Pavement Distress & Ride Scores

Introduction

2009 DOTSC Student Seminars

July 30, 2009

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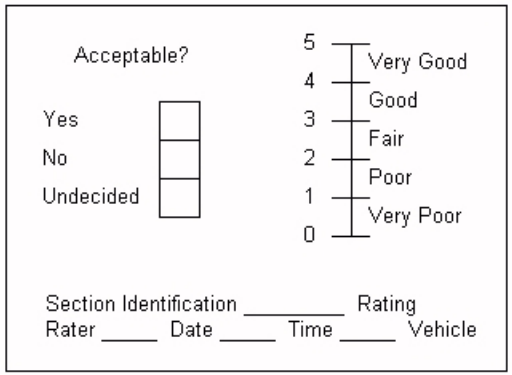
Pavement Distress & Ride Scores

How are they Derived?

I. Ride Scores

- Measurement: roughness is typically quantified using a form of either Present Serviceability Rating (PSR) or International Roughness Index (IRI).

- Present Serviceability Rating (PSR)
  - Based on individual observation
  - Defined as the judgment of an observer as to the current ability of a pavement to serve the traffic it is meant to serve.
  - Range: 5 (excellent or very smooth) to 0 (essentially impassable)



PSR Form

- International Roughness Index (IRI)
  - Based on the average rectified slope (ARS).
  - ARS: a filtered ratio of a standard vehicles accumulated suspension motion divided by the distance traveled by the vehicle during the measurement.
    - Metric units (m/km)
    - English units (in/mile)

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Pavement Distress & Ride Scores

How are they Derived?

II. Distress Scores

- Measurement: can be either subjective or objective
  - Subjective: may be a rating of high, medium, or low based on a brief visual inspection
  - Objective: generally more expensive to obtain, uses different types of automated distress detection equipment.

- Established rating systems that associates penalty points with specific distress type, severity, and extent combinations.
  - These points can be summed and subtracted from some upper limit or maximum value (99 in North Dakota's case) to give an overall rating of a pavements structural condition.
  - The equations that describe how to convert from severity and extent of a certain type to an index number, or score, vary from state to state and can rather be complex.

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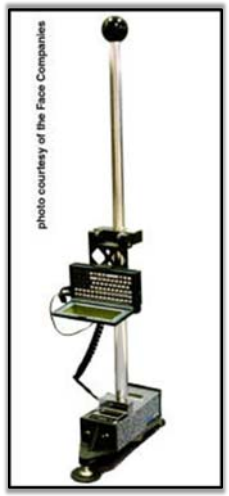
Types of Equipment and Measurement Techniques

I. Ride Scores

- Rod and level Survey
  - A survey (performed by a survey crew) provides an accurate measurement of the pavement profile
  - The use of surveys for large projects is impractical and cost prohibitive.

- Dipstick Profiler
  - Can be used to collect a relatively small quantity of pavement profile measurements.
  - A strip can be surveyed by a single operator in about one-half the time of a survey crew.
  - Commonly used to measure a profile for calibration of more complex instruments.



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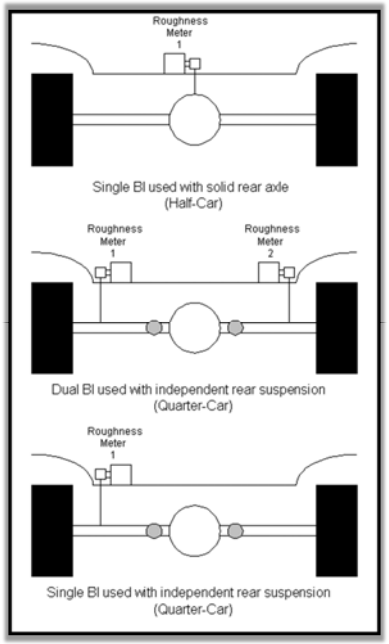
Types of Equipment and Measurement Techniques

- Profilographs
  - Not practical for network condition surveys
  - Most commonly used for rigid pavement construction inspection, quality control, and acceptance.

- Response Type Road Roughness Meters (RTRRMs)
  - Adequate for routine monitoring of pavement network and providing an overall picture of the condition of the network
  - Can provide managers with a general indication of the overall network condition and maintenance needs.
  - Measures the vertical movements of the rear axle of an automobile or the axle of a trailer relative to the vehicle frame.



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Types of Equipment and Measurement Techniques

- Profiling Devices
  - Used to provide accurate, scaled, and complete reproductions of the pavement profile within a certain range.
  - Equipment can be expensive and complex
  - Usually installed in vans that contain microcomputers and other data handling and processing instrumentation
  - Profiles are used to calculate a mathematical measure of roughness and an estimate of rutting at specified intervals along the roadway.

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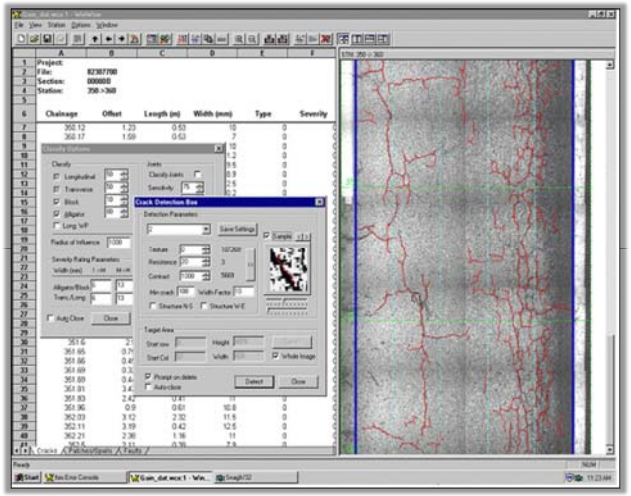
Types of Equipment and Measurement Techniques

II. Distress Scores

- Older Method (Visual Method)
  - Used teams of individuals who drove across every mile of pavement to be measured and visually measured the distress of the pavement.

- Newer Methods (High-Speed Video Imaging)
  - Records pavement surface video images at highway speeds using a specially equipped van.
  - Evaluation is either done manually or automatically.
    - Manually: video is played back on specially designed workstations while trained crews rate the recorded road surface.
    - Automatically: road surfaces are recorded automatically by computer software.



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Pavement Distress & Ride Scores

How Does the NDDOT Derive and Use the Pavement Condition Scores?

- NDDOT Methods of Measurement
  - ➢Ride Score: Use IRI Scores and the IRI ranges to describe ride quality.
  - ➢Ride scores are listed in the Hwy Information Booklet, but pavement management is no longer using these to describe ride quality.
  - ➢Distress Score: Uses a condition rating system that associates deduct points with specific distress type, severity, and extent combinations.

- NDDOT Highway Information Booklet
  - ➢Acronyms
  - ➢Pavement Condition Rating Deduct Values

- Where to find pavement distress and Ride Scores for state and US roads in North Dakota?
  - ➢ Mainframe/Rims

- Questions

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Flexible Pavement
Condition Rating Deduct Values

CONDITION	EXTENT				SEVERITY
CODE	NONE	<10%	10-30%	>30%	LENGTH
ALLIGATOR CRACKING AC	0	2	4	6	HAIRLINE
		8	10	12	SPALLED & TIGHT
		14	16	18	SPALLED & LOOSE
	NONE	<10%	10-30%	>30%	LENGTH
BLEEDING BLD	0	1	2	3	OCCASIONAL SMALL PATCHES
		4	5	6	WHEEL TRACKS SMOOTH
		7	8	9	LITTLE VISIBLE AGGREGATE
	NONE	<100'	100'-200'	>200'	L.F. in 100'
LONGITUDINAL CRACKING LC	0	1	2	3	<1/4" WIDTH
		4	5	6	1/4-1"
		7	8	9	>1" AND/OR SPALLED
	NONE	<100'	100'-200'	>200'	L.F. in 100'
TRANSVERSE CRACKING TC	0	1	2	3	<1/4" WIDTH
		4	5	6	1/4-1"
		7	8	9	>1" OR SPALLED OR
	NONE	<10%	10-30%	>30%	LENGTH
BLOCK CRACKING BC	0	1	2	3	<1/4" WIDTH
		4	5	6	1/4-1"
		7	8	9	>1" AND/OR SPALLED
	NONE	<10%	10-30%	>30%	AREA OF SAMPLE
RAVELING AND/OR WEATHERING RW	0	1	2	3	MINOR LOSS
		4	5	6	SOME SMALL HOLES / PITS
		7	8	9	HIGHLY PITTED / ROUGH
	NONE	< 5%	5-15%	>15%	AREA OF SAMPLE
BITUMINOUS PATCHING BP	0	2	4	6	GOOD CONDITION
		8	10	12	FAIR CONDITION
		14	16	18	POOR CONDITION
	< 1/4 ■	1/4-3/8"	3/8-1/2"	>1/2"	DEPTH SEVERITY CATEGORY
RUTTING RT	0	4	9	18	WITH 20% TRIGGER

INTRODUCTION

This report contains summary information of the pavement condition data collected in the fall of 2008. It is a compilation of information related to the pavement distress, IRI , traffic volumes, and construction history, of the North Dakota state highway system for the District referenced on the cover. Much of the data is presented in a more general form than its original source. While more detailed information can be obtained by going directly to individual files, this report provides an accurate overall picture of the state highway system for the referenced District. Similar books are available for the other 7 Districts.

PAVEMENT MANAGEMENT CONDITION RATINGS

Category	Distress	IRI (in/mile)	Rut (in)
Excellent	>=98	0-60	<0.25
Good	88-97	61-99	0.25-0.37
Fair	77-87	100-145	0.38-0.50
Poor	<77	>145	>0.50

DISTRESS SECTION RANKING

This section contains a ranking of all highway segments for the District sorted by distress score from worst to best. Manual "scoring" is done to arrive at a distress score. A distress score of 99 is the starting point and describes a pavement with no distresses. Deduct values are assigned to distresses and are subtracted from 99 to arrive at a distress score. The lower the distress score, the worse the pavement distress condition. Sections that were not scored will have a -1 in the distress score column.

IRI SECTION RANKING

This section contains the ranking of project segments from worst to best, based on the International Roughness Index (IRI). The IRI is a measure of pavement smoothness that is calculated from the longitudinal profile of the roadway surface. The higher the IRI, the worse the pavement surface smoothness. Sections that were not scored will have a -1 in the IRI column. The IRI category ranges were modified in fall 2008.

MAINTENANCE SECTION RANKINGS

Due to software changes to the maintenance data system in 2004, we are not able to query this data at this time

MISCELLANEOUS INFORMATION

As stated previously, the IRI ranges were modified in fall 2008. The following chart shows the history of the IRI ranges, since there was also a revision to the IRI ranges in 2004. This is provided for informational purposes only. Any past IRI value can be compared to the current ranges.

Category	2003 & earlier IRI Ranges	2004-2007 IRI Ranges	Current IRI Ranges (adopted 2008)
Excellent	0-60	0-80	0-60
Good	61-95	81-129	61-99
Fair	96-132	130-177	100-145
Poor	>=133	>177	>145

The following scale is used to categorize average rut.

Category	Rut (in)
Excellent	<0.25
Good	0.25-0.37
Fair	0.38-0.50
Poor	>0.50

Average rut (inches) is calculated as the average of the raw rut data collected for the mile. The rut deduct used in the distress score is arrived at by a severity analysis. The category, from the rut scale above, with the worst 20% of the values is used to assign the deduct.

PRPI and Ride scores are listed in this document; however pavement management is no longer using these measures to describe ride quality. Refer to the IRI score and the IRI ranges to describe ride quality.

On Line

All data found in this book is easily accessible and in more detail through the mainframe database. Contact the RIMS coordinator in your district or division or the Pavement Management and Scoping Section of Planning & Programming Division if you need help in using the mainframe.

This document was created by the Planning and Programming Division's Pavement Management and Scoping Section. Please forward any comments on this document to Jane Berger, PE, at 328-2607 or by email at jeberger@nd.gov. Further assistance pertaining to this document may also be obtained from Dirk Kienzle at 328-1219 or by email at dikienzl@nd.gov.

D	HWY	S	D	FROM REF PT	FROM OFFSET (MI)	TO REF PT	TO OFFSET (MI)	LENGTH (MI)	LEFT SHLDR WIDTH	DRVNG LANE WIDTH	RIGHT SHLDR WIDTH	SURF DPTH	BASE DPTH	GRAD WDTH	PIN WDTH	TAADT	AADT	ESALS	PAV AGE	EFF PAV AGE	LAST YEAR SEAL	PVMT TYPE	PVMT DESC	HWY PTY SYS	INTL CONS	PREV CONS	LTST CONS	LTST REHAB
1	94	W		193	000	0	1110	201	000	0	1790	8 0709	10 0	24 0	3 0	7 0	3 0	48 0	37 0	1678	7100 2002	2060	38	26		COMPO	AOCRC	RI	1966	1983	1988	CPR_ONLY

BURL COUNTY LINE TO LONG LAKE

BOTH SHOULDERS SEALED 1966 AND 1981 JOINTS REPAIRED IN 1983 RESTORING CONTINUITY "D" CRACKING IS APPEARING QUITE RAPIDLY 3 FOOT SHOULDER SHOT WITH MC-3000 (NO CHIPS ORSAND) 1987 RESTORED CONTINUITY AGAIN IN 1988 BOTH SHOULDERS SEALED WITH REINFORCED RECLAMITE IN 1992 1995-R/P 195 & 196 3 3" OVERLAY 1997- R/P 193 TO 195 DR LN 3" TO 4 25" OVERLAY, PA LN 3 0 TO 4 25" OVERLAY, 1997- R/P 197 TO 201 12FT PA LN 3 0 TO 4 25" 12FT DR LN 4 25 TO 3 5" OVERLAY (1997 TEST SECTIONS) 12FT DR LN ONLY-2MI SECTNS R/P197 TO 199 CLASS 27 R/P199TO 201 CLASS 29 --PCN-14082-SIGNING RP97 188 TO RP208 702

1994	DIST	86	RIDE	3	91	PRPI	N/A	IRI	88	1999	TOT	MTC	47	11
1995	DIST	87	RIDE	3	93	PRPI	N/A	IRI	86	1999	AVG	MTC	5	89
1996	DIST	88	RIDE	4	06	PRPI	N/A	IRI	78	2000	TOT	MTC	670	74
1997	DIST	88	RIDE	3	76	PRPI	N/A	IRI	71	2000	AVG	MTC	83	84
1998	DIST	99	RIDE	4	41	PRPI	N/A	IRI	43	2001	TOT	MTC	709	85
1999	DIST	98	RIDE	4	33	PRPI	POOR	IRI	46	2001	AVG	MTC	88	73
2000	DIST	98	RIDE	4	14	PRPI	POOR	IRI	54	2002	TOT	MTC	4,257	80
2001	DIST	98	RIDE	4	06	PRPI	POOR	IRI	58	2002	AVG	MTC	532	23
2002	DIST	97	RIDE	4	18	PRPI	GOOD	IRI	53	2003	TOT	MTC	3,994	25
2003	DIST	96	RIDE	4	23	PRPI	GOOD	IRI	51	2003	AVG	MTC	499	28

REF PT	RIDE	DST	RUT (IN)	IRI IN/MI	PRPI	AVG NUM (2003) AVERAGE RIDE, DISTRESS & RUT FLT	FLT AC	BLD	LC	TC	BC	RW	BP	RT	(2003) MAINTENANCE COSTS TO DATE MAINT	BPC	HPC	SPC	CPC	RFC	SCC	SHC	CRC	RMC	ROC	BOC
194	4	28	97 0 08	48	79 GOOD	0 00	0 0	0	1	1	0	0	0	0	25	95	0	6	0	19	0	0	0	0	0	0	0
195	3	53	95 0 11	82	37 FAIR	0 00	0 2	0	1	1	0	0	0	0	3,400	16	0	56	3,325	19	0	0	0	0	0	0	0
.96	3	76	97 0 11	72	23 GOOD	0 00	0 0	0	1	1	0	0	0	0	25	95	0	6	0	19	0	0	0	0	0	0	0
.97	4	37	96 0 19	44	35 GOOD	0 00	0 0	0	1	1	0	1	0	0	25	95	0	6	0	19	0	0	0	0	0	0	0
.98	4	50	98 0 17	39	28 GOOD	0 00	0 0	0	0	1	0	0	0	0	25	95	0	6	0	19	0	0	0	0	0	0	0
199	4	50	97 0 14	39	28 EXCL	0 00	0 0	0	1	1	0	0	0	0	317	57	0	298	0	19	0	0	0	0	0	0	0
200	4	47	97 0 12	39	92 GOOD	0 00	0 0	0	1	1	0	0	0	0	146	77	0	6	0	139	0	0	0	0	0	0	0
201	4	42	94 0 11	42	45 GOOD	0 00	0 0	0	1	4	0	0	0	0	25	95	0	6	0	19	0	0	0	0	0	0	0
AVG	4	23	96 0 13	51	08 GOOD	0 00	0 0	0	1	1	0	0	0	0	499	28	0	49	416	34	0	0	0	0	0	0	0

12 OCCURS

DPTH (IN)	COMPONENTS	LSHL WDTH (FT)	RDWY WDTH (FT)	RSHL WDTH (FT)	OIL/CON TYPE	CLS AGG	YEAR	COST THOUS	DSN LFE	PCN	SUB	H
	GRADE		48 0				1965	226				
	C-C 84 FEET						1965					
3 0	AGGREGATE BASE		27 0				1966					
7 0	CONT - REINF PCC		24 0				1966	811	20			
3 7	AGGREGATE BASE	13 1		7 7			1966					
2 0	PLANT MIX BIT BASE	11 9		5 8	120-150		1966					
3 0	HOT BIT PAVEMENT	10 0		3 0	120-150		1966	167				
	CONTRACT CHIP SEAL	10 0		3 0	MC-3000		1981	12				
	CONCRETE PAVEMENT REPAIR						1983	21	10			
	MAINTENANCE GRAVEL SEAL			3 0	MC-3000		1987	40				
	CONCRETE PAVEMENT REPAIR						1988	69	10			
	DISTRICT SAND SEAL	10 0		3 0	RCLMITE		1992					

PROJECT SPECIFIC CONSTRUCTION, TRAFFIC, DISTRESS,
RIDE, AND MAINTENANCE DATA (LISTING)

The various fields of information and their sources are as follows:

D - District
Hwy - Highway
S - Suffix(900 mileage will have a B here for business loop)
D - Direction
From Ref Pt - Reference point defining start of project section
From Offset(mi) - Distance from a reference point, defining start of a project
To Ref Pt - Reference point defining end of project section
To Offset(mi) - Distance from a reference point, defining end of a project
Length - Length of project section
Left shldr width - Left shoulder width
Drving lane width - Driving lane width
Right shldr width - Right shoulder width
Surf dpth - Total pavement depth
Base dpth - Total base depth
Grad wdth - Graded width of section below base
Fin wdth - Finished width of section below pavement
TAADT - Truck Annual Average Daily Traffic - The **Taadt, Aadt & Esals** shown for each
AADT - Annual Average Daily Traffic - section is the total for all lanes. Example:
Esals - Equivalent Single Axle Loads(18 kip) - The total would include all four or more
- lanes of a two direction roadway.

Pav age - The number of years since last(20 year design life) rehab
Eff pav age - The effective age of a pavement based on the design life of the last rehabilitation. See examples #1 and #2 on following pages.
Last year seal - The last year this section was sealed
Pvmt type - Flex for Asphalt, Concr for concrete and Compo for composite pavement of Asphalt over concrete
Pvmt desc - If pvmt type is Flex then pvmt desc will be Asphalt, if pvmt type is concr then pvmt desc will either be Crcp or Jointed, if pvmt type is compo then pvmt desc will be Aocrc(asphalt over crcp) or Aopjc(asphalt over jointed)
Hwy pty sys - INT(interstate), NHS(national highway system), HL(highload), LL(lowload)
Intl cons - Year of first construction
Prev cons - Year of first rehabilitation
Ltst cons - Year of most recent rehabilitation
Ltst rehab - Type of latest rehabilitation(overlays, cpr, recycle...etc...)

LEGENDS

DISTRESS

DC=•D• CRACKING, **LJS**=LONGITUDINAL JOINT SPALLING, **LC**=LONGITUDINAL CRACKING, **TC**=TRANSVERSE CRACKING, **TCS**=TRANSVERSE CRACK SPALLING, **BP**=BITUMINOUS PATCHING, **CP**=CONCRETE PATCH DETERIORATION, **BU**=BLOW-UP REPAIRS, **AC**=ALLIGATOR CRACKING, **BLD**=BLEEDING, **BC**=BLOCK CRACKING, **RW**=RAVELING AND/OR WEATHERING, **RT**=RUTTING, **CB**=CORNER BREAKS, **BS**=BROKEN SLABS, **CP**=CONCRETE PATCH DETERIORATION, **FLT**=FAULTING,

MAINTENANCE

BPC=BLADE PATCHING COST, **HPC**=HAND PATCHING COST, **SPC**=SCOTCH PATCHING COST, **CPC**=CRACK POUR COST, **RFC**=RUBBER FILL COST, **SCC**=SEAL COAT COST, **SHC**=SHOULDER WORK COST, **CRC**=CONCRETE REPAIR COST, RMC=BITUMINOUS MILLING COST, **ROC**=ROUTINE ROADWAY OPERATIONS COST, **BOC**=CONTRACT BITUMINOUS OVERLAY COST.

		Ride	Distress
RP	152	1.71	77
RP	153	1.82	73
Ave:			

152.892 - 153.318

2,250 feet total

1 - .892 = .108

5280 x .108 = 570.24'

.318 x 5280 = 1679.04'

> 2250'

570/2250 = .253 = 25.3%

1679/2250 = .746 = 74.6%

1.71 x .25 + 1.82 x .75 = **1.79 Ride Score** ⇐

Ave Distress Score:

77 x .25 + 73 x .75 = **74 Ave. Distress Score** ⇐

Ave. Rutting: 0.18 (.25) + .21(.75) = **0.20 in** ⇐

Linear Cracking: .25(7) + .75(7) = 7

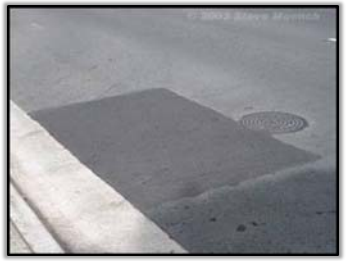
Transverse Cracking: 7(.25) + 7(.75) = 7

Alligator Cracking: 2(.25) + 2(.75) = 2

Bituminous Patching: 6(.25) + 6(.75) = 6

Alligator cracking

Deterioration & Raveling



Bituminous Patching

Longitudinal Cracking

Block Cracking

Bleeding