NCDOT Pavement Condition Data Elements and Variability

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National Workshop on Highway Asset Inventory and Data Collection

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NCDOT Rating Methods

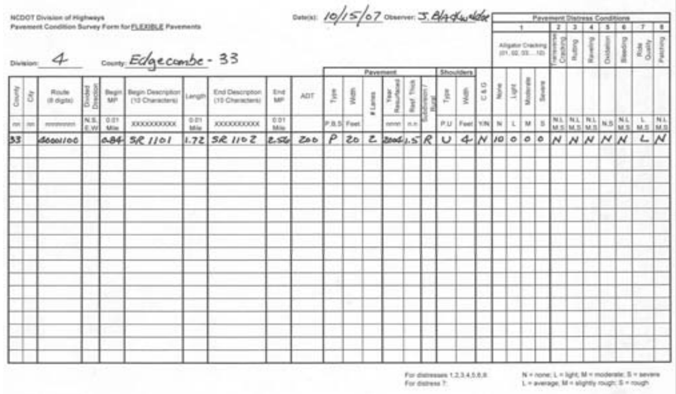
NCDOT Rating Method

- Windshield Survey
- Asphalt Survey covers the entire length of the survey section
- Concrete survey is the first 0.2 miles of a given 1 mile section (generally 40 to 70 slabs depending on joint spacing)
- Both result in a rating value between 0 (poor) and 100 (perfect)

NCDOT Survey Method

- Asphalt
  - Alligator cracking includes severity level and percent of the route exhibiting that severity
  - All other distresses are single values that include distress and extent in the definition: (N)one, (L)ight, (M)oderate, and (S)evere

Sample Asphalt Distress Sheet


NCDOT Division of Highways
Pavement Condition Survey Form for FLEXIBLE Pavements

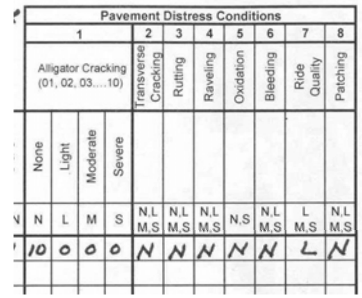
Date(s): 10/15/07 Observer: J. Blackwelder

Division: 4 County: Edgecombe - 33

County	City	Route (8 digits)	Divided Direction	Begin MP	Begin Description (10 Characters)	Length	End Description (10 Characters)	End MP	ADT	Pavement Type	Pavement Width	Pavement # Lanes	Pavement Year Resurfaced	Pavement Resf Thick	Subdivision / Rural	Shoulders Type	Shoulders Width	C & G	1 Alligator Cracking (01, 02, 03....10) None	Light	Moderate	Severe	2 Transverse Cracking	3 Rutting	4 Raveling	5 Oxidation	6 Bleeding	7 Ride Quality	8 Patching
nn	nn	nnnnnnnn	N,S E,W	0.01 Mile	XXXXXXXXXX	0.01 Mile	XXXXXXXXXX	0.01 Mile		P,B,S	Feet		nnnn	n.n		P,U	Feet	Y/N	N	L	M	S	N,L M,S	N,L M,S	N,L M,S	N,S	N,L M,S	L M,S	N,L M,S
33		60001100		0.84	SR 1101	1.72	SR 1102	2.56	200	P	20	2	2006	1.5	R	U	4	N	10	0	0	0	N	N	N	N	N	L	N

For distresses 1,2,3,4,5,6,8: N = none; L = light; M = moderate; S = severe
For distress 7: L = average; M = slightly rough; S = rough

Asphalt Rating Detail



Pavement Distress Conditions 1 Alligator Cracking (01, 02, 03....10) None	Light	Moderate	Severe	2 Transverse Cracking	3 Rutting	4 Raveling	5 Oxidation	6 Bleeding	7 Ride Quality	8 Patching
N	L	M	S	N,L M,S	N,L M,S	N,L M,S	N,S	N,L M,S	L M,S	N,L M,S
10	0	0	0	N	N	N	N	N	L	N

Asphalt Deductions

Distress	Severity Level	Deduction
Alligator Cracking***	(L)ight	3.3 points - 10% to 90%; 1 point > 90%
	(M)oderate	7.5 points - 10% to 40%; 2 points > 40%
	(S)evere	15 points - 10% to 20%; 3 points > 20%
Transverse Cracking	(L)ight	5 points
	(M)oderate	15 points
	(S)evere	30 points
Rutting	(L)ight	5 points
	(M)oderate	20 points
	(S)evere	30 points
Raveling	(L)ight	2 points
	(M)oderate	5 points
	(S)evere	15 points
Bleeding	(L)ight	10 points
	(M)oderate	20 points
	(S)evere	30 points
Patching	(L)ight	5 points
	(M)oderate	10 points
	(S)evere	20 points
Oxidation	(L)ight	0 points
	(S)evere	5 points

Concrete Survey Notes

- Jointed Concrete
  - Number of slabs with a given distress are counted and a percentage is used to calculate distress deductions
  - Shoulder drop-off is rated with a single value of N, L, M, S
  - Patches are deducted a set amount for each patch

JCP Survey Form

NCDOT PCS FORM
FOR **JOINTED CONCRETE**

DIVISION ______ COUNTY ______________ DATE ______________ OBSERVER ________________

ROUTE __________

Dir	Beg MP State / County	Begin Description	End MP State / County	End Description	# Lanes	C & G	Joint Spacing	# Slabs	Shoulder Conditions: Type Pvd (F/B/C)	Width Paved	Cond Pvd (N/L/M/S)	Width Unpvd	Cond Unpvd (N/L/M/S)	Dropoff (N/L/M/S)	Shldr-Lane Jnt (L/M/S)	Surface Conditions: Conc Patch # (X G / F P)	Asp Pat. #	Surface Wear(%) (N L / M S)	Pump #	Long Cracks (X L / M S)	Trans Cracks (X L / M S)	Corner Break (X L / M S)	Spall (X L / M S)	Joint Seal (X L / M S)	Avg Fault Inches	Ride (N/L/M/S)
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
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																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		
																X				X	X	X	X	X		

Revised: 3/2/2004

JCP Rating Detail

Shoulder Conditions: Type Pvd (P/B/C)	Width Paved	Cond Pvd (N/L/M/S)	Width Unpvd	Cond Unpvd (N/L/M/S)	Dropoff (N/L/M/S)	Shldr-Lane Jnt (L/M/S)	Surface Conditions: Conc Patch # (X G / F P)	Asp Pat. #	Surface Wear(%) (N L / M S)	Pump #	Long Cracks (X L / M S)	Trans Cracks (X L / M S)	Corner Break (X L / M S)	Spall (X L / M S)	Joint Seal (X L / M S)	Avg Fault Inches	Ride (N/L/M/S)
							X				X	X	X	X	X		
							X				X	X	X	X	X		
							X				X	X	X	X	X		
							X				X	X	X	X	X		

Concrete Deductions

DISTRESS TYPE	SEVERITY LEVEL	POINTS TO DEDUCT
Cracking (all types)	Low	0.2 points / 1%
	Moderate	0.5 points / 1% to 60%; 0.1 points / 1% > 60%
	Severe	0.75 points / 1% to 40%; 0.2 points / 1% > 40%
Corner Breaks	Low	0.1 points / 1%
	Moderate	0.15 points / 1%
	Severe	0.375 points / 1% to 80%; 0.1 points / 1% > 80%
Joint Seal Damage	Low	0.1 points / 1%
	Moderate	0.6 points / 1% to 50%; 0.1 points / 1% > 50%
	Severe	1.0 points / 1% to 30%; 0.2 points / 1% > 30%
Spalling of Joints	Low	0.15 points / 1%
	Moderate	0.375 points / 1% to 80%; 0.1 points / 1% > 80%
	Severe	0.5 points / 1% to 60%; 0.2 points / 1% > 60%
Shoulder Drop-off	Low	5 points
	Moderate	15 points
	Severe	25 points
Patching	3.75 points per patch to 8 patches; > 8 patches - 1 pt. / patch	

The Test Loop

- 90+ Miles of a mixture of Asphalt and Concrete Pavement
- Surveyed manually:
  - NCDOT Survey Methods
  - LTTP Survey Methods
- Surveyed automatically by several vendors

NCDOT Survey of Loop

- 4 Pavement Management Unit Personnel surveyed each pavement section independently
- All 4 rater data sets were used for Asphalt Comparison
- 3 rater data sets used for Jointed Concrete Comparison

Before diving in… what did we find?

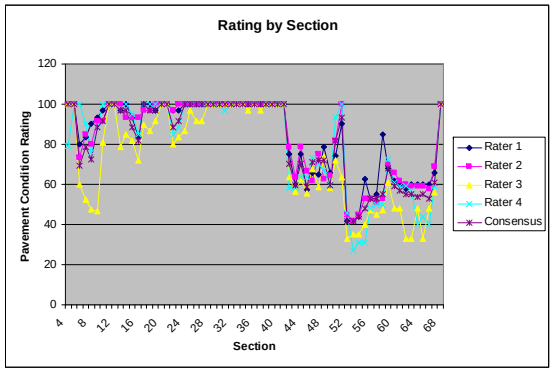
- High levels of variability
- Rater patterns
  - Some consistently more harsh than others
- Asphalt rating more consistent than concrete rating

Comparing Ratings

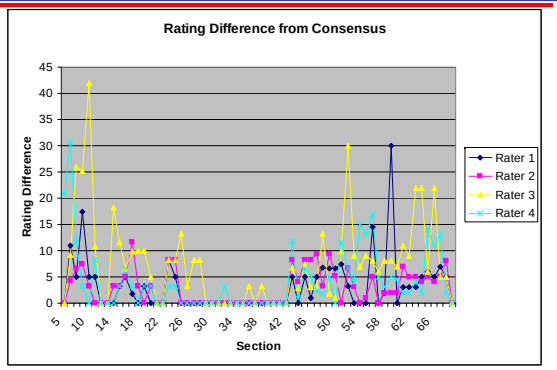
- A “consensus” rating was selected based on the most frequent occurrence of a given specific distress value
  - Average is swayed too much by extremes
- This rating was used as a baseline to calculate differences from each rater to the consensus baseline

Asphalt Comparison

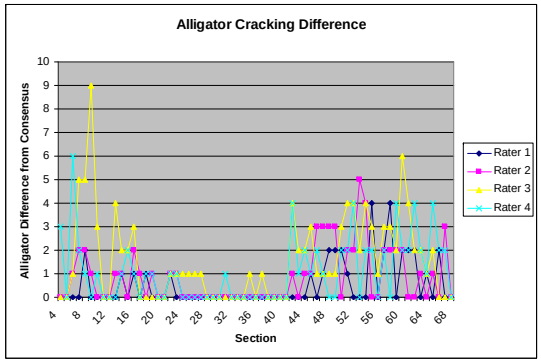
Asphalt Ratings by Section and Rater



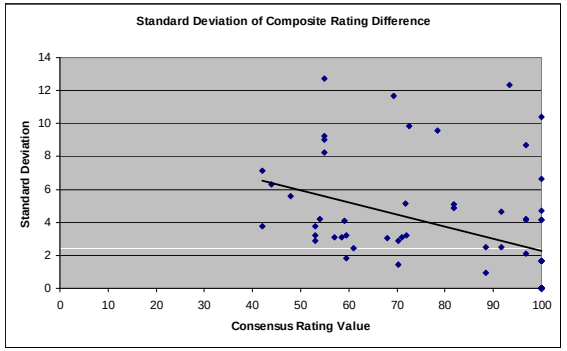
Composite Rating Difference



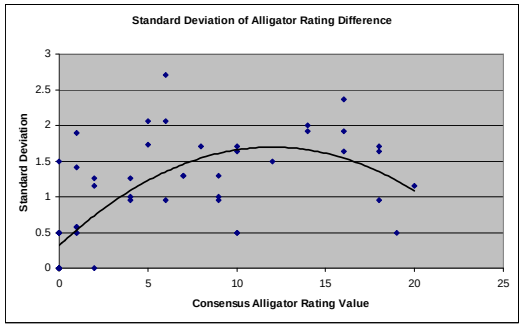
Alligator Rating Difference



Composite Rating Difference Standard Deviation



Alligator Cracking Difference Standard Deviation



Comparing Rating Average and Standard Deviation

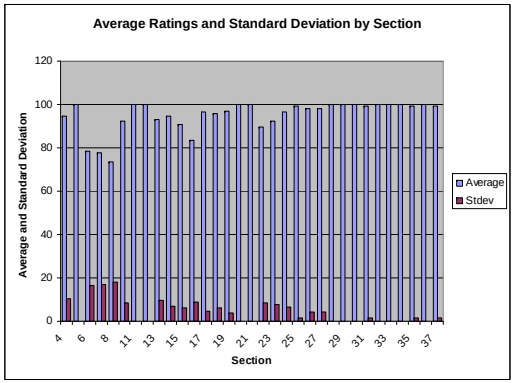
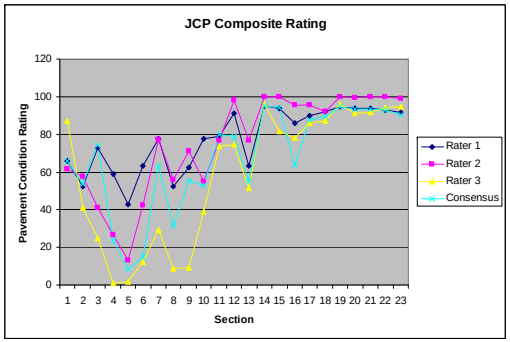


Table Comparing Raters

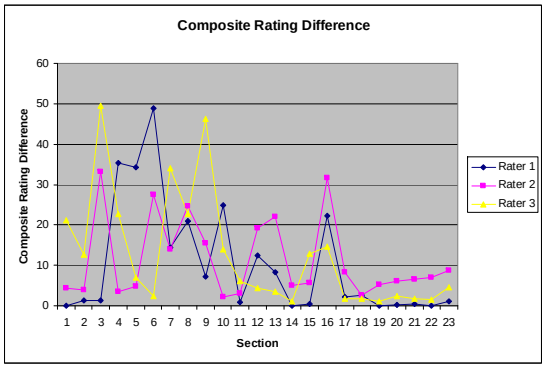
Rater	Average of Calc Rating	Average of Composite Difference	Average of Alligator Index	Average of Alligator Difference	Average of Transverse Index	StdDev of Composite Difference	StdDev of Alligator Difference
1	84.03	3.49	4.76	0.64	2.05	6.00	1.32
2	83.56	3.21	5.08	0.92	2.35	4.09	1.33
3	73.95	7.35	6.64	1.58	3.86	8.37	1.81
4	79.84	4.98	4.70	1.24	3.18	8.71	1.91
Consensus	81.25	0.00	5.06	0.00	2.88	0.00	0.00
Grand Total	80.52	3.81	5.25	0.88	2.86	6.71	1.53

Concrete Comparison

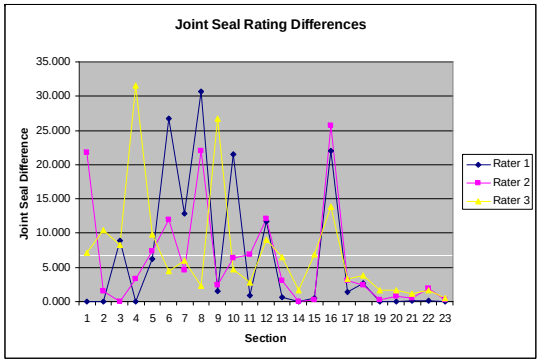
JCP Ratings by Section andRater



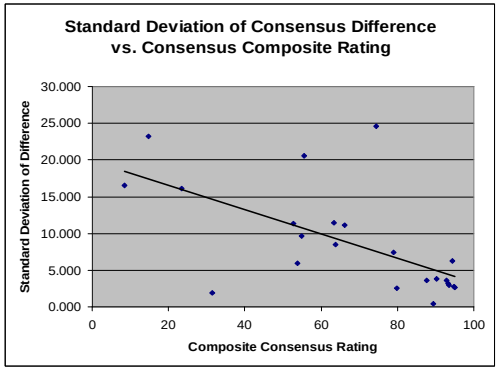
Composite Rating Difference by Section and Rater



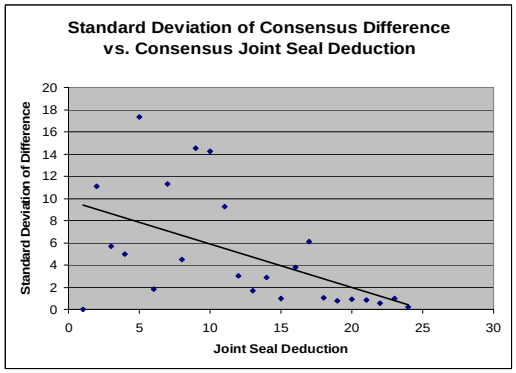
Joint Seal Rating Differences by Rater and Section



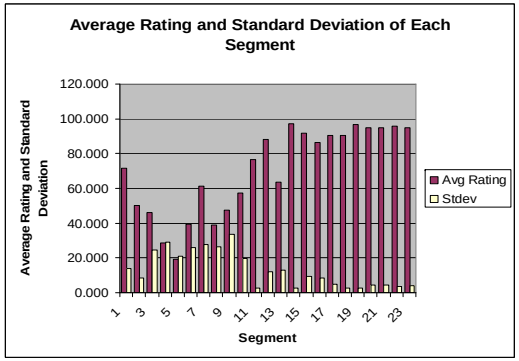
Composite Difference Standard Deviation



Joint Seal Difference Standard Deviation



Comparing JCP Rating Average and Standard Deviation



JCP Tabular Data

Rater	Average Rating	Average Composite Rating Difference	Average Longitudinal Cracking Deduction	Average Cracking Difference	Average Joint Seal Deduction	Average Joint Seal Difference	Std Dev of Composite Difference	Std Dev of Cracking Difference	Std Dev of Joint Seal Difference
1	77.54	10.41	5.99	1.22	3.63	6.47	14.09	2.43	9.71
2	75.43	11.50	3.67	2.43	8.73	6.01	9.91	4.43	7.64
3	58.70	12.61	7.15	2.05	14.94	7.21	14.26	3.52	7.78
10	67.47	0.00	5.99	0.00	9.96	0.00	0.00	0.00	0.00
Overall Average	69.79	8.63	5.70	1.42	9.32	4.92	12.11	3.17	7.74

Phew – so what have we learned?

- Manual surveys demonstrate high levels of variability
- NCDOTs concrete survey methods appear to be more variable then the asphalt methods
- Even highly-trained raters do not “agree” on many distresses
- Additional, focused training is needed to ensure consistency

That leads to the following questions:

- How do we reduce this variability?
  - More frequent training?
  - "Buddy System" requirements?
- Can this situation be helped by using an automated distress survey instead?
  - Is the variability and repeatability of an automated survey superior to a manual survey?

Questions and Comments?