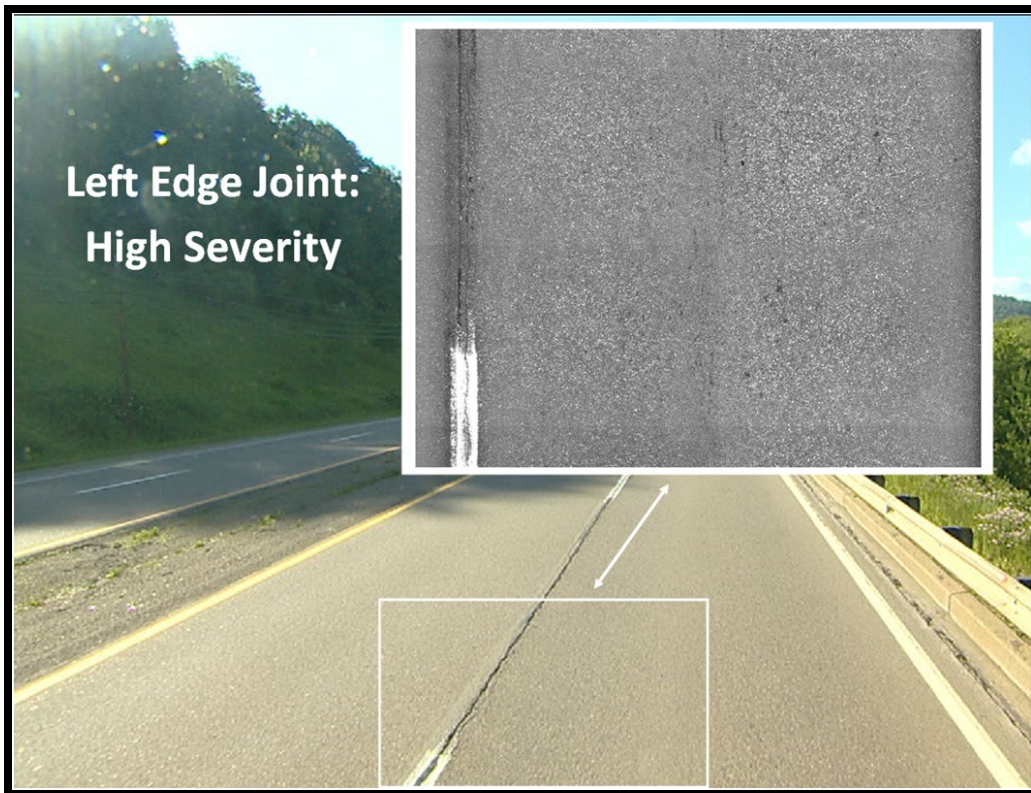
Left Edge Joint: Low Severity



Left Edge Joint: Medium Severity



Note: Assume construction joint is within one foot of the white lane markings for the purpose of this example.



RIGID PAVEMENTS

Faulted Joints

Description:

This condition is characterized by a difference in elevation across a transverse joint.

Possible Cause:

Faulting can result from the erosion and re-depositing of base material beneath the slabs due to excess water in the base and heavy traffic loads.

Rating Procedure:

Faulting is measured in the outside wheel path as defined for profile data collection. Each joint, including concrete patch joints, is evaluated for faulting potential. Positive and negative faulting are categorized the same way by taking the absolute value of the measured fault.

Severity:

Medium: Absolute value of elevation difference is ≥ 0.25 in and < 0.5 in

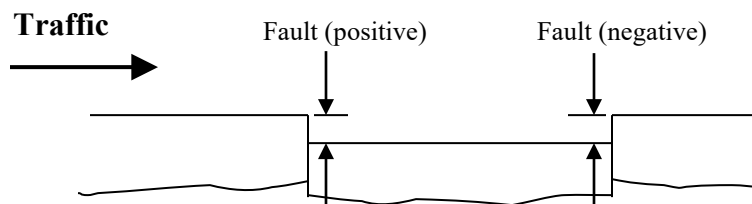
High: Absolute value of elevation difference is ≥ 0.5 in

Extent:

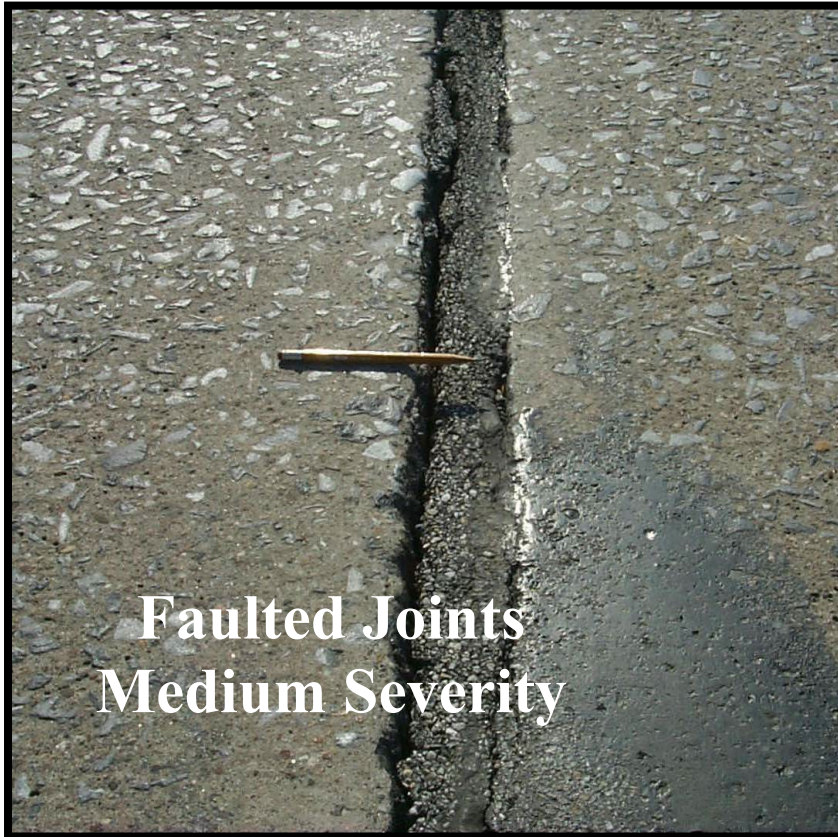
Record the number of joints that are faulted in each category.

Example Rating:

A 1000-foot STAMPP segment has 16 joints. Of these 16 joints, 3 are measured as medium severity, and 5 as high severity. The rating for this section is: 8 joints none, 3 joints medium, and 5 joints high severity faulting.



Faulted Joints Example



Broken Slab

Description:

This condition is characterized by the cracking or breaking of the concrete slab into four or more pieces, within a 20-ft length of the slab, the pieces generally being greater than 1 sq ft in area.

Possible Cause:

Broken slabs can be caused by a condition of heavy load repetitions and poor base support.

Rating Procedure:

Each slab is evaluated separately for a broken slab condition. For the purposes of this distress, the “slab” is considered to begin 1-foot from the upstream traffic joint (the approach side) and end 1-foot before the downstream traffic joint (the leave side). On jointed concrete pavements, profile is evaluated for two sample intervals, the first for roughness and the second in 20-foot sample intervals along each slab. The second roughness measurement will be used to estimate the severity level for the slab. **Once a slab is rated as broken, no other distress shall be recorded for that slab.**

Severity:

- Low: At least 4 pieces in a 20-foot length with average width \leq hairline in the outside Wheel path, no faulting and IRI \leq 100 in/mi.
- Medium: At least 4 pieces in a 20-foot length with an average crack width $>$ hairline and \leq 0.25 in, may have faulting $>$ 0.25 in and \leq 0.50 in OR IRI $>$ 100 and \leq 200 in/mi.
- High: At least 4 pieces in a 20-foot length with an average crack width $>$ 0.25 in, may have faulting $>$ 0.5 in OR IRI $>$ 200 in/mi.

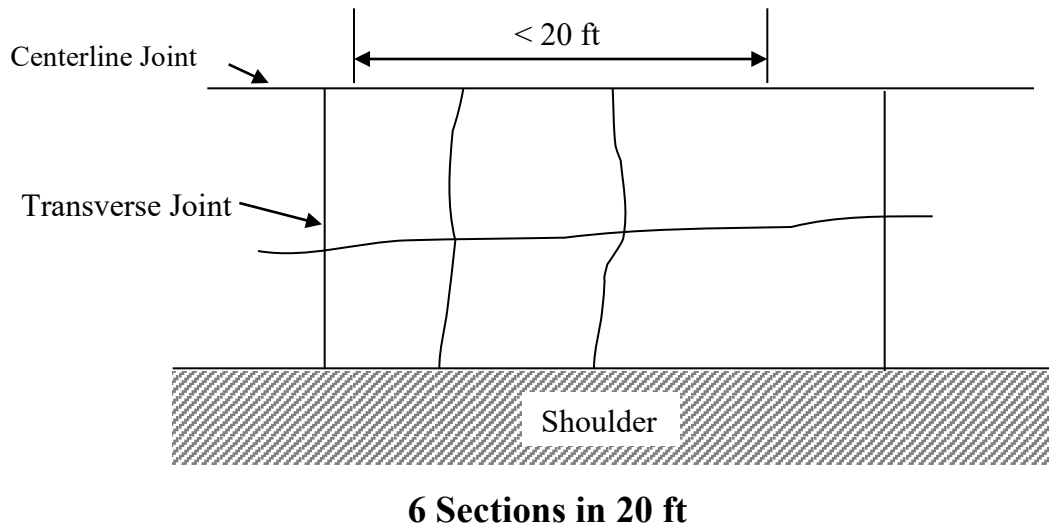
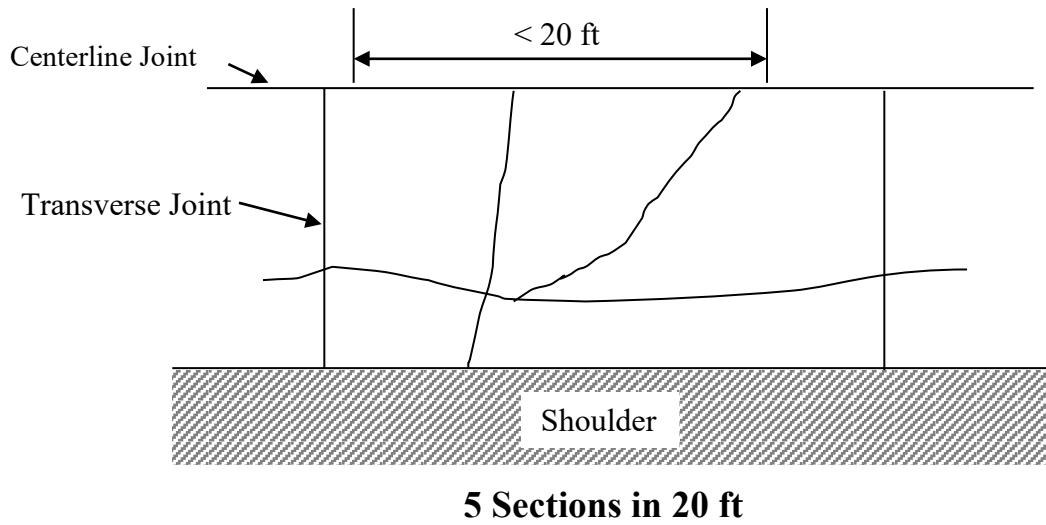
Extent:

Record the number of slabs in each severity category. If any single crack, faulting, or IRI meets the criteria for the next highest severity, then rate at that severity level.

Example Reporting:

A 1000-foot STAMPP segment has 16 slabs. Of the 16 slabs, 2 have cracking patterns and roughness or faulting to place them in the medium severity level. The rating for this segment is: 14 slabs none and 2 medium severity broken slabs.

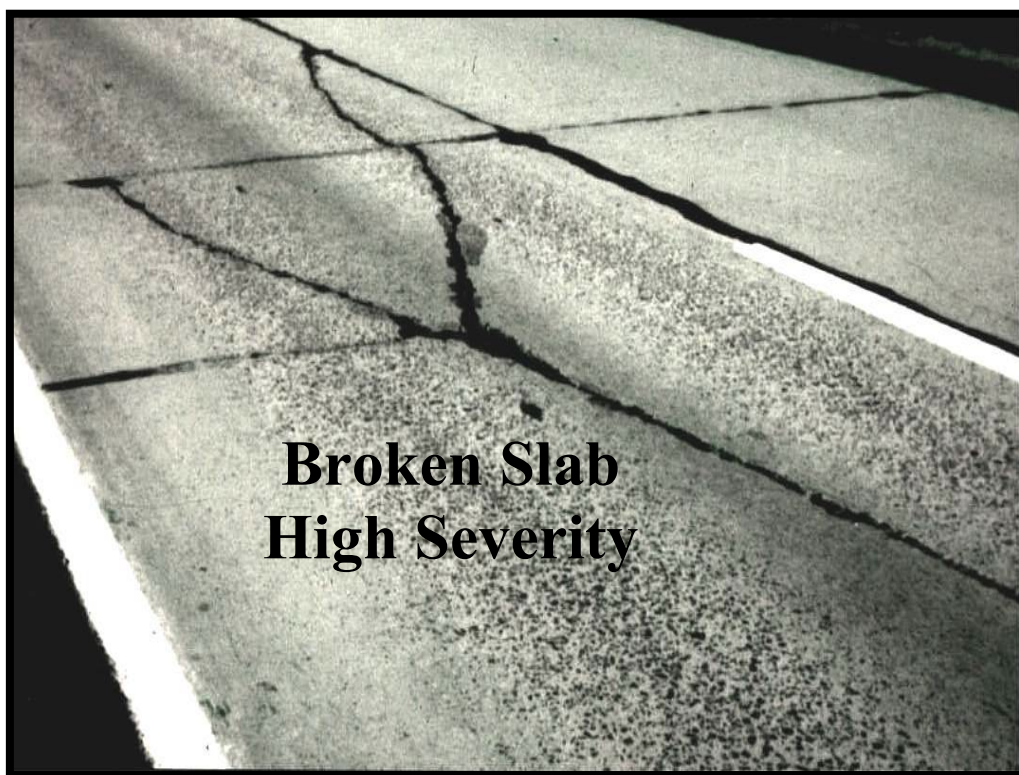
Broken Slab Examples







**Broken Slab
High Severity**



**Broken Slab
High Severity**

Transverse Joint Spalling

Description:

This condition is characterized by the cracking, breaking, or chipping of concrete slab edges adjacent to a transverse joint or the transverse joint created by a patch. It usually does not extend through the thickness of the slab but meets the joint at an angle. It may be currently filled with bituminous material. If so, record the width of the spall as the width of the bituminous material.

Possible Cause:

Spalling is usually caused by excessive stresses at a joint due to infiltration of incompressible materials and subsequent thermal expansion of the concrete. It can also be caused by weak concrete at the joint combined with traffic loading, or poorly designed or constructed load transfer devices.

Rating Procedure:

Evaluate the pavement for spalling 1.0 foot on either side of the joint. The width of the joint shall be removed from the spall width estimates used in the evaluation. If a joint formed by a concrete patch is spalled and meets the criteria below, the new joint formed by the slab and patch must be included in that severity level. Count all transverse joints, including those formed by concrete patches, in the total number of joints per segment.

Severity Levels:

Low: ≤ 2.0 in wide for any length of the joint

Medium: > 2.0 in wide for $\leq 50\%$ of joint length

High: > 2.0 in wide for $> 50\%$ of joint length

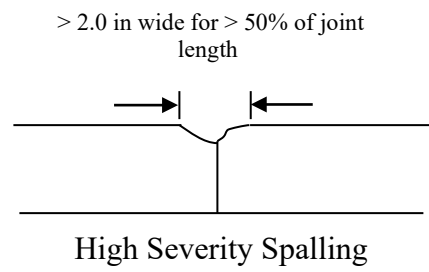
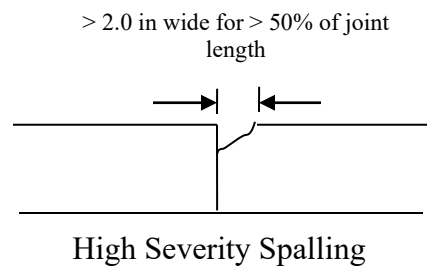
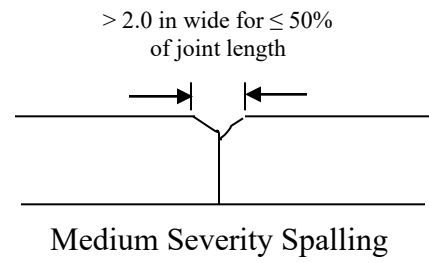
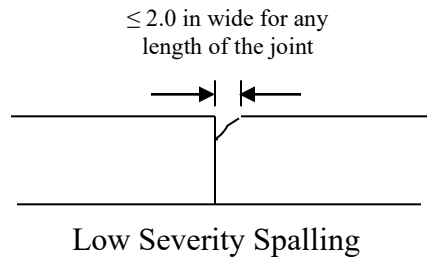
Extent:

Record the number of joints (original and created by concrete patches) for each severity level. The total is not to exceed the total number of joints in the segment.

Example Rating:

A 1000-foot STAMPP segment has 16 transverse joints. Five joints have low severity spalling, 6 have medium and 3 have high. The rating for this segment is: 2 transverse joints none, 5 transverse joints low severity, 6 transverse joints medium severity and 3 transverse joints high severity spalling.

Transverse Joint Spalling Examples







Transverse Cracking

Description:

This condition is characterized by random cracks, sealed or unsealed at least 6 feet in length. Cracks are rated as transverse cracks if the angle formed by the crack and the concrete pavement is between 45° and 90° to the direction of travel.

Possible Cause:

These cracks are usually caused by a combination of heavy load repetition, thermal and moisture gradient stresses, and drying shrinkage stresses.

Rating Procedure:

The entire pavement lane width is analyzed for transverse cracking for the full STAMPP segment. Only transverse cracks that are ≥ 6 feet long are evaluated on a slab by slab basis. Each slab can have only one severity level. When a concrete patch exists within a slab, rate any transverse cracking on the patch as part of the slab. Record the slab at the highest severity level defined below.

Severity:

Low: Average crack width \leq hairline, no spalling, no faulting

Medium: Average crack width $>$ hairline & ≤ 0.25 in wide,
Spalling ≥ 2.0 in wide for $\leq 50\%$ length,
Or faulting ≥ 0.25 in and < 0.50 in

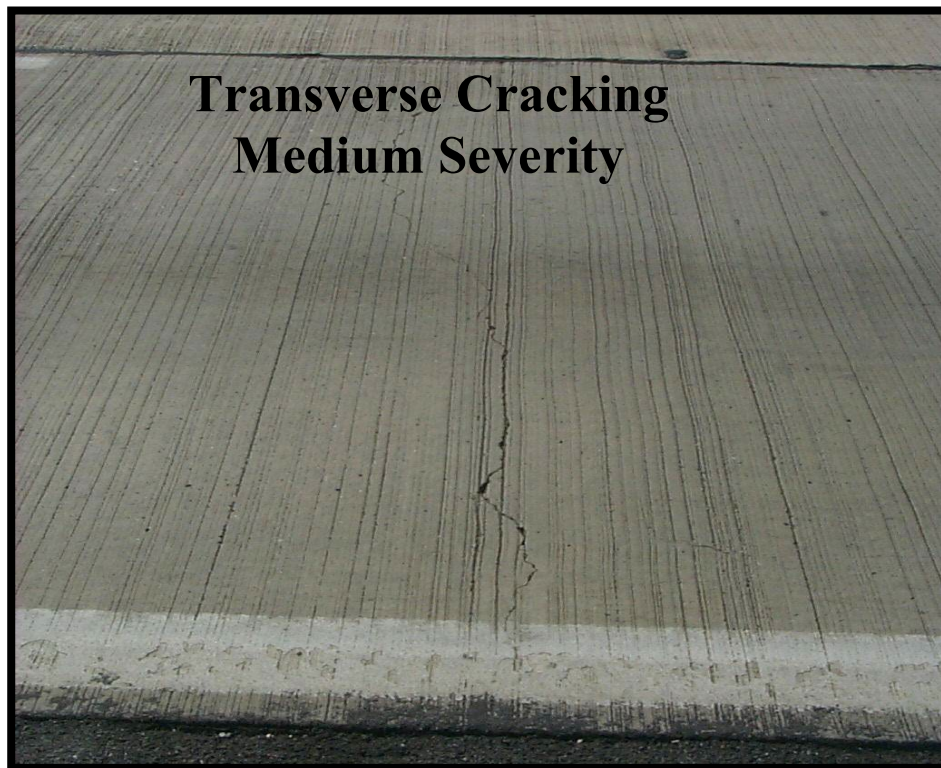
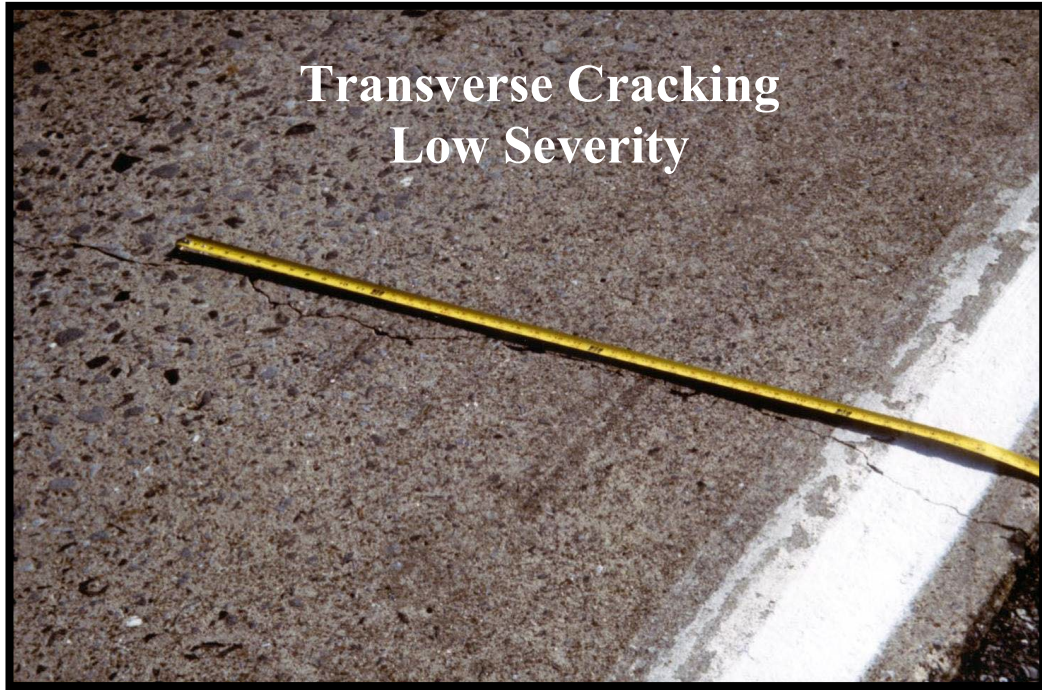
High: Average crack width > 0.25 in wide, spalling ≥ 2.0 in wide for $> 50\%$ length,
Or faulting ≥ 0.5 in

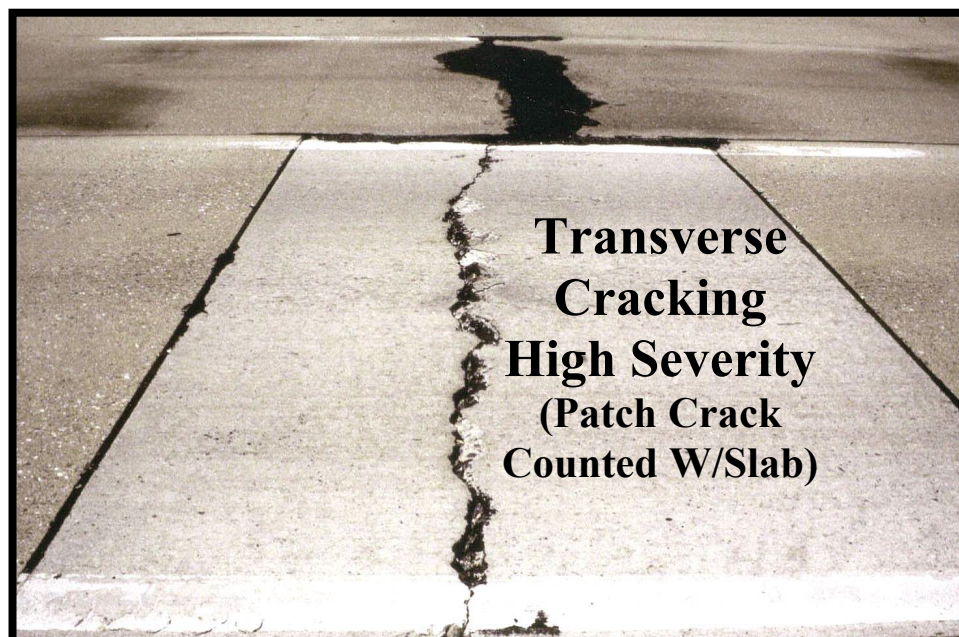
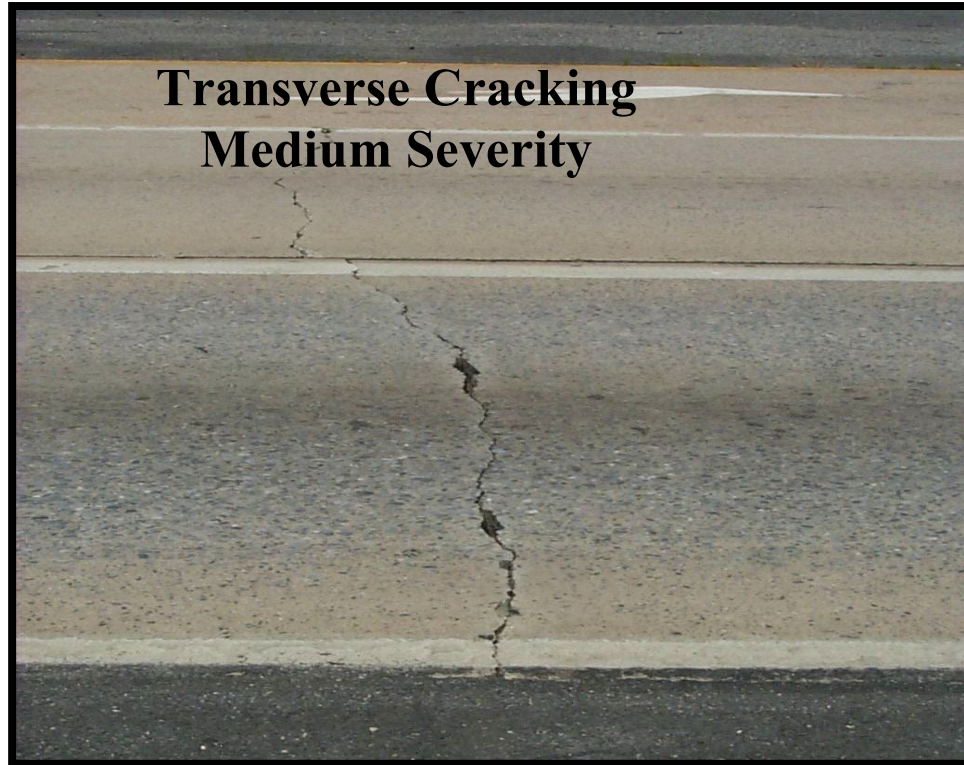
Extent:

Record the number of slabs with each severity rating. If any one condition causes the transverse crack to be placed in the next highest severity rating, then record in the next highest severity rating.

Example Rating:

A 1000-foot STAMPP segment has 16 slabs with 2 slabs showing transverse cracking in the low severity category and 6 in the medium severity category. The rating for this segment is: 8 slabs none, 2 slabs low severity and 6 slabs medium severity transverse cracking.





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Longitudinal Cracking

Description:

This condition is characterized by random cracks, sealed or unsealed. Cracks are rated as longitudinal cracks if the angle formed by the crack and the concrete pavement is between 0° and 45° to the direction of travel.

Possible Cause:

These cracks are usually caused by a combination of reactive materials, heavy load repetition, thermal gradient stresses, and drying shrinkage stresses.

Rating Procedure:

The entire pavement lane width is analyzed for longitudinal cracking for the full STAMPP segment. Only longitudinal cracks that are ≥ 6 feet long are evaluated on a slab by slab basis. Each slab can have only one severity level. When a concrete patch exists within a slab, rate any longitudinal cracking on the patch as part of the slab. Record the slab at the highest severity level defined below.

Severity:

Low: Average crack width $>$ hairline and ≤ 0.25 in wide

Medium: Average crack width ≤ 0.25 in wide, spalling ≥ 2.0 in wide for $\leq 50\%$ length

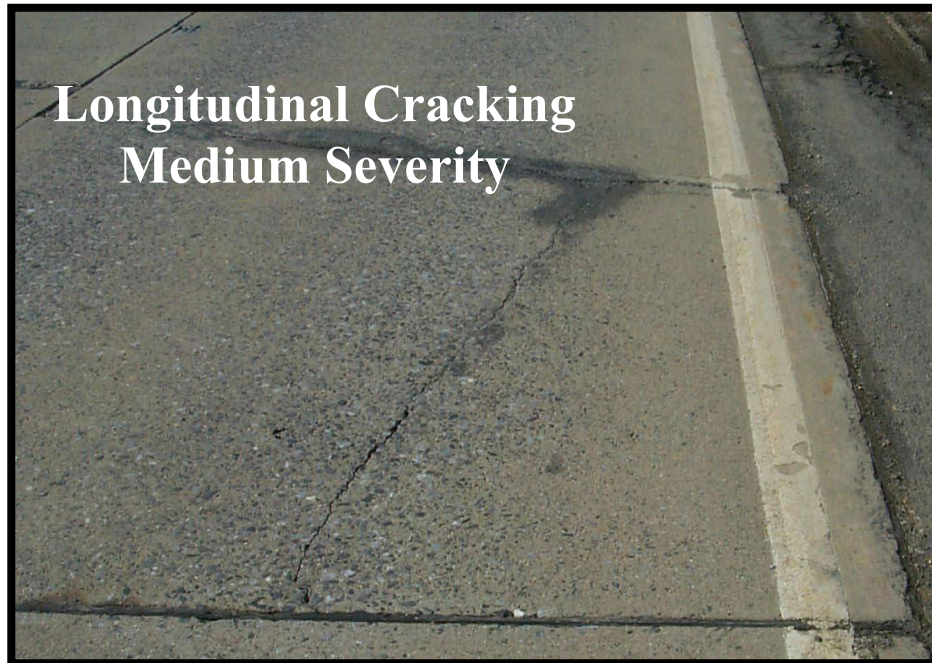
High: Average crack width > 0.25 in wide, spalling ≥ 2.0 in wide for $> 50\%$ length

Extent:

Record the number of slabs with each severity rating. If any one condition causes the longitudinal crack to be placed in the next highest severity rating, then record in the next highest severity rating.

Example Rating:

A 1000-foot STAMPP segment has 16 slabs with 2 slabs showing longitudinal cracking in the medium severity category and 5 in the high severity category. The rating for this segment is: 9 slabs none, 2 slabs medium severity and 5 slabs high severity longitudinal cracking.



Longitudinal Joint Spalling

Description:

This condition is characterized by the cracking, breaking or chipping of concrete slab edges adjacent to the longitudinal joint. It usually does not extend through the thickness of the slab, but meets the joint at an angle. It may be currently filled with bituminous material. If so, record the width of the spall as the width of the bituminous material.

Possible Cause:

Longitudinal joint spalling is generally caused by low quality concrete at the joint in combination with low air content in the concrete, wet-dry and freeze-thaw cycling and traffic loads.

Rating Procedure:

Rate the entire longitudinal joint (at the inside edge of slab) for longitudinal joint spalling. Record longitudinal joint spalling only when the total accumulated length (for all severity levels) is 25 feet or more. If there is more than one longitudinal joint within the lane being surveyed, count all joints in the total length of longitudinal joint spalling with the maximum total equal to the number of longitudinal joints times the segment length.

Severity:

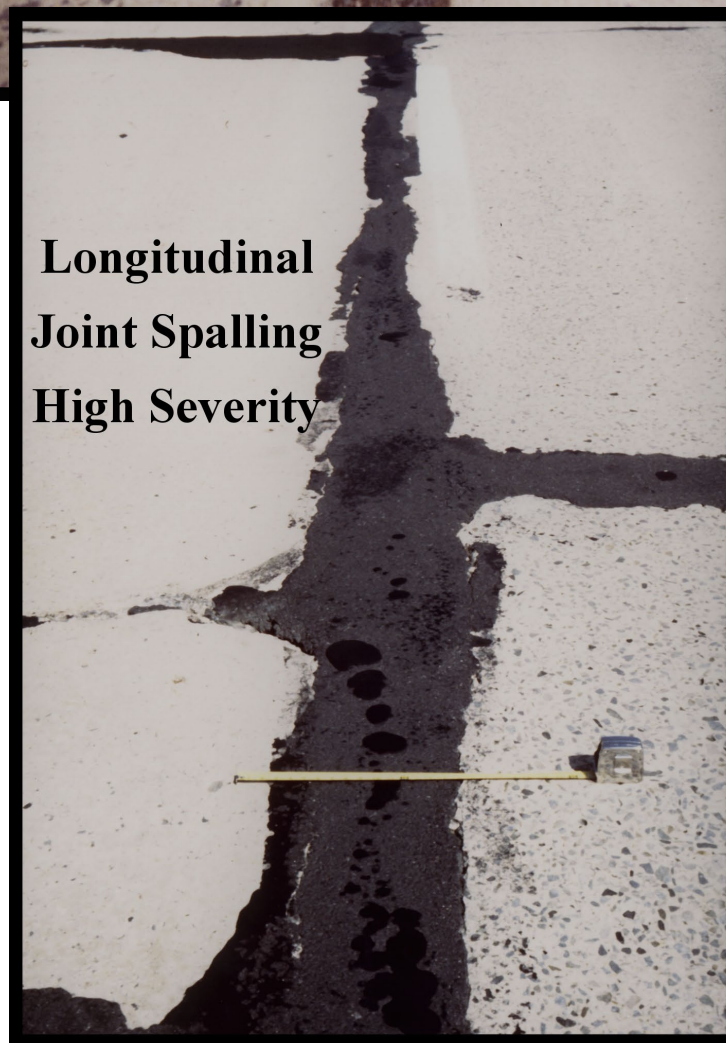
- | | |
|---------|--|
| Low: | Average spalled width ≥ 1.0 in and < 3.0 in for an accumulated spalled length of at least 25 feet |
| Medium: | Average spalled width ≥ 3.0 in and < 6.0 in for an accumulated spalled length of at least 25 feet |
| High: | Average spalled width ≥ 6.0 in for an accumulated spalled length of at least 25 feet |

Extent:

Record the total length of each severity.

Example Rating:

The accumulated length of spalling on a 1000-foot STAMPP segment is broken down into the following two amounts: 200 feet of medium severity and 150 feet of high severity longitudinal joint spalling. The rating for this section is 650 ft none, 200 ft medium and 150 ft high severity longitudinal joint spalling.



Bituminous Patching

Description:

This condition is characterized by an area of the original concrete pavement, which has been repaired with bituminous material greater than 36 sq ft in area it may be a surface or full depth patch.

Possible Cause:

Bituminous patching may have been required for one of several reasons such as high severity spalling, broken slab, faulting, or surface defects.

Rating Procedure:

Evaluate the full pavement lane width and determine the number of bituminous patches with an area exceeding 36 sq ft. Report the number and total area.

Severity:

None

Extent:

Count the number and record the area.

Example Rating:

A 1000-foot long, 11-foot wide STAMPP segment has three bituminous patches. One of the patches is 1 foot long and six feet wide (6 ft²), the second is 7.4 feet long and half a lane width (40.7 ft²) and the third is 9 feet long and a full lane width (99.0 ft²). The rating for this STAMPP segment is two bituminous patches and 139.7 ft² area.



Portland Cement Concrete Patching

Description:

This condition is characterized by an area of the original concrete pavement that has been repaired with portland cement concrete material greater than 36 sq ft in area. It may be a surface or full depth patch.

Possible Cause:

Portland cement concrete patching may have been required for one of several reasons such as high severity spalling, broken slab, faulting or surface defects.

Rating Procedure:

Evaluate the full pavement lane width and determine the number of portland cement concrete patches with an area exceeding 36 sq ft. Report as the number and total area of patches.

Severity

None. If a patch is distressed, the condition rating will be reflected in the pavement rating for both the patch and the distress.

Extent:

Count the number and record the total area of all patching.

Example Rating:

A 1000-foot long, 11-foot wide STAMPP segment has three portland cement concrete patches. One of the patches is 2 feet long and 5 feet wide (10 ft²), the second is 8.2 feet long and half a lane width (45.1 ft²) and the third is 6 feet long and a full lane width (66.0 ft²). The rating for this STAMPP segment is two portland cement concrete patches with 111.1 ft² total area.

