they all agreed to implement all six programs by December 30, 1983.

These assignments and deadlines were put in writing so that their tasks and deadlines were clear. All six programs were written and implemented by the deadline of December 30, 1983.

At this point, we ran into a bit of a delay in that NYSDOT as a whole had not stood still concerning microcomputers. There was great interest in micros by other program areas and several different micros were being acquired by different programs. This forced our administrative staff, who have overall responsibility for computer support, to insist on a common operating system for micros to facilitate the exchange of computerized information. They decided on the MS/DOS operating system, which runs the IBM PC and several other makes. Up to that point all the committee's work had been based on the CP/M operating system.

Therefore, the committee had to convert the software they had developed and acquire hardware that could use the MS/DOS operating system. The committee decided to use a new microcomputer on the market, the Tandy TRS-80, Model 2000. This machine uses the required MS/DOS operating system and is a faster machine than the older Model 12. At the same time, it was decided to adopt a new printer, the Okidata Microline, Model 93P.

The committee modified their programs so they could be used with the Tandy TRS-80 and eight useful menu driven programs have been developed for direct application at residency level. Six more are being developed.

One example of a useful program is the payroll change program. Our payroll system is set up to print out the same checks to the same people unless it is instructed to change. The residency is responsible for initiating changes for their staff; this is a large, repetitious, and tedious task, especially in the winter when all of the blue-collar employees are earning overtime on snow and ice control. It was common for residency clerks to spend 15 man-hours per biweekly pay period on this task. With the micro, this work is reduced to 1 man-hour. We feel this one program application will pay back the cost of the hardware in a year.

The committee's work showed that micros can be used successfully at the residency level, so successfully, that once installed, they become almost indispensable. Consequently, we plan to install micros in 38 residencies this year and the remainder in 1985.

In summary, we have been successful by following the procedure of defining possible applications, finding software that should do the job, and then matching hardware to the software.

We were also successful because the users developed the programs to meet their needs; nothing was imposed from above. We were fortunate in having intelligent, technically trained, enthusiastic users, who had the capability of effectively putting micros to work.

In closing, I would like to give credit to the members of the committee. They are David Palma, Saratoga residency; Richard Bassler, Cortland residency; Fred Ames, Steuben-Chemung residency; Chet Moody, Cattaraugus residency; Albert Dicesare, Niagara residency; and William Dixon, main office.

Merging Construction and Maintenance Activities in South Dakota

WILLIAM M. GERE

South Dakota is responsible for maintaining some 18,500 single-lane miles of highway and administering the activities of contractors on an average of 250 construction projects annually.

In the fall of 1980 because of continued pressure to reduce the number of department employees, it became obvious that we were going to have to reorganize to provide adequately staffed and trained construction inspection and maintenance crews to handle the work assignments.

We reviewed the last 8 to 10 years of our maintenance activities and determined that we were adequately staffed in the rural areas at the rate of 20 two-lane miles per maintenance worker including a foreman and 15 two-lane miles per worker in urban areas. The construction inspection and engineering staff need was being planned by a construction engineering management system that had been initiated in 1979 and a 5-year construction program that we were reasonably comfortable with.

The South Dakota Department of Highways was established in the late 1930s. It was organized into five districts with a district engineer in charge of each district, and the mileage assignment among the districts was reasonably equitable. In 1974 the South Dakota Department of Transportation was created.

As a general rule the maintenance work was assigned on a county basis with at least one maintenance crew with a foreman in charge in each county. In some of the more densely populated counties with a greater number of miles of road there were two or three maintenance crews.

Construction engineering and inspection was assigned to an individual identified as the resident engineer with a crew of professionals and subprofessionals varying in number depending on the amount of work. In the early 1950s we had 30 to 35 of these residencies looking after construction work and 90 to 100 maintenance crews. With the advent of Inter-
In 1961 the district engineer in concert with the central office management decided that there was a need for another level of supervision in the field headquarters office; this was provided by appointing two assistant district engineers, one in charge of construction and the other in charge of maintenance. This was our organization until 1980. An increasing awareness that construction activities would have to be curtailed because of dollar inflation made it necessary for us to assess the efficiency of the existing organization. A full-time equivalent ceiling, imposed by the budget, required a change that would allow placement of construction or maintenance personnel at a project site.

We started at the top in the central office merging functions and reassigning supervision. The central office had four regions with four regions of four field districts each, and the field districts were organized into three areas and the other four districts still operating with one of the five districts organized into three areas with an area engineer, who is responsible directly to the region manager for administering the construction and the other in charge of maintenance. Along with the personnel from the former maintenance and construction offices, other personnel from property management, traffic operations, billboard control, labor compliance, utility, and railroad operations were transferred into this office. The result was that the total department staff was reduced by 10 to 12 full-time employees.

At this time we transferred some of the responsibility that had been in the construction office to the field offices (e.g., construction change orders, price adjustments, and claims). District engineers (later region managers) were given the responsibility for administering these requests without central office approval. Some apprehension went along with this reassignment of responsibility but after 3 years of operating in this fashion it is working satisfactorily.

A vacant assistant district engineer position was created in making the changes. Instead of appointing someone to fill that position, we looked at some of the other states and decided that a far more economical benefit in trying to operate maintenance crews responsible for fewer than 100 two-lane miles. Units were closed as personnel retired and equipment wore out. By 1983 14 units remained in the elimination plan. The July 1, 1983, reorganization addressed this plan immediately. Notice was sent to each unit with a limited mileage responsibility that it was being closed and its responsibility transferred to neighboring units. This was done with some amount of complaint from local communities and some objection on the part of the maintenance workers; however, the closures were accomplished by year end and the surplus property and equipment was disposed of.

The construction engineering stations that were not located at the 12 area headquarters were also put on a list for elimination. There are 10 of these engineering stations, 4 of which will be closed by January 1985. The others are scheduled for closing as the construction work in their area is completed or at least reduced. With the current construction program and assuming that increased funding will continue, it appears that it will be near the end of the decade before these engineering stations are closed.

On July 1, 1984, the department will have a field staff of 930 people (down from 1,100 in 1969). This includes the four region headquarters and their administrative and operations staff, the 12 areas with their construction engineering crews, and 75 maintenance units. The maintenance units were organized into crews of from 5 to 10 people charged with the responsibility of looking after from 100 to 200 two-lane miles of highway.

With the reduced staff of field personnel and a highway system that requires as much if not more maintenance attention than when the staff was larger and an increasing construction program, the department found itself in a bind. There were two obvious courses of action: (a) Some of the maintenance work
A Maintenance Management System for Road Markings

PER SIMONSEN

The Danish Road Directorate has recently issued provisional specifications for marking traffic lanes of main roads beginning in 1984. Simultaneously recommendations on materials for, and maintenance of, marking were issued. Specifications and maintenance strategy are based exclusively on the functional requirements of the markings. It is to be expected that the introduction of the recommendations will result in a higher standard of marking and thus contribute to increased road safety.

GENERAL SPECIFICATIONS FOR MATERIALS AND EXECUTION

Marking performed by contractors is required to meet a number of conditions [referred to in Denmark as the AAB (1,2)] before delivery and before the expiration of the guarantee period. These fall into three general categories: (a) optical properties, (b) skid resistance, and (c) durability. The required minimum values are stated in Table 1.

Optical Properties

A recently developed reflectoscope (i.e., a small box with white opal glass plates) is used for measuring optical properties (see Figure 1). The measurement is made by comparing the road line with a number of filters placed in front of the opal glass plate.

For unlighted roads, the reflection of the road marking in the dark, which is indicated by the specific luminance (SL), is determined in the light of the main beams of the headlights of an automobile. The reflectoscope is placed behind the road marking with the measuring face turned toward the spot of observation, which is chosen to be about 50 m in front of the reflectoscope at a height of 1.2 to 1.5 m above the carriageway (see Figure 2). The reflection is determined by comparing the road marking with the different reference surfaces.

For lighted roads and in daylight the reflection properties of the carriageway markings are deter-

<table>
<thead>
<tr>
<th>Time</th>
<th>Mean Luminance Coefficient, ( Q_0 ) (cd/m²/lx)</th>
<th>Specific Luminance, SL (cd/m²/lx)</th>
<th>Skid Resistance (srt) (% of area)</th>
<th>Maximum Wearing (%)</th>
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</thead>
<tbody>
<tr>
<td>At delivery</td>
<td>0.16</td>
<td>0.16</td>
<td>55</td>
<td>0</td>
</tr>
<tr>
<td>Expiration of guarantee period</td>
<td>0.13</td>
<td>0.13</td>
<td>55</td>
<td>30</td>
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