Status of Highway Condition Scoring in New York State

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ABSTRACT

In this paper highway condition rating methods and results in New York State, as of the summer of 1983, are summarized. The focus of the paper is on procedures that the New York State Department of Transportation uses to assess the condition of highways in the state, and to provide that information in an accurate, rapid, and consistent fashion. The history of highway condition assessment in New York is briefly reviewed, and activities in scoring are described. Improvements in training procedures, tests of field consistency, improvements in data processing, and similar activities that are being undertaken in other agencies are reviewed. Results indicate that the overall condition of New York's 15,750-mile Touring Route System is generally good, but that 13 percent of road surfaces and 17 percent of road bases are rated in poor condition. It is concluded that the highway condition rating procedures used in New York are currently moving into a "shake-down" phase, where required improvements are less from year to year and results are generally satisfactory.

Pavement management is a broad strategy to protect the capital investment in the highway system and to ensure maximum serviceability of the highway system to the motoring public at a reasonable cost. It encompasses all aspects of highway planning, design, construction, and maintenance of pavement systems. Pavement management involves comparing investment alternatives for individual projects as well as network strategies, coordinating the various activities of the highway agency in maintaining and improving the highway system, and using information to make decisions in the best long-term interests of the motoring public.

The New York State Department of Transportation (NYSDOT) has established a Pavement Management Task Force to review its procedures and practices in pavement evaluation and to recommend methods for improving these procedures. The department has also developed a model to predict long-term network condition and funding requirements for alternative rehabilitation strategies, as well as to identify sections likely to need repair in future years.

An additional major effort described in this paper is the department's highway condition rating procedures. The most recent progress on this particular subject, which builds on earlier papers presented to the Transportation Research Board (1,2), is reviewed.

REVIEW OF NYSDOT ROAD RATING PROCEDURES

As Figure 1 shows, the department has conducted several types of surveys of highway condition. The condition survey consisted of road ratings on a verbal scale of 1 to 10. It is similar to the pavement serviceability rating (PSR). Highway condition assessment was undertaken periodically by regional teams in the department's 11 regional offices. Over time individual regional teams began to drift apart in consistency of using these verbal scales, and difficulties in processing the data and making it available in a useful form considerably reduced its value. As a result, the highway condition rating process, termed the sufficiency process, fell into disfavor in the 1970s and was conducted only periodically. In the meantime, the department used a road roughness measure called the present rideability index (PRI). But changes in vehicles and calibration problems associated with the system, as well as concerns about the process by which technical data on road roughness were correlated with perceptual data on rideability, led to the decline in the use of the system. PRI data were last collected in 1981.

The department has currently (spring 1984) reassessed its system-level condition data needs.

The department also uses various sample-based road rating systems: (a) the federally mandated Highway Pavement Management System (HPMS) sample of 2,800 sections, which uses the familiar PSR rating scale; (b) the department's own system of continuous counters at which roads are rated by using the highway condition assessment; and (c) the Albany County highway deterioration study, which tracks the deterioration of 121 test and control sections using several condition measures.

INVENTORIES

- HIGHWAY CONDITION SURVEY
- PRI (RIDEABILITY)

SAMPLES

- HPMS (2,800 SECTIONS)
- CONTINUOUS COUNTERS (59 SECTIONS)
- ALBANY CO. DEMO (121 SECTIONS)

○ Planned
□ Photograph Scale

FIGURE 1 NYSDOT highway condition data.
Improvements in condition rating procedures were initiated by NYSDOT in 1981. To remove some of the problems with the highway condition survey, the department undertook the following major improvements.

1. Photograph scale: To improve the consistency and accuracy of data collected in the field, the department constructed a scale of photographs for use in the field. Each photograph was selected by standard methods in psychology and arranged in such a way that they formed a 10-point interval scale. The photographs were then reproduced and made available to regional rating teams along with revised verbal and technical description material on particular distress signals. Examples of this scale are given elsewhere (1,2).

2. Training: Detailed training was held in Albany for regional rating teams on the use of the photographs and the revised verbal scales.

3. Consolidation: The number of sections and the information collected were reviewed and consolidations of information were made wherever possible to streamline the rating effort.

4. Computer processing: Computer processing was streamlined and automated so that data would be made available to regional offices within 2 to 3 weeks of receipt. This allows data collected in one year to be used directly in program development for the next year.

5. Summaries: New summary capabilities were added to the department’s processing system, so that relevant and useful summaries of the data could be provided to the department's program managers. Summaries of the condition of the entire system were prepared and distributed.

6. Forecasts of condition: The department developed a condition forecasting method, called the highway condition projection model (3), which uses these data to project highway condition in the future and estimate the cost of highway repair strategies.

These activities have greatly improved the repeatability, consistency, accuracy, and relevance of highway condition data. The highway condition information now being collected is finding its way into many aspects of the department’s project development process, and it is being used as the primary method of highway condition assessment for the state highway system.

RECENT IMPROVEMENTS

The 1981 and 1982 experience indicated that the visual rating procedure was extremely easy to use in the field and it was satisfactory in accuracy, consistency, and reliability of the data provided. Therefore, additional improvements since 1983 have been minor.

Tie-Breaker Photographs

The department’s 10-point scale is generally suitable, but great accuracy is needed in the 5- to 8-point range of this scale, where most decisions concerning pavement rehabilitation are made. Accordingly, the department selected tie-breaker photographs for insertion between points 5 and 6, 6 and 7, and 7 and 8. These photographs allow better judgments of which condition level a particular pavement section falls into. The department considered the development of half-point positions in the middle of the scale, but found the effort unnecessary. A typical condition scale is shown in Figure 2.

Special Codes

Although the two major highway condition scales (surface or base) allow for the classification of pavement condition, certain other rating needs arise. An excellent example would be the recent extensive joint-failure problems associated with I-84 in southern New York. These problems are associated with block faulting as a result of failure of load-transfer devices between the concrete sections, primarily in the driving lane. Such problems are associated with underlying distress and are recognized as such by regional raters, but management believed that it was important to specifically identify certain distress symptoms. Accordingly, a third code was added, called the special code, to provide other information believed necessary to have a thorough picture of the road condition. The special codes used for the 1983 surveying effort are given in Table 1. As may be noted, the codes focused primarily on faulting problems and on particular distress signals associated with overlays, such as edge faulting.

TABLE 1 Special Codes, 1983

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Pavement Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Faulting, low to medium severity (&lt;0.25 in.)</td>
<td>PCC/overlay</td>
</tr>
<tr>
<td>2</td>
<td>Faulting, high severity (&gt;0.25 in.)</td>
<td>PCC/overlay</td>
</tr>
<tr>
<td>3</td>
<td>Shoulder wash-out</td>
<td>All</td>
</tr>
<tr>
<td>4</td>
<td>Widening dropoff</td>
<td>Overlay</td>
</tr>
<tr>
<td>5</td>
<td>Distortion</td>
<td>Flexible</td>
</tr>
<tr>
<td>6</td>
<td>Localized, severe distress</td>
<td>All</td>
</tr>
<tr>
<td>9</td>
<td>Other (write in margin of score sheet)</td>
<td>All</td>
</tr>
</tbody>
</table>

Note: PCC = portland cement concrete.

Special codes may be changed each year as new issues develop, thus increasing substantially the flexibility of the rating process. In effect, the special codes operate like a marginal note, allowing the regional scorer to tell the main office about particular problems that need attention, but they do not necessarily fall under the more systematized rating procedures developed thus far.

Maintenance Index

The department periodically asks its resident engineers (those individuals responsible for highway maintenance in each of the state’s 62 counties) to prepare an assessment of the difficulty of maintaining each section of highway in its present condition. Discussions with the department’s maintenance people and with the resident engineers led to improvements in this particular index for the 1983 rating effort. The maintenance index is given in Table 2. Note that the rating is not quantified in visual terms; it is essentially a verbal scoring system.
The department developed materials for a training film. The data were then discussed thoroughly the follow­
ing day.

Field Tests

Previous training processes were highly successful in introducing consistency and accuracy among the 11 regional scoring teams. The resulting consistency in estimates of condition by 11 regional teams was described in previous papers (1,2), but the estimates were based on films of roads, not actual field tests. Therefore, training did not ensure that field scores would be consistent. To ensure this, the department instituted a field test for the 1983 survey. The 11 regional teams were asked to drive over a route in the Albany area consisting of 10 test sections. These sections had been filmed for training purposes. The route (Figure 3) contains pavements of different types (rigid, flexible, and overlay), varying condition levels, and varying urban and rural settings. Regional scoring teams drove over the route shown in the figure, and recorded their estimates of surface and base ratings as well as the special codes previously described. The data were then discussed thoroughly the follow­
ing day.

Training Film

The department developed materials for a training film on highway rating. The film shows the field test described in the previous section, and the results of the field tests and the visual field rating principles are discussed.

The videotape of the field test sections was shown to regional teams after they had completed their training. After each test section was traversed, the regional rating teams were invited to discuss their scores against the discussion on the videotape. The training film will also be used to train other governments in condition rating.

OVERALL PAVEMENT CONDITION, 1983

The overall pavement condition of the State Touring Route system remains quite good. Road surfaces are in slightly better condition than road bases. As of 1983, approximately 87 percent of road surfaces were in fair to excellent condition (level 6 or higher), compared with about 83 percent of road bases. Approximately 13 percent of road surfaces and 17 per­

ence of road bases were in poor condition (level 5 or lower). These percentages are slightly different from those obtained in 1982, but the differences are smaller than probable scoring errors. About 1,909 sections out of 18,331 (10.4 percent) have special problems, primarily faulting and localized distress.

The average surface condition of the New York State Touring Route is about 6.93 (Table 3). Over­

lage condition of road bases is about 6.79 and has remained quite stable. These 1982-1983 differences

are not large. More than 70 percent of the mileage
remains in the good-to-fair range, with an especially large proportion (55 percent) in categories 7 and 6 (just above the poor range). No progress has been made in decreasing this proportion, and without attention, this mileage will slip into the lower range, thus necessitating more extensive work in the future.

FIELD CONSISTENCY IN RATING

The field training goes a long way to ensure that when highway sections are rated in the field, they will be rated consistently by different teams. But unless sections are checked in the field, there is no guarantee that the rating was accurate. To ensure this, NYSDOT undertook two measures.

Double-Scored

In 1982 and 1983 the department field-checked a representative sample of highway sections. These sections, totaling approximately 10 percent of the state highway system, are shown in Figures 4 and 5. For half of these highway sections, a field team from the Albany main office estimated the condition of the section (Figure 4). For the other half, regional teams double-scored sections in adjacent regions (Figure 5). The data in Table 5 indicate that in a high proportion of cases, the difference between the two scores was one point or less. These results substantially improved the department's confidence in the overall rating process as it occurs in the field.

Consistency with Field Distress

To ensure that the department's photograph scale system is consistent with more detailed field dis-

TABLE 3  Surface Condition, New York State Touring Route System

<table>
<thead>
<tr>
<th>Condition Level</th>
<th>1981 Lane Miles</th>
<th>Percent</th>
<th>1982 Lane Miles</th>
<th>Percent</th>
<th>1983 Lane Miles</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>1,188</td>
<td>3.0</td>
<td>1,021</td>
<td>2.6</td>
<td>1,487</td>
<td>3.7</td>
</tr>
<tr>
<td>Good to fair</td>
<td>8,381</td>
<td>21.1</td>
<td>7,656</td>
<td>19.3</td>
<td>10,534</td>
<td>26.5</td>
</tr>
<tr>
<td>7,487</td>
<td>18.0</td>
<td>11,858</td>
<td>29.8</td>
<td>16,638</td>
<td>29.1</td>
<td>75.0</td>
</tr>
<tr>
<td>Poor</td>
<td>5,828</td>
<td>9.7</td>
<td>4,249</td>
<td>10.7</td>
<td>6,214</td>
<td>15.5</td>
</tr>
<tr>
<td>1,153</td>
<td>2.9</td>
<td>10,411</td>
<td>2.7</td>
<td>7,759</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>154</td>
<td>0.4</td>
<td>234</td>
<td>0.6</td>
<td>168</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>0.05</td>
<td>19</td>
<td>0.05</td>
<td>10</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.005</td>
<td>2</td>
<td>0.005</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39,661</td>
<td></td>
<td>39,729</td>
<td></td>
<td>40,005</td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>6.82</td>
<td></td>
<td>6.82</td>
<td></td>
<td>6.93</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 4  Base Condition, New York State Touring Route System

<table>
<thead>
<tr>
<th>Condition Level</th>
<th>1981 Lane Miles</th>
<th>Percent</th>
<th>1982 Lane Miles</th>
<th>Percent</th>
<th>1983 Lane Miles</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>1,115</td>
<td>2.8</td>
<td>1,044</td>
<td>2.6</td>
<td>1,275</td>
<td>3.2</td>
</tr>
<tr>
<td>Good to fair</td>
<td>6,473</td>
<td>16.3</td>
<td>6,461</td>
<td>16.3</td>
<td>6,298</td>
<td>15.7</td>
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<tr>
<td>10,610</td>
<td>26.8</td>
<td>11,039</td>
<td>27.8</td>
<td>10,795</td>
<td>27.1</td>
<td>70.1</td>
</tr>
<tr>
<td>11,712</td>
<td>29.5</td>
<td>10,439</td>
<td>26.3</td>
<td>10,982</td>
<td>27.4</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>5,641</td>
<td>14.3</td>
<td>5,763</td>
<td>14.5</td>
<td>5,130</td>
<td>12.8</td>
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<tr>
<td>2,217</td>
<td>5.6</td>
<td>1,753</td>
<td>4.4</td>
<td>1,552</td>
<td>3.4</td>
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<tr>
<td>409</td>
<td>1.0</td>
<td>403</td>
<td>1.0</td>
<td>257</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>0.1</td>
<td>77</td>
<td>0.2</td>
<td>57</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.005</td>
<td>-</td>
<td>0.005</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39,661</td>
<td></td>
<td>39,729</td>
<td></td>
<td>40,005</td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>6.53</td>
<td></td>
<td>6.64</td>
<td></td>
<td>6.79</td>
<td></td>
</tr>
</tbody>
</table>

FIGURE 4  Main office field check.

FIGURE 5  Boundary scoring.
The department's highway condition projection model (HCPM) (3) is a recently developed tool that allows the analysis of alternative rehabilitation strategies. A projection is made of a condition of a highway section under its jurisdiction, and it provides information on cracking, rutting, and patching are collected annually for each test and control section. This is a study that contains 121 test and control sections in Albany County. These sections have been treated with various kinds of improvements and then allowed to deteriorate. Detailed distress information on cracking, rutting, and patching are collected annually for each test and control section on the same highway. To develop the regression relationships between these detailed parameters and the overall scores, the analysis team has visually scored the same 121 sections annually.

### PROCESSING

The following improvements have been made to the department's procedures for processing the highway condition data.

### Summaries of Deteriorated Sections

The department has streamlined the procedure for developing its "red flag" list (i.e., highway sections that are in deteriorated shape). An "English names" version of highway sections is being added to the file so that the data may be listed in verbal rather than coded form. This facilitates the process of looking up deteriorated sections and identifying their locations. In addition, coordinates are being added to the highway sufficiency file so that the locations of sections may be plotted. This plotting capability will allow visual map-type summaries of data to be provided directly to the regional offices.

### Processing and Modeling

The department's highway condition projection model (HCPM) (3) is a recently developed tool that allows the analysis of alternative rehabilitation strategies. A projection is made of a condition of a highway section under its jurisdiction, and it provides information on cracking, rutting, and patching are collected annually for each test and control section on the same highway. To develop the regression relationships between these detailed parameters and the overall scores, the analysis team has visually scored the same 121 sections annually.

### Paneling of Data

To ensure the accuracy of deterioration rates used in a variety of studies, the department has tightened its highway section measurement procedures. The result is that condition tracking of sections over time is now possible. Deterioration rates for highway sections over time from 1981, 1982, and 1983 highway condition surveys are given in Table 6.

### Table 6 Deterioration of Sections, 1982 to 1983

<table>
<thead>
<tr>
<th>Centerline Miles</th>
<th>Surface</th>
<th>Base</th>
<th>Combined</th>
<th>Avg</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>1,130</td>
<td>1,173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>1,173</td>
<td>1,173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>14,309</td>
<td>14,310</td>
<td>14,309</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Of the 15,750 centerline miles inventoried in 1983, the department was able to match and compare the 1982 condition on 14,309 miles (90.6 percent). (Unmatched sections generally result from added or realigned mileage and are generally in good-to-excellent shape.) The data in Table 6 indicate that, of these, about 988 miles were improved an average of 3.14 points, whereas about 9,500 miles remained unchanged (0 or +1 in score), 3,496 miles declined 1 point, and 325 miles deteriorated 2 or more points. The particular causes of this rapid deterioration are unknown, and the department is attempting to isolate the factors. Therefore, although the overall data suggest a stable mean condition, the underlying reality is inexorable but slow deterioration that will eventually result in even greater future costs.

### Applications by Other Groups

The highway condition ratings procedures described here have received considerable attention and interest from other groups. Current efforts to use the highway condition assessment process in other places are as follows.

1. **New York State Thruway**: The New York State Thruway Authority, which is responsible for the 587-mile-long Thruway, used this scoring process. Thruway personnel attended the training sessions and conducted a rating assessment of the Thruway in 1983.

2. **Albany area**: The metropolitan planning organization responsible for planning in the Albany metropolitan area used the rating process to evaluate the condition of Federal-Aid highways in the Albany area. They are also rating a sample of local roads, so that overall condition of different systems in different jurisdictional and functional classes can be compared on a consistent basis.

3. **Niagara County**: In the Buffalo metropolitan area a complete rating of county roads was undertaken in 1982 using the department's highway condition rating procedures. The data were processed by the Niagara County planning and engineering staff. Erie County (Buffalo City) is currently studying the use of the method for its needs.

4. **New York City**: New York City is planning to rate highway sections under its jurisdiction, and it is currently undergoing training by NYSDOT personnel in the use and application of the rating methods.
CONCLUSION AND DISCUSSION

The status of the department's highway condition rating efforts is reviewed. Great progress has been made in the past 3 years in improving the consistency, accuracy, and quality of the highway condition data collected by New York and in providing it to a variety of clients in rapid and relevant fashion. Virtually all aspects of the highway condition assessment and data processing effort have been reviewed and streamlined. The big effort, in terms of methodology development, is over, and the procedure is now moving into an implementation and "shake-out" phase in which refinements to the methodology are becoming more detailed and fewer changes are occurring from year to year. Overall, the department is pleased with the methodology, and is placing greater reliance on the results of the survey and on the analyses that are conducted from it.

No highway condition assessment procedure should be static. Issues, highway conditions, and concerns change. The procedure being developed by the department is flexible and is capable of undergoing change to meet evolving needs, while at the same time retaining consistency in data so that trends may be computed. A fully integrated and static data base is probably beyond the need of the department, but it can be reasonably well approximated by the application of consistent measurement principles and a tightened rating and data provision process. This is the goal that the department is working toward, and it is the goal to which the department believes it has made considerable progress.

REFERENCES


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Use of Pocket Computers for Rehabilitation of Rural Roads in Dominica

LOUIS BERGER and JACOB GREENSTEIN

ABSTRACT

A 50-km rural road that connects Roseau-Pont Casse and Hatton Garden in Dominica was evaluated by means of the Benkelman beam in February 1983. The rebound deflection basin obtained under a dual-wheel axle load was interpreted by means of a pocket computer with 8-K RAM. The subgrade modulus, subgrade California bearing ratio, base modulus, asphalt modulus, and the required asphalt concrete overlay were calculated for each point while performing the nondestructive testing (NDT) survey. Although measurement of deflection basins with the Benkelman beam is not common practice, satisfactory results were obtained. A team composed of the truck driver and his assistant, an experienced engineer and his assistant, and two traffic control men was able to measure 80 to 100 deflection basins, or about 10 km of road, in a typical working day. By using the pocket computer, all calculations, including the overlay thickness of each tested point, can be completed in about 1 min. Therefore, the road rehabilitation design can be completed while conducting the NDT. In Dominica both the NDT and the strengthening design of the 50-km road were done simultaneously and completed in 1 week. The detailed methodology and computer programs are presented in this paper. The program is based on the theory of linear elastic systems and written in BASIC language. It can be easily adjusted and implemented with other nondestructive pavement evaluation devices such as the road rater or the falling weight deflectometer.

In the evaluation process of pavement systems by means of nondestructive testing (NDT), the response of the pavement is observed and material properties can be back-calculated. Among the different responses of the pavement to load, the only practical measurements are elastic deflections. Two methods