Windshield Surveys of Highway Condition: A Feasible Input to Pavement Management

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The procedure used by the New York State Department of Transportation to collect highway condition data by using an in-motion windshield survey is described. The windshield survey is performed by road rating teams from the department's regional offices. Cost is about $50,000 for the 16,000-mile system or about $3.12/mile. Rating is done with carefully developed photograph scales in which photographs show not specific distress signals but rather general impressions of roads at various condition levels. Periodic training ensures consistency in assessing highway condition, and this decentralized approach permits a rapid data collection effort at a low cost to the agency. Also presented are the many uses of these data in the state's pavement management activity, both as a network-level condition-assessment process and as a screening process to identify sections of highway that require further engineering analysis. The conclusion is that windshield surveys conducted in accordance with the outlined rating methods can provide pavement managers with a current and reliable assessment of network-level highway condition and point to possible problem sections that require more detailed analysis. Low costs, speed of delivery of data, and avoidance of expensive measuring devices are also significant advantages of the method.

The purpose of pavement management is to protect the capital investment in the highway system and to ensure maximum serviceability to the motoring public at reasonable cost. Pavement management involves planning, design, construction, maintenance, and periodic evaluation of pavement structures. The pavement management process involves comparison of investment alternatives at both the network and project levels, coordination of the various activities of the highway agency, and the efficient use of existing information and methodology.

The New York State Department of Transportation (NYSDOT) is taking a number of steps to improve its pavement management practices. A pavement management task force is reviewing department practices and procedures in pavement evaluation as well as the information needed for sound management. Methods are also being developed to predict network-level condition and funding needs for alternative rehabilitation strategies. Considerable work has also been undertaken to improve and streamline various condition rating procedures. This paper reviews progress in this last subject; another paper (1) describes the condition prediction model. The purpose of this paper is to describe New York's current windshield condition survey, the various uses of the data, and the improvements that were made to the scoring procedures for the 1981 and 1982 effort.

OVERVIEW OF CONDITION SURVEY METHODS

Reliable, current highway condition data are vital to sound pavement management (2-7). These data are used to establish priorities for capital construction and maintenance, to decide on treatments for roads in need of attention, and to project pavement performance over time (4).

The amount and type of data collected for pavement management depend primarily on the intended uses of data in the management process. Pavement condition is often assessed by analyzing data on surface condition, structural adequacy, roughness, and skid resistance. Clearly, the collection and processing of these data for each highway link on an annual basis would be ideal. This is not possible on large (16,000 miles) highway systems like New York State's without a large expenditure. Lack of available funds and staff for full detailed surveys, along with the relatively slow rate of change for many of these items, suggests that collection of full data on all sections is neither efficient nor necessary.

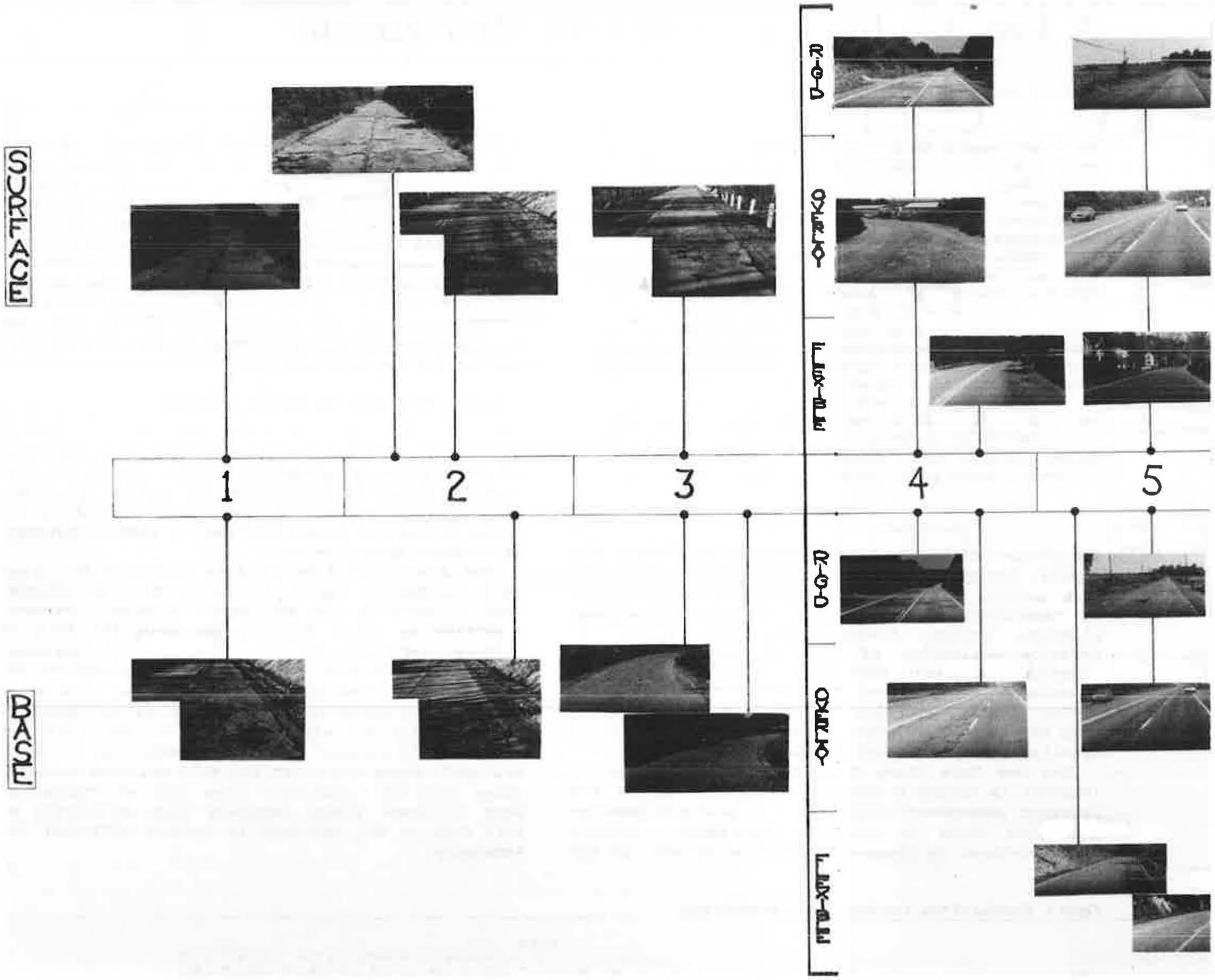
Figure 1. Overview of New York State highway condition data.

Item	YEAR 59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
Total System - Surface Condition	X	X	X		X		X	X	X	X		X		X		X		X		X			X	X
• Highway Condition Survey - Base Condition	X	X	X		X		X	X	X	X		X		X		X		X		X			X	X
Partial System - PRI																								
• PRI Survey																	X	X	X	X	X	X	X	
Samples																								
• HPMS (1,800 sections*) - PSR Rating																						X		X
• Continuous Counters (59 sections) - Hy Condition Scores																							X	X
• Albany Co. Deterioration Study (121 sections) - PRI																						X	X	X
- BPR Roughometer																						X	X	X
- Crack/Patch indices																						X	X	X
- Highway Condition Scores																								X

* State System Only

■ Focus of this paper (Total System, 81–82)

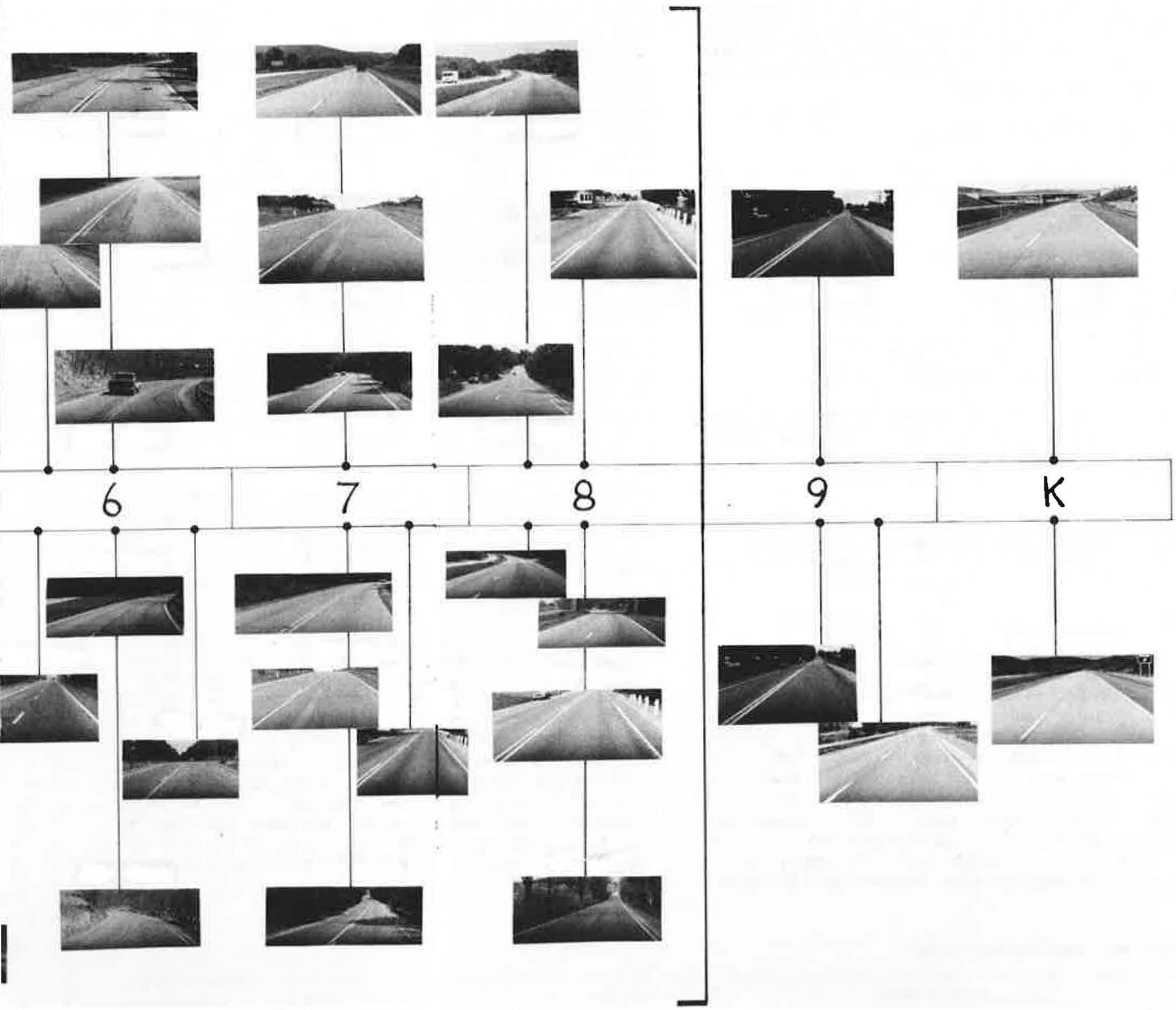
Figure 2. Photographic scales of pavement condition.



Note: K is used to represent 10.

Sampling procedures are one alternative to the more expensive mass-inventory method of data collection (4,5,8,9). Detailed data that require intricate measurement could be collected on the sample sections on a regular basis. A small number of samples carefully monitored over time could provide the analyst with all the information necessary for developing performance curves, determining service lives of various rehabilitation actions, and evaluating current construction practices. Expansion of the sample data to the entire highway system could also provide network-level estimates of condition and cost information. The federal government has recently adopted this approach in its Highway Performance Monitoring Sytem (10), which will track a sample of highway sections over time. Sampling strategies, however, are not without problems. Extreme care must be applied to the design of the sampling process to balance the cost of collecting the data and the information gained from the survey (5). Every sample survey contains sampling errors, thus results are not known with certainty. And, although sampling strategies can provide valuable input to the pavement management process, they cannot (because they are sample-based) provide the information necessary for project selection and priority ordering.

Another method used in the collection of condition data is known as a partial survey. A partial survey occurs where a preliminary visual examination of the highway system is made and is used to identify highway segments that require additional, more detailed information (8). This approach combines the best elements of the complete inventory (a census of all sections) but does not collect unnecessary detail for sections in good condition. Detailed data, comparable to those collected in sample approaches, may then be collected on selected sections to determine the exact nature of the prob-



lems. The partial survey is therefore best viewed as a filtering mechanism that provides overall monitoring capability and serves as an arrow to point to potential problems.

The methods used by NYSDOT involve both partial surveys and samples. Rideability data were collected on most of the state system (that portion that has posted speeds of 30 mph or more) annually (11) until 1981. These data were obtained by mechanical measurement of rideability at posted speed and converted to a 0 to 5 present rideability index. Pavement condition is also assessed annually on the entire state system by using a visual scoring process. These items are summarized by system (and section) and made available to the department's regional offices to assist in preparing the next year's work program. These data are being supplemented by detailed condition, characteristics, and work history data at three sample panels of highway sections. The history of these surveys is shown in Figure 1.

Highway condition surveys have been undertaken periodically in New York State for more than 20 years. In the early 1960s one team of main office engineers conducted this assessment; results were then reported in the New York State Highway Sufficiency Ratings publication, which was used extensively in highway planning and programming. In the mid-1960s, the field scoring function was decentralized to the department's regional offices. Problems with the sufficiency survey (staff turnover, inadequate training for consistency among regions, slow data processing, and lack of useful summaries) reduced the usefulness of the information. A major effort was undertaken in 1981 and 1982 to solve these problems. Procedures were implemented to enable a rapid and accurate windshield assessment of the highway network. These procedures involved the use of visual and verbal scales developed to ensure consistency among the regional field scoring teams. Teams were trained intensively in the use of these scales. Data processing procedures were also revised, and the results were furnished to the regions 2 to 3 weeks after receipt. Uses of the data include project selection, network summaries for the governor's message on transportation and capital plant renewal (12), and projection of condition under various repair strategies.

DEVELOPMENT OF CONDITION SCALES

The goal of the windshield condition survey is to provide preliminary data indicative of overall condition. The data must be

1. Consistent between regions or highway types,
2. Rapidly collectable,
3. Repeatable over time,
4. Reasonably accurate but not overly precise,
5. Easily understandable by lay persons,
6. Inexpensive to collect, and
7. Consistent with existing procedures.

The procedure developed by NYSDOT to achieve these objectives involves the use of visual and verbal scales designed to standardize the scoring process. Two separate scales have been developed:

1. Surface condition: A 1 to 10 scale that represents the condition of the pavement surface and
2. Base condition: A 1 to 10 scale that reflects problems with the underlying base.

Visual Scales

In early 1981 NYSDOT developed a set of visual scales to be used by regional staff in conducting the highway condition survey. These scales were developed through a modification of a psychological perception measurement technique known as Q-sort. Basically, this method involves a small number of experts (judges) who sort or rate a large number of photographs that show highways in various stages of condition. Eight pavement experts from various offices within the department ranked each of 50 photographs on a 1 to 10 scale once for the pavement surface and once for the base (rupture and displacement) condition. Those photographs that have the least variance in scores among the judges were selected for the photographic scales and assembled to form the actual visual scales for surface and base.

Slight refinements were made to the visual scales before the 1982 field scoring effort. Additional photographs were added to the midrange of 4 to 8, a critical area where investment decisions are often made, and the scales were stratified by pavement type. The refined scales were reproduced and included in the field scoring manual used by the regional survey teams. These scales are shown in Figure 2. Note that these photographs represent actual scale values. They are not used to portray various examples of distress signals. Details of the Q-sort procedure, including statistical validation, are described in detail in another paper (13). The use of photographs for describing the various distress signals and defining frequency and severity measures is a well-known and extensively used procedure (4,8,14); the use of photographs as scale points in evaluation of pavements has not been tried, at least to our knowledge.

Verbal Scales

Before 1981 verbal scales formed the basis of NYSDOT's highway condition surveys. These scales were also revised in 1981 and 1982 for use with the visual scales. The pavement management task force determined the types of distress most common to New York State pavements. The task force defined the distress signals for rigid (portland cement concrete), flexible (asphalt concrete), and composite (asphalt surface course overlaid on concrete slabs) pavements. Once the types of distress were determined, verbal scales were reviewed for the surface and base (rupture and displacement) for each type of pavement according to the frequency and severity of distress. Photographs of each distress signal for both surface and base (not the scale photographs determined earlier) and the frequency and severity criteria to be used when scoring were included in the field scoring manual (15) supplied to the regional survey teams. The verbal scales are given in Tables 1 and 2.

Table 1. Verbal rating scales for pavement surface.

Score	General Condition	Frequency of Distress	Rigid Pavements		Flexible Pavements		Overlay Pavements	
			Distress	Severity	Distress	Severity	Distress	Severity
10[a]	Excellent		No distress, recently constructed or reconstructed		No distress, recently constructed or reconstructed		No distress, recently overlaid	
9	Excellent		No distress, joints functioning properly		No distress, recently resurfaced		No distress, hairline reflection cracking may exist	
8	Good	Infrequent	Joint spalling, cracking, and scaling	Very slight	Raveling, cracking, and wheel track wear	Very slight	Reflection cracking	Very slight
7	Good	Infrequent to occasional	Joint spalling, cracking, and scaling	Slight	Raveling, cracking, and wheel track wear	Slight	Reflection cracking, multiple cracking at reflection cracks	Slight
6	Fair	Infrequent to occasional	Joint spalling, cracking, scaling and patching may exist	Moderate	Raveling, cracking, rutting, and patching may exist	Moderate	Multiple cracking, raveling along cracks	Slight to moderate
5	Poor	Occasional to frequent	Joint spalling, cracking, scaling, and patching may exist	Moderate to severe	Raveling, cracking, rutting, and patching may exist	Moderate to severe	Multiple cracking, raveling along cracks	Moderate to severe
4	Poor	Occasional to frequent	Joint spalling, cracking, scaling, and patching may exist	Severe	Raveling, cracking, rutting, and patching may exist	Severe	Surface delamination	Severe
3	Poor	Frequent	Joint spalling, cracking, scaling, and patching may exist	Severe	Raveling, cracking, rutting, and patching may exist	Severe	Surface delamination	Severe
2	Poor		Extremely deteriorated, motorist discomfort, and travel difficult		Extremely deteriorated, motorist discomfort, and travel difficult		Extremely deteriorated, motorist discomfort, and travel difficult	
1	Poor		Impassable at posted speed		Impassable at posted speed		Impassable at posted speed	

[a]Coded K in Figure 2.

Table 2. Verbal rating scales for base.

Score	General Condition	Frequency of Distress	Rigid Pavements		Flexible Pavements		Overlay Pavements	
			Distress	Severity	Distress	Severity	Distress	Severity
10[a]	Excellent		No distress caused by underlying roadbed movement, recently constructed or reconstructed		No distress caused by underlying roadbed movement, recently constructed or reconstructed		No distress caused by movement or deterioration of the underlying portland cement concrete slab	
9	Excellent		No distress caused by underlying roadbed movement		No distress caused by underlying roadbed movement			
8	Good	Infrequent	Slab displacement, pumping with resultant fines	Very slight	Longitudinal cracking in wheelpaths	Very slight	Non-joint-related reflection cracking	Very slight
7	Good	Infrequent to occasional	Pumping, faulting, and base-related cracking (longitudinal, diagonal, corner)	Slight	Wheelpath rutting, multiple wheelpath cracks	Slight	Non-joint-related reflection cracking, surface distortion	Slight
6	Fair	Infrequent to Occasional	Pumping, faulting, and base-related cracking	Moderate	Wheelpath rutting, alligator cracking	Moderate	Non-joint-related reflection cracking, surface distortion (faulting)	Moderate
5	Poor	Occasional to frequent	Pumping, faulting, and base-related cracking	Moderate to severe	Wheelpath rutting, alligator cracking	Moderate	Non-joint-related reflection cracking, surface distortion (faulting)	Moderate to severe
4	Poor	Occasional to frequent	Pumping, faulting, and base-related cracking	Severe	Wheelpath rutting, alligator cracking, and pieces of asphalt displaced	Severe	Non-joint-related reflection cracking, surface distortion (faulting)	Severe
3	Poor	Frequent	Faulting, cracking	Severe	Wheelpath rutting, alligator cracking, and pieces of asphalt displaced	Severe	Slab exposed and deteriorated	Severe
2	Poor		Extremely deteriorated, rupture, and displacement frequent, and motorist discomfort		Extremely deteriorated, rupture and displacement frequent, and motorist discomfort		Slab exposed and extremely deteriorated, motorist discomfort	
1	Poor		Impassable at posted speed		Impassable at posted speed		Impassable at posted speed	

[a]Coded K in Figure 2.

A note of explanation is in order concerning evaluation of the base. Obviously, one cannot see the base or any material underlying the surface when scoring a section of highway; however, certain problems manifested in the pavement surface are caused by inadequate road bed support (2,14,16,17). The base scale addresses this type of structural problem and is helpful in estimating different costs for rehabilitation (see Uses of the Survey Data).

Validation of Scales

Even though considerable effort was expended to ensure consistency in condition assessment, the question always arises as to whether the scales are being used properly in the field.

To ensure this the following procedures were followed. To ensure internal validity (replicability of the scales themselves), the scales were redeveloped by the same judges three months after initial development. Test-retest correlations showed excellent ($r > 0.9$) reproducibility (13). To ensure historical comparisons, differences among the improved scales developed in 1981 and those in use earlier were quantified and found to be negligible (13). To ensure external validity (replicability of field scores by using the scales), a small portion of the highway system (750 miles) was surveyed twice in 1982 by different raters. Table 3 gives the results: of 1,130 sections double-scored, 96 percent were scored within ±1 scale unit by both teams. The overall difference was -0.11 units (±1 percent) for surface and -0.45 (±4 percent) for base. These tolerances are satisfactory and demonstrate that visual rating systems can have high consistency if properly designed.

DATA COLLECTION AND PROCESSING

NYSDOT's highway condition survey process is shown in Figure 3. The cycle begins in early spring when refinements and modifications, if necessary, are made to procedures. A training seminar is held in the main office. Each team receives a manual of instructions for conducting the survey, complete with photographs and verbal scales (18). A series of films that simulate travel over highways in various conditions is shown at the training seminar. Each film is scored and then discussed, and the individual scorers are then instructed on how to improve their ability to make judgments by using the visual scoring materials. Additional films of highways are then shown and convergence of scoring is reasonable. In 1983 a field test over a fixed route was included. The training lasts 1.5 days and is viewed as essential to a decentralized windshield condition scoring procedure.

The survey itself is conducted by 11 two-person crews, one from each of NYSDOT's regional offices. Crew members vary in background. Some are technicians, engineers, and analysts; others are not technically trained but perform administrative or clerical functions. The quality or quantity of the work produced by these teams has been consistent if all teams receive the same intensive training.

The crew drives each highway section, usually at the posted speed, and uses the photographs for scoring. Field scoring sheets are given to each crew, arranged by route within county for easy driving sequence. The score sheets show detailed characteristics and condition data for each section; sections are short pieces of road, about 0.75 mile in length, usually with homogeneous characteristics, and built or repaired under one contract. As each section is traversed the surface and base scores are determined and placed on the score sheet and other corrections are made to field data.

Experience has shown that the team need not stop or even slow down on most sections, so the work proceeds rapidly. Scoring is done on all sections, not just those shown a given speed or outside of cities. Typically, about 125 to 200 miles a day can be surveyed, depending on weather, number of sections, and variation in condition. In 1981 and 1982 the 11 teams completed the scoring of the 16,000-mile touring route system in 10 calendar weeks, interspersed with other duties. In 1982 the scoring cost about $50,000 or $3.12/mile. Data processing and analysis were completed for another $25,000.

After each county is rated in the field, field sheets are sent to each county's resident engineer, who completes the scoring process by providing a maintenance index rating for each score section. The maintenance index is also a 1 to 10 scale, indicative of the amount of maintenance being performed on each section. Once this activity is completed, the field scoring sheets are sent back to the regional offices where they are assembled, packaged, and sent to the main office for final processing.

The main office processing procedure begins with a manual edit. Each score sheet is checked for accuracy and completeness; at the same time, current traffic volume and design hour volume are added to each record. The data are then passed through a series of programmatic contingency checks designed to find errors missed in the manual edit. The data are then summarized and transmitted to the region for review and analytic use.

Although the time alloted for the 1982 field scoring effort was two months (mid-May to mid-July) most of the regional administrators allow the scoring crews about a one month window in existing work loads to perform the survey. All data are scheduled to be returned to the regional offices by mid-August. Since main office and regional administrators are particularly interested in a timely product, this rapid turnaround is important to the success of the project.

USES OF THE DATA

The data from NYSDOT's windshield condition survey are used extensively in the pavement management process. The freshness and easy accessibility of the data appeal to both the administrator and technician. Results of the 1981 and 1982 surveys have

Table 3. Comparison of ratings for sections rated by two teams.

		Surface		Base	
Region	No. of Samples	Mean Differences in Rating	Percentage Within ±1 Unit	Mean Differences in Rating	Percentage Within ±1 Unit
1	113	0.23	95.6	-0.20	95.6
2	155	-0.08	97.4	-0.50	91.6
3	87	-0.09	100.0	-0.26	98.9
4	130	0.05	98.5	-0.06	97.7
5	60	-0.02	95.0	-0.55	90.0
6	83	0.12	95.2	-0.31	92.8
7	153	0.65	98.7	0.80	92.2
8	135	-0.21	94.1	0.22	88.9
9	81	-0.35	98.8	-1.07	67.0
10	109	-0.44	91.7	-0.51	89.0
11	24	0.21	100.0	-0.42	100.0
Total	1,130	-0.11	96.6	-0.39	91.2

Figure 3. Annual cycle of highway condition assessment.

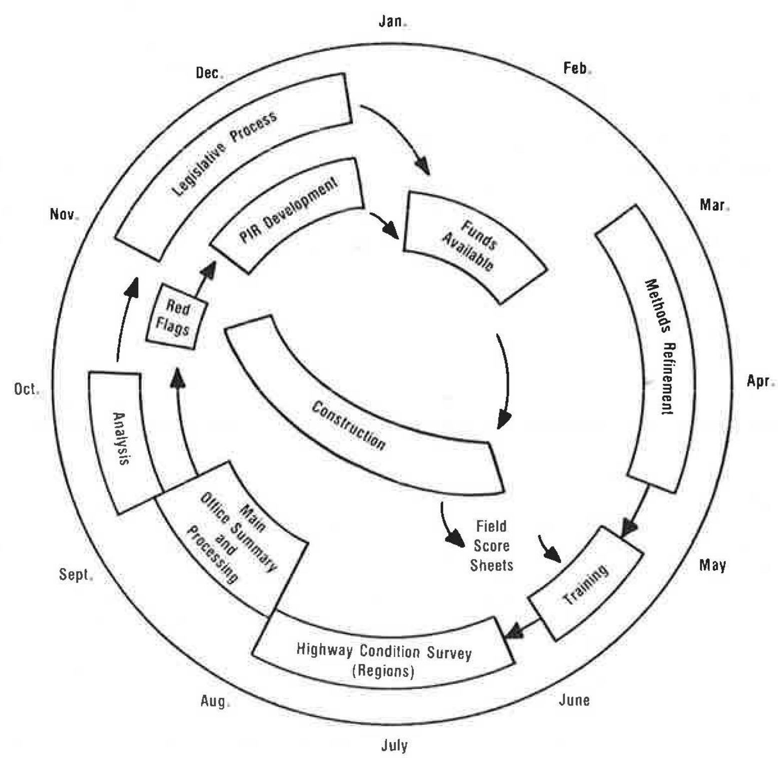


Figure 4. Sample red flag listing.

RED FLAG LISTING

INPUT FILE: 1982 SUFFICIENCY

RC ET GY	ROUTE	CO TRC YDS	BEGIN MILEPT	END MILEPT	PVMT WDTH	SHLD WDTH	1980 PRI	AADT/YR	FEDERAL AID SYSTEM	SURFACE SCORE <6	RUPT SCORE <6	MAINT INDEX <6	STRUCT SCORE <60	V/C RATIO >1.0	SUFF SCORE <60	SECTION LENGTH
18	196	011	00.45	00.87	28	00		2600 81	FAUS	5	5		56			.42
18	196	011	00.87	01.16	20	05		2600 81	FAUS	5	5		56			.29
18	196	011	01.28	02.43	20	02		2600 81	SECONDARY	5	5	5	50			1.15
18	196	011	02.43	02.50	24	00		2600 81	SECONDARY	5	5	5	50			.07
18	196	011	02.50	03.36	20	05		2600 81	SECONDARY	5	5	5	50			.86
18	196	011	03.36	05.93	20	04		2600 81	SECONDARY	5	5	5	50			2.57
18	196	011	05.93	05.97	22	10		2600 81	SECONDARY	5	5		59			.04
18	196	011	05.97	06.02	48	04		2600 81	SECONDARY	5	5		59			.05
18	197	021	00.23	00.31	24	00		5500 81	PRIMARY URB	3	3		42			.08
18	197	021	00.94	01.01	18	03		2000 81	FAUS			5	57			.07
18	197	021	06.12	06.38	20	10		3000 79	SECONDARY			5	57			.26
18	254	021	00.00	00.53	24	03		11500 79	PRIMARY URB	5	5	5	50			.53
18	254	021	00.53	00.67	24	00		11500 79	PRIMARY URB	5	5		56			.14
18	313	011	00.00	00.85	22	08		1400 77	SECONDARY	5	5		53			.85
18	313	011	00.85	01.60	22	08		1400 77	SECONDARY	5	5		53			.75
18	313	011	01.60	04.52	22	08		1400 77	SECONDARY	5	5		53			2.92
18	338	011	01.80	02.88	20	03		900 81	SECONDARY	5	5	5	50			1.08
18	338	011	02.88	03.17	20	03		600 81	SECONDARY	5	5	5	50			.29
18	338	011	03.17	06.93	20	03		600 81	SECONDARY	4	4	4	40			3.76
18	372	011	00.00	00.24	36	00		1800 81	PRIMARY RUR			5	57			.24
18	372	011	00.30	00.34	26	00		1800 81	PRIMARY RUR	4	4		49			.04
18	372	011	00.34	00.54	20	05		1800 81	PRIMARY RUR	4	4		49			.20

	SURFACE SCORE	RUPT SCORE	MAINT INDEX	STRUCT SCORE	V/C RATIO	SUFF SCORE
TOTAL RED FLAG MILES IN COUNTY ARE:	60.27	62.37	83.38	95.15	4.80	.00
TOT CTY MILES: 243.11 PERCENT OF MILES IN COUNTY FLAGGED:	24.79%	25.66%	34.30%	39.14%	1.97%	.00%
TOTAL RED FLAG MILES IN REGION ARE:	384.35	380.20	592.28	597.03	76.29	10.26
TOT REG MILES: 2035.48 PERCENT OF MILES IN REGION FLAGGED:	18.88%	18.68%	29.10%	29.33%	3.75%	.50%

THIS TOTAL EXCLUDES OVERLAP MILEAGE; OVERLAP RED FLAG MILES SHOWN ON LOWEST NUMBER ROUTE ONLY.

been used by the department in determining network-level highway needs and in preparing legislative requests.

Red Flag Analysis

The red flag computer summary is provided to the regions immediately after main office processing of the survey data is completed. The red flag programming gives the location of highway sections that fall below a selected level of condition. Thus, it serves as an early alert on problem sections that may need attention.

The select criteria are determined by the user and can be changed readily to accommodate a variety of requests. (The highway condition system is stored on-line and can be quickly assessed through remote computer terminals. Each year's file is about 20,000 records of 150 characters each.)• The red flag also computes the total mileage deficient in each county and region and the percentage of the total mileage that fails the desired criteria. Figure 4 shows typical red flag output.

Specialized Computer Summaries

Many specialized computer summaries are prepared in response to requests from numerous main office and regional administrators and technicians. The department's general purpose computer programs allow for quick on-line access and versatile output capabilities. For example, condition values can be summarized by miles of facilities in various states of condition, by pavement type within county, or by any other variable contained on the file.

Deterioration Rates

A knowledge of deterioration rates is vital in selecting optimal treatment strategies for rehabilitating pavements and for projecting network deterioration over time. NYSDOT reviewed data from the highway condition file to obtain preliminary estimates of deterioration. This analysis was conducted by arranging highways according to condition score versus the number of years that have elapsed since the last contract work was performed on the pavement (the year of last contract work is included on the condition file). The results of this analysis (19) yielded preliminary network-level estimates of deterioration by type of pavement. A research endeavor is currently being conducted (20) to provide the data necessary for deterioration analysis. This study involves long-term monitoring of pavements in the Albany area to determine the effects of various rehabilitation strategies on pavement serviceability.

Highway Condition Projection Model

The Highway Condition Projection Model (HCPM) is a long-range forecasting tool used to predict the long-term impact on highway condition of alternative general rehabilitation strategies. The model operates by projecting the condition of each highway section and the costs necessary to repair it under a given rehabilitation strategy specified by the analyst. A recent paper (1) describes the model.

Highway Sufficiency Ratings Publication

NYSDOT publishes the Highway Sufficiency Rating Book, a complete list of all sections and their condition. The publication displays comprehensive location, physical, operational, and rating measure data for each link on the state touring route system. It contains highway condition scores, including surface and base condition, maintenance index, and computed values for capacity, volume/capacity rates, and sufficiency rating. The publication

Figure 5. Sample from sufficiency rating publication.

IDENTIFICATION INFORMATION								PHYSICAL CHARACTERISTICS									OPERATIONAL CHARACTERISTICS							RATING MEASURES			
Route Number	County Name	Region & County	County Order	Control Segment	End Milepoint	Reference Marker	State Highway Number	Section Length	Lanes	Roadways	Median	Pavement Width	Surface Base Subbase	Shoulder Width	Access	Area Type	F.A. System	Funct. Class	Traffic Count Yr	AADT Volume	Design Hour Volume	Adjusted Rated Capacity	Volume Capacity Ratio	Yr. Sr. Rub Maint	Structural Rating	PRI	Sufficiency Rating
9	ALBANY	11	08	1	00.00	ALBANY CO CITY OF ALBANY ROUTE 20 OVERLAP CONTINUES																					
9	ALBANY	11	08	1	00.04		66-1	00.04	4	2	4	56	077	00	2	5	2	B	80	23900	1480	2610	0.5	668	66		83
9	ALBANY	11	08	1	00.09		66-1	00.05	4	2	4	56	077	00	2	5	2	B	80	23900	1480	2610	0.5	668	66		83
9	ALBANY	11	08	1	00.09	END ROUTE 20 OVERLAP																					
9	ALBANY	11	08	1	00.21		66-16	00.12	2	2	4	56	075	00	2	5	2	B	78	17700	1100	930	1.1	668	66		76
9	ALBANY	11	08	1	00.38		66-16	00.17	2	2	4	48	075	00	2	5	2	B	78	17700	1100	930	1.1	778	73		79
9	ALBANY	11	08	1	00.49		66-16	00.11	4	2	4	44	075	00	2	5	2	B	78	7600	470	2530	0.1	778	73		87
9	ALBANY	11	08	1	00.63		66-16	00.14	6	2	4	80	065	00	2	5	2	B	78	7600	470	4100	0.1	888	80		90
9	ALBANY	11	08	1	00.79		66-16	00.16	UNDER CONSTRUCTION								2	B									
9	ALBANY	11	08	1	00.91	ROUTE 787I IS OVER NO CONN																					
9	ALBANY	11	08	1	01.10		66-16	00.31	UNDER CONSTRUCTION								2	B									
9	ALBANY	11	08	1	01.19		66-16	00.09	UNDER CONSTRUCTION								2	B									
9	ALBANY	11	08	1	01.26		CTYST	00.07	8	2	2	80	073	00		5	0	F	78	10600	660	4100	0.1	889	83		92
9	ALBANY	11	08	1	01.26	ROUTE 32 JUNCTION																					
9	ALBANY	11	08	1	01.31		CTYST	00.05	4	1		54	073	00		5	0	F	78	7900	490	1310	0.3	889	83		92
9	ALBANY	11	08	1	01.89		CTYST	00.58	4	1		54	482	00		5	0	F	78	7900	490	1310	0.3	559	62		61
9	ALBANY	11	08	1	01.89	ROUTE 9W JUNCTION LEFT																					
9	ALBANY	11	08	1	02.00		CTYST	00.11	4	1		54	487	00		5	0	F	78	9100	560	1380	0.4	889	83		92
9	ALBANY	11	08	1	02.24		CTYST	00.24	2	1		36	465	00		5	0	E	79	15100	930	840	1.1	889	83		87
9	ALBANY	11	08	1	02.34		67-18	00.10	3	2	2	66	454	00		5	0	E	79	15100	930	880	1.0	889	83		88
9	ALBANY	11	08	1	02.38		67-18	00.04	6	2	4	74	477	00		5	0	C	79	15100	930	4100	0.2	889	83		92
9	ALBANY	11	08	1	02.46		67-18	00.08	6	2	4	66	077	00		5	0	O	79	15100	930	3760	0.2	889	83		92
9	ALBANY	11	08	1	02.62		67-18	00.16	6	2	4	74	077	00		5	0	O	79	15100	930	3890	0.2	889	83		92
9	ALBANY	11	08	1	02.70	RR IS UNDER																					
9	ALBANY	11	08	1	02.86	ROUTE 90I IS UNDER																					
9	ALBANY	11	08	1	02.96		67-17	00.34	4	2	4	64	077	00		5	0	C	80	3900	240	2480	0.1	889	83		92
9	ALBANY	11	08	1	03.37		67-17	00.41	4	2	4	52	075	10		5	0	C	80	3900	240	2910	0.0	889	83		92
9	ALBANY	11	08	1	03.37	ROUTE 377 IS OVER WITH CONN																					
9	ALBANY	11	08	1	03.51		67-18	00.14	2	2	4	46	075	00		5	0	C	80	3900	240	930	0.2	889	83		92
9	ALBANY	11	08	1	03.72		67-18	00.21	4	2	4	60	075	00		5	0	E	79	15900	980	2480	0.4	889	83		92
9	ALBANY	11	08	1	03.82		67-18	00.10	2	2	5	30	075	08		5	0	E	79	15900	980	970	1.0	889	83		91
9	ALBANY	11	08	1	03.82	CITY OF ALBANY																					
9	ALBANY	11	08	2	00.00	TOWN OF COLONIE																					
9	ALBANY	11	08	2	00.55	9 1108 2005	22	00.55	2	1		30	462	04		4	0	E	76	14400	1050	930	1.1	988	83	3.48	86
9	ALBANY	11	08	2	01.60	9 1108 2013	22	01.05	2	1		30	462	04		4	0	E	78	15800	980	930	1.0	677	67	3.73	81
9	ALBANY	11	08	2	01.60	ROUTE 378 JUNCTION																					
9	ALBANY	11	08	2	03.04	9 1108 2031	22	01.44	2	2	5	24	472	04		4	0	E	78	21100	1310	930	1.4	998	87	4.00	79
9	ALBANY	11	08	2	03.69	9 1108 2037	119	00.65	2	2	5	24	482	04		4	0	E	80	19400	1200	770	1.5	888	80	3.29	72
9	ALBANY	11	08	2	03.91	9 1108 2040	119	00.22	4	2	5	48	475	00		4	0	E	80	19400	1200	1830	0.[illegible]	778	73	2.86	87
9	ALBANY	11	08	2	03.91	ROUTE 155 JUNCTION																					
9	ALBANY	11	08	2	04.38	9 1108 2044	119	00.47	4	2	5	48	475	00		4	0	E	78	32100	2340	1830	1.2	779	76	3.11	77
9	ALBANY	11	08	2	04.49	9 1108 2045	119	00.11	4	2	5	48	475	00		4	0	E	78	32100	2340	[illegible]	1.2	777	70	3.38	74
9	ALBANY	11	08	2	04.70	9 1108 2048	119	00.21	4	2	4	48	075	00		4	0	E	78	32100	2340	1830	1.2	667	63		71
9	ALBANY	11	08	2	04.70	ROUTE 7 OVER																					
9	ALBANY	11	08	2	05.08	9 1108 2051	119	00.38	4	2	5	48	075	00		4	0	E	78	21700	1580	1830	0.8	667	63	3.71	82
9	ALBANY	11	08	2	05.65	9 1108 2057	119	00.57	4	2	5	48	475	00		4	0	E	78	21700	1580	1830	0.8	667	63	3.56	82
9	ALBANY	11	08	2	05.65	ROUTE 9R JUNCTION																					
9	ALBANY	11	08	2	06.06	9 1108 2061	5555	00.41	4	2	5	48	475	00		4	0	E	79	21900	1790	1830	0.9	777	70	4.27	85
9	ALBANY	11	08	2	06.59	9 1108 2065	5555	00.53	4	2	5	48	445	10		4	0	E	79	21900	1790	2030	0.8	776	67	3.85	84

presents link data contiguously by route within county and is used as a handy reference for highway information both within and outside the department. A typical page from the sufficiency ratings is shown in Figure 5.

CONCLUSIONS

A pavement management system is a valuable process used to optimize investments in the highway infrastructure. Current, reliable, and easily accessible condition data are essential to pavement management activity. Procedures being developed by NYSDOT to improve its existing windshield condition survey procedure are described in this paper. The survey, conducted annually by scoring teams from the department's 11 regional offices, involves the use of visual scales based on photographs. Intricate measurements are not required; therefore, data can be collected, processed, and summarized in a short period of time at relatively low cost to the agency. In 1982 the entire process from data collection through summarization took about 5 months and cost approximately $75,000. (This cost was not a new cost to the agency because a condition survey has historically been conducted. The effort actually cost less than in previous years because of improvements in scoring and processing procedures.)

Decentralization of data collection is the key to rapidity in data turnaround time. A strong training and validation effort ensures accuracy and consistency. The results of the survey can be used with confidence to determine network-level condition, to estimate network deterioration rates, to estimate overall costs to rehabilitate the system, and to forecast long-range implications of various rehabilitation strategies.

The most important use of the data is to red flag candidate highway sections that require more detailed engineering evaluation. The windshield survey data are used by this agency as a screening process to identify highway sections that are candidates for rehabilitation and require further analysis. Detailed engineering analysis can then be conducted in the regional offices, generally by design personnel. Decisions on the best treatment strategy for the candidate section can then be developed. Because it can serve as both a screening device for project selection and as input to network needs, the windshield survey is an important part of New York State's pavement management process.

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