FLORIDA DEPARTMENT OF TRANSPORTATION

FLEXIBLE PAVEMENT CONDITION SURVEY HANDBOOK

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STATE MATERIALS OFFICE

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Executive Summary

This handbook has been developed as a guide for personnel responsible for conducting the Florida Department of Transportation Pavement Condition Survey (PCS) on flexible pavements and to ensure consistency among raters. It also serves as a reference to staff in each district involved in the PCS data verification process. This reference describes the procedures for conducting a visual, mechanical and automated condition evaluation of the Department's flexible pavement system. Items evaluated in the survey include:

1. Class IB Cracking
2. Class II Cracking
3. Class III Cracking
4. Raveling
5. Patching
6. Profiler Rut Depth (automated)
7. Manual Rut Depth
8. Ride Quality (roughness)

The data collected during the PCS is used as input into the pavement management system and for project prioritization purposes.

Keywords: Crack Rating, Ride Rating, Rut Rating, International Roughness Index (IRI), Ride Number (RN), Pavement Evaluation, Flexible Pavement Condition Survey, Profiler, Roadway Characteristics Inventory (RCI), Straight Line Diagram (SLD)

I. Introduction

The present condition of Florida's flexible pavement system is of interest to Pavement Management, Design, Planning, Maintenance, consultants, and other groups within the Florida Department of Transportation.

The information provided in this handbook describes the methods used to evaluate surface distresses and determine the ride quality and the rut depth of the flexible pavement. Any mention of rigid pavement is only discussed when necessary for the completion of the Flexible Pavement Condition Survey. For information relating to the evaluation of rigid pavements, please refer to the Rigid Pavement Condition Survey Handbook.

The results of this evaluation provide information that is used in conjunction with other data for the following purposes:

1. Determine the present condition of the State Highway System
2. Compare present with past condition
3. Predict future deterioration rates
4. Estimate rehabilitation funding needs
5. Provide justification for annual pavement rehabilitation budget
6. Provide justification for prioritizing rehabilitation projects
7. Provide justification for distribution of rehabilitation funds to Districts

The various changes and enhancements that have been implemented with each survey are recorded. The "History of Florida Pavement Condition Survey" is located at the following web address:

http://www.dot.state.fl.us/statematerialsoffice/pavement/performance/pcs/pcshistory.pdf

II. Pavement Section Selection and Identification

The length of pavement to be evaluated will vary depending upon a number of factors. Typical factors that create section limits (rated sections) include the following:

1. County line
2. County section or subsection
3. Construction Limits
4. Significant changes in pavement condition.
5. Structures in excess of 0.25 mile.
6. Rigid Pavement in excess of 0.50 mile within a Flexible Pavement section.
7. Changes in the number of lanes (2 to 3 lanes, etc.)

As implied by the list above, a certain amount of office preparation is required prior to the field evaluation. The Rater should have access to Construction Plans, Straight Line Diagrams (SLD), Video-logs, Maps, Roadway Characteristics Inventory (RCI) data, and historical PCS Data for those highways to be evaluated.

Construction Limits

Section limits should be based initially upon construction project limits. The section may deteriorate at different rates, requiring additional "breaks" within the overall section, but the beginning and ending mileposts must not be modified. To preserve the history of PCS data, section limits must only be changed if the limits of a new construction project extend into previously existing project limits. For new construction projects equal to or greater than one mile in length, provide a financial project number (FIN), if possible.

Section Length

Pavement sections less than 0.50 miles should not be rated separately. Combine any sections shorter than 0.50 miles with the adjacent section having the most similar condition.

Roadway Direction

The direction a section is rated depends on the following criteria:

Divided

Any pavement section 0.50 miles or greater that has a physical median or permanent barrier wall separating traffic traveling in different directions. One lane in each direction must be rated for divided roadways.

Composite (Undivided)

Pavement sections without dividers or sections where any consecutive divided segment is less than 0.50 miles are considered composite. Composite pavement sections include areas with paved center turn lanes. One lane in only one direction must be rated. Rate these sections in the same direction each year, unless an obvious difference exists based upon visual observation of the pavement condition. In this case, the rater must rate the direction having the greatest amount of distresses.

The direction rated is coded in the Roadway column of the Field Workbook. See Table 1 below.

TABLE 1

ROADWAY DIRECTION

ROADWAY CODE	PAVEMENT DIVISION	MILEPOST DIRECTION	DIRECTION (NOTE1)
1	Composite	Ascending	North or East
4	Composite	Descending	South or West
2	Divided	Descending	South or West
3	Divided	Ascending	North or East

Note 1: A limited number of sections have mileposts that are descending in the North or East direction or are ascending in the South or West direction. For example, the PCS Roadway designation of a 1 or 3 could be South or West. Refer to the construction plans or SLD's for clarification if needed. Regardless of these exceptions to the rule, a roadway code of 1 or 3 is always evaluated in the ascending direction and a code of 2 or 4 is always evaluated in the descending direction.

Pavement Type (Type)

The Type column of the Field Workbook is used to denote the surface type of the roadway as well as other conditions the rater observes while performing the survey. The following is a list of all Type codes used:

Exceptions (Type 0)

Exceptions include pavement sections that are not state-maintained or sections that overlap other sections that have been surveyed and are state-maintained. Only code Remarks for sections having Type 0.

Asphalt Pavement (Type 1)

Type 1 is for standard asphalt pavement sections that do not fall under any of the other pavement Type codes.

Section Improvement (Type 2)

Type 2 is for sections that have been partially rehabilitated. This includes but is not limited to: overlaid intersections, wheel path leveling, resurfacing in one lane only, area resurfacing or manhole adjustments. This code is used to note that changes to the pavement surface were made that influence the Crack, Rut or Ride ratings. This can result in either positive or negative changes to the ratings. Unless additional improvements are made this type must change in the following year. This new type will be assigned by rater. Normally this will be type 1.

Skin Patch (Type 3)

Type 3 is for sections that have large areas covered by a thin overlay or skin patch (often applied as maintenance overlay). These areas are considered patching. Combine estimates of patching with Class III cracking and include in rating for entire section.

Rigid Pavement (Type 4)

Type 4 is for rigid pavement sections. No ratings should be recorded in the Flexible PCS for these sections.

New Construction (Type 5)

Type 5 is for a newly constructed section of roadway. As an example, when a composite roadway has new construction that changes it to a divided roadway, the lanes added in the new direction are coded as Type 5 and the existing composite lanes that were resurfaced are coded as a Type 7. The following year this type must change to a different code assigned by the rater, usually type 1. Provide a financial project number (FIN), for projects equal to or greater than one mile in length, if possible.

No Ride (Type 6)

Type 6 is for sections where the profiler is unable to achieve a repeatable ride rating. These are normally sections that are too short, but sometimes other longer sections have characteristics that the profiler is unable to repeat. These sections are usually in urban areas and have features such as cross streets with signalized intersections and radical intersecting profiles. Do not provide a Ride Number for these sections, only collect a value for rut depth and crack rating. Rut depth should be collected with the profiler, but if a reliable rut depth cannot be achieved, manual rut depth (page 29) must be taken. This decision is left to the discretion of the rater.

If a section that is New Pavement (Type 7) is also a No Ride (Type 6), code as New Pavement (Type 7) and do not enter any values for Ride Number (RN) or International Roughness Index (IRI). Include comments for New Pavement (NP) and No Ride (NR) in the remarks.

New Pavement (Type 7)

Type 7 is for newly overlaid asphalt pavement. Provide a financial project number (FIN) for projects equal to or greater than one mile in length, if possible. The following year this type must change to a different code assigned by the rater, usually type 1.

Under Construction (Type 8)

Type 8 is for areas that are under construction during the survey. Areas that are signed as under construction can be rated providing the original surface is

undisturbed and no lane shifts or other deviations from the previously surveyed roadway exists. This code can be used for more than one year. Typically, the following year, the section will change to a Type 7. Upon returning the next year it is determined that no rehabilitation took place, the section must be coded Type 1 and Not New Pavement (Not NP) coded in the remarks.

Structures (Type 9)

Type 9 is for Structures including bridges, box culverts and other permanent objects that are equal to or greater than 0.25 miles. These structures should be represented by separate pavement section limits and coded as Type 9. Any structure less than 0.25 miles must remain combined with the larger section and profiler roughness turned off. Crack, Rut or Ride rating data must not be reported for any structure.

Mileposts recorded for structures (bridges, box culverts and other permanent objects) as well as exceptions must come from SLD's or RCI whenever possible, not from distance-measuring instrument. This allows for data cross checks with Department RCI (feature code 258).

If a structure is located between a flexible and rigid pavement section, coding as Type 9 in the flexible pavement survey adds the structure to the flexible pavement system. If coded as Type 0 the structure is excluded from the flexible pavement system. It is important to ensure any structures coded as Type 9 in the flexible pavement survey are coded as Type 0 in the rigid pavement survey. Not doing so would add the mileage for the structure to both surveys.

Mileage from sections coded Type 9 is also used to denote pavement sections that have been added to the state-maintained system since the PCS was completed. This allows the mileage to be added to the survey and also serves as a reminder for the rater to rate the section the next year. Always code number of Travel Lanes and Remarks for sections listed as Type 9.

Lanes

For composite roadways, this is the total number of through travel lanes. For divided

roadways, this is the number of through lanes in the direction of travel. Do not include turn lanes, parking lanes or emergency lanes in the number of Lanes. The value used for Lane must be in agreement with RCI feature code 212 (Thru Lanes). Include the total number of lanes in the Lanes column of the Field Workbook.

Rated Lane

The lane having the worst pavement condition shall be rated for the direction being tested. It is coded in the Rated Lane column of the Field Workbook. This value is noted by ascending (R) or descending (L) followed by the count of through lanes starting from the inside lane. For example, a road with 3 lanes in each direction, the middle lane in the ascending direction is named R2, and the inside lane in the descending direction is named L1.

Verification

The Verification (Ver) column is used to denote results of the verifications done per district request and to record the status of any re-runs due to ride data not matching previous year's data.

When a district requests verification of a particular rated section, it is re-evaluated for Crack Rating only. If the results of this re-evaluation determine that the original crack rating was correct, an "A" is placed in the Verification column to denote that the re-evaluation agreed with the original rating. If the results determine the original crack rating was incorrect, the change(s) are made and a "C" is placed in the Verification column. This value remains in the next version of the workbook (next year) so the rater is aware that the verification was performed.

If a Ride re-run was performed (according to Appendix B) by the operator and the previously collected ride data was replaced by the ride data collected during the re-run, a "U" is placed in the Verification column to denote that the re-run was used. If ride data collected during the re-run is not used, an "N" is placed in the Verification column to denote that the re-run was not used. The re-run information is eliminated prior to the creation of the workbook each year.

Remarks

The Remarks column is used to record information regarding the condition of the section being rated. See Table 2 for a detailed listing of all standard remarks.

TABLE 2

STANDARD REMARKS

REMARKS	STANDARD CODE
New Pavement (A) (see note[1])	NP
New Construction (A)	NC
Under Construction (A)	UC
Not New Pavement (A)	NOT NP
Bridge Number	BR ###### (County Number and Bridge Number)
Rigid Pavement (A)	Rigid Pavt
No Ride (A)	NR
Patching (A)	PT
Raveling (A)	RAV
Off RCI (A)	Off RCI
Survey Next Year	Add in XX (XX = Survey Year)
Lane Realignment	RAL
Brick Crosswalks	BW
Manholes in wheel path	MH
Rippling	RIP
Depressions	DEP
Bleeding	BLD
Shoving	SHV
Delamination	DEL
Spalling	SPL
Pot Holes	PH
Corrugations	COR
Sealed Cracks	SLDCK
Crowning	CRN
Transverse Cracking	TRVCK
Scaring	SCR
Speed Reduction Device (i.e. Rumble Strips)	RS

Note[1]: An (A) after the remark in the REMARKS above column indicates an automated remark (based upon an entry in another field).

Comments

The Comments column is used to record information specific to the section that will assist rater in future surveys. Examples include County section numbers for exceptions and any other non-standard remarks that will help identify the section. This column can also contain standardized remarks that exceed the seventeen character limit of the Remarks column.

III. Evaluation Methods

Data collection is accomplished by visually estimating distresses present within each roadway section and through use of an inertial profiler to collect Rut and Ride data at highway speeds.

Crack Rating

Consideration is given to three types of cracking in flexible pavements. The classes of cracks are described as follows:

Class IB - Hairline cracks that are less than or equal to ⅛ inch (3.18 mm) wide in either the longitudinal or transverse direction. These may have slight spalling and slight to moderate branching. These cracks are estimated individually for the total linear length of the cracks. The width of the affected area is considered one (1) foot (0.30 m). See Figures 2, 5 and 8 (pages 17, 20 and 23).

Class II - Cracks greater than ⅛ inch (3.18 mm) and less than ¼ inch (6.35 mm) wide in either the longitudinal or transverse direction. These may have moderate spalling or severe branching. Also includes all cracks less than ¼ inch (6.35 mm) wide that have formed cells less than 2 feet (0.61 m) on the longest side, also known as alligator cracking. Class II cracks are considered rectangular, and the total affected area in square feet is counted. See Figures 3, 6 and 9 (pages 18, 21 and 24).

Class III (including Raveling and Patching) - Cracks greater than ¼ inch (6.35 mm) wide that extend in a longitudinal or transverse direction and cracks that are opened to the base or underlying material. Also includes progressive Class II cracking resulting in severe spalling with chunks of pavement breaking out. Class III cracks are considered rectangular, and the total affected area in square feet is counted. See Figures 4, 7 and 10 (pages 19, 22 and 25).

Raveling - Raveling is the wearing away of the pavement surface caused by the dislodging of aggregate particles. See Figure 12 (page 27). Only significant areas of raveling are considered. Do not count an isolated area in a long section if it's not representative of the rated section.

The severity levels used to describe raveling are as follows:

Light - The aggregate and/or binder has begun to wear away but has not progressed significantly, with some loss of aggregate.

Moderate - The aggregate and/or binder has worn away and the surface texture is becoming rough and pitted; loose particles generally exist; loss of aggregate has progressed.

Severe - The aggregate and/or binder has worn away and the surface texture is very rough and pitted, loss of aggregate very noticeable.

Record the predominant severity level and percent affected area of raveling in the Raveling column of the field workbook using the codes shown in Table 3.

TABLE 3

RAVELING CODES

PERCENT OF PAVEMENT AREA AFFECTED BY RAVELING	RAVELING SEVERITY LEVEL AND CODE		
	LIGHT	MODERATE	SEVERE
01 -- 05	1	1	1
06 -- 25	2	2	2
26 -- 50	3	3	3
51+	4	4	4
Note: Code the Predominant severity level only			

Patching - A patch is an area of the pavement that has been replaced with a newer material after the time of original construction. Patching should reflect a defect in the pavement that has been repaired. (See Figure 11 on page 26) Only significant areas of patching should be considered. Record the percent of pavement area affected by patching by using the codes shown in Table 4.

TABLE 4

PATCHING CODES

PERCENT OF PAVEMENT AREA AFFECTED BY PATCHING	
PERCENT	**CODE**
01 -- 05	**1**
06 -- 25	**2**
26 -- 50	**3**
51+	**4**

Calculating Crack Rating

To calculate the total area affected by cracking, combine the percent area affected estimations as follows:

Class 1B + Class II + Class III + Raveling + Patching = Total Percent Affected Area

To determine the predominant class of cracking, first combine values for percent affected area for Raveling and Patching with Class III cracking estimates. Next, compare the percent affected area from the three classes of cracking (with Class III cracking now including Patching and Raveling). The predominant crack class has the highest percent affected area value.

The above values must be determined for cracking confined to the wheel path (**CW**) and cracking outside of the wheel path (**CO**), each representing 100 percent of their respective areas. See Figure 1 (page 16) for a diagram of this wheel path designation.

Table 5 (page 15) explains how to determine the final crack rating from the above values.

Crack Type

The Crack Type is denoted when the presence of specific types of cracks are predominant. These Crack Types are used to help determine the underlying cause of cracks. Crack Type codes are as follows: Alligator (A), Block (B) and Combination (C).

TABLE 5

NUMERICAL DEDUCTIONS FOR CRACKING METHOD

PERCENT OF PAVEMENT AREA AFFECTED BY CRACKING	CONFINED TO WHEEL PATHS (CW) *PREDOMINANT CRACKING CLASS*					
	1B CRACKING		II CRACKING		III CRACKING (Including RAV & PT)	
	CODE	DEDUCT	CODE	DEDUCT	CODE	DEDUCT
00 -- 05	A	0.0	E	0.5	I	1.0
06 -- 25	B	1.0	F	2.0	J	2.5
26 -- 50	C	2.0	G	3.0	K	4.5
51+	D	3.5	H	5.0	L	7.0

PERCENT OF PAVEMENT AREA AFFECTED BY CRACKING	OUTSIDE OF WHEEL PATHS (CO) *PREDOMINANT CRACKING CLASS*					
	1B CRACKING		II CRACKING		III CRACKING (Including RAV & PT)	
	CODE	DEDUCT	CODE	DEDUCT	CODE	DEDUCT
00 -- 05	A	0.0	E	0.0	I	0.0
06 -- 25	B	0.5	F	1.0	J	1.0
26 -- 50	C	1.0	G	1.5	K	2.0
51+	D	1.5	H	2.0	L	3.0

Notes: - Total percent of cracking is determined by combining Class 1B, Class II, Class III, Raveling and Patching).

Percentages for CW and CO are estimated separately, each representing 100% of its respective area.

Only the predominant cracking class will be recorded for CW and CO. When determining which crack type is predominant, combine percentages for Class III cracking with Raveling and Patching, then compare this value to percentages for Class 1B and Class II. The larger of these values is considered predominant.

CW Example: 1B = 10%, II = 12%, III =6% Total = 28%

Predominant is Class II in the 26-50% category (code G – deduct 3.0)

CO Example: 1B = 10%, II = 6%, III =6% Total = 22%

Predominant is Class 1B in the 6-25% category (code B – deduct 0.5)

Given the formula below:

CRACK RATING = 10 - (CW + CO).
CRACK RATING =10-(3.0+0.5)
CRACK RATING=6.5

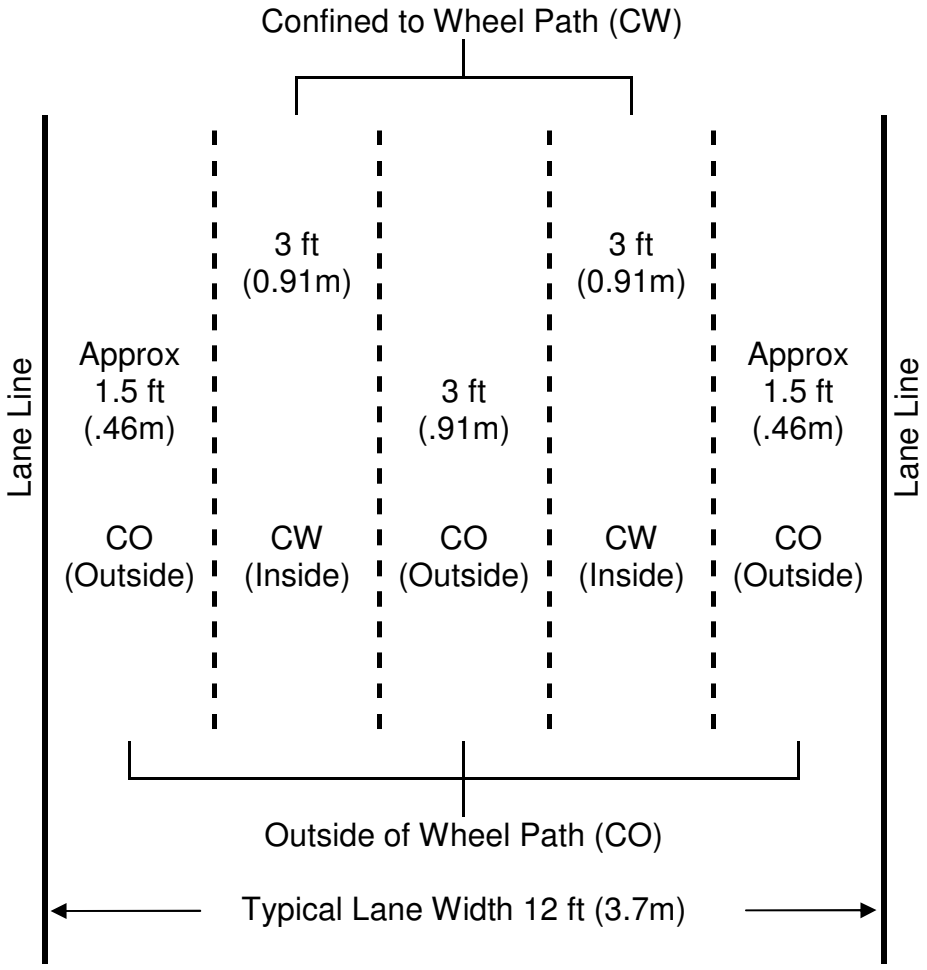
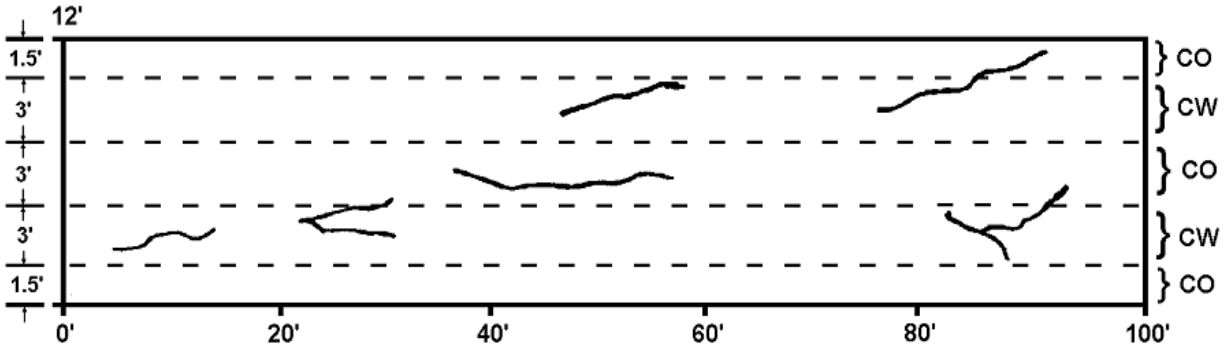


FIGURE 1. WHEEL PATH DESIGNATION



AREA DIMENSIONS

CW = 56 ft. (17.07m) x 1 ft. (0.30m) = 56 ft^2 (5.20m^2)
÷ 600 ft^2 (55.74m^2) = 9%

CO = 30 ft. (9.14m) x 1 ft. (0.30m) = 30 ft^2 (2.79m^2)
÷ 600 ft^2 (55.74m^2) = 5%

NOTE: CW = Confined to Wheel Paths
CO = Outside of Wheel Paths
Single Cracks considered 1 ft. (0.30m) in width
Alligator Cracks considered as affected area
Block Cracks considered 1 ft (0.30m) in width

FIGURE 2. CLASS 1B CRACKING ESTIMATES