Highway Maintenance Service Levels

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This report is concerned with maintenance quality levels now being introduced on highways throughout the province of Ontario. The quality standards discussed have resulted from a maintenance management study being undertaken at the Department of Highways, Ontario. The methods of formulating and distributing the standards are given, together with a brief outline of some of the procedures adopted for the training of the maintenance staff.

THE maintenance management study currently in progress in Ontario is basically an attempt to view maintenance operations objectively and provide managers at all organizational levels with factual data on which decisions can be based. A maintenance management system is being developed, based on the fundamental responsibility of management in planning, organizing, directing, and controlling. Major components of this system are the establishing of levels of service and standards of performance, defining workloads, training of personnel, and reporting of results achieved. The first step in the development of the management system was to set the level of service to be provided by field maintenance personnel by establishing quality standards. These are a quantitative guide to operating personnel and stand as a permanent statement of policy that can be referred to at any time. This paper describes a formalized procedure which has been devised for the development of maintenance quality standards.

THE QUALITY STANDARD

For maintenance purposes, highways are usually divided into a number of administrative units of decreasing size. Thus, the central office will usually have direct control over a number of district or regional offices, each of which will control a number of smaller units. The organizational structure of the Department of Highways, Ontario, is shown in Figure 1. Because at the field or working level there may be several hundred independent work gangs, it is necessary, if control is to be exercised and planning made possible, to insure that each management unit performs like tasks in a similar fashion to produce a similar end product.

Highway maintenance can be compared to a factory production line. Highway maintenance involves mobile work crews operating on a fixed line, whereas on a production line the work units normally remain at a fixed location and the line goes past. The end result, however, should be a product of uniform quality or, in the case of mixed production, products (different classes of highway) conforming to predetermined quality levels. It is necessary therefore to establish the quality or level of service required as a head office policy so that all units in the organization work toward the same end. Quality standards also affect work quantity and may indirectly affect productivity levels. Therefore, setting quality standards forms one vital part of the task of management.

FORMULATING THE MAINTENANCE QUALITY STANDARD

Prior to the preparation of quality standards the Department issued a maintenance manual to field personnel. Although the manual adequately covered most maintenance
activities it was formulated by field engineers and was not readily understood by operating personnel.

A panel was appointed to formulate quality standards. The personnel assigned to the panel were experienced field supervisors and engineers. The reasons for this were twofold: first, experienced field personnel insure a practical application of a level of service, and second, standards are more likely to be generally accepted by field supervisors if it is known that experienced field managers produced them.

Standards in draft form were first prepared by head office personnel as a starting point. Subsequent reviews by the panel revealed a wide divergence of opinion on the level of service expected. Reasonable allowable tolerances were set as well as the action to be undertaken when conditions departing from the standards are observed.

Subjective terms such as "pleasing to the eye" and "appropriate height" are not used, since they are open to individual interpretation. An example of a quality standard for guide rail maintenance is given in Appendix A. When it is felt that a standard is in a near-final form it is distributed to a number of random field units. These units review the standard and are interviewed to insure understanding and to further confirm (or deny) the practicability of the documents. These standards must be written in a form that is readily understood by the personnel who have to use them.

In producing quality standards, it is apparent that different service levels will be required for different highways. For example, it is reasonable to expect that a higher level of service will be maintained on a major expressway than on a rural secondary highway. Although these different service levels exist now, a quality standard sets them down in terms. A typical example of difference in quality level applicable to four classes of road is as follows:
2. Description

2.1 BARE PAVEMENT—Under this level of service, every effort shall be made to maintain the pavement in a bare condition at all times through the continuous use of all assigned men, equipment, and materials suited to the conditions.

2.1.1 Two highway classifications fall within this level of service:

Class I—Bare pavement level of service applying to all hard-surfaced highways having a winter ADT (average daily traffic) in excess of 1,500 in southern Ontario and 1,200 in northern Ontario.

Class II—Bare pavement level of service applying to all highways having a winter ADT in the range of 500 to 1,500 in southern Ontario and between 400 and 1,200 in northern Ontario.

Note: The distinction between class I bare pavement and class II bare pavement levels of service is that under class I, every effort shall be made to ensure that the accumulation of snow on the road surface at any time shall not exceed 1 in.; under class II, the allowable accumulation is $1\frac{1}{2}$ in.

2.2 CENTER BARE—Under this level of service, the attempt shall be made to bare at least the center 6 to 8 ft of pavement within 24 hours of the end of the storm by the continuous use of all assigned men, equipment, and materials suited to the conditions.

Note: When favorable weather prevails, the pavement should be bared for the full width.

2.2.1 The level of service applies to all highways having a winter ADT in the range of 250 to 500 in southern Ontario and from 200 to 400 in northern Ontario.

2.3 SNOWPACKED—Under this level of service the attempt shall be made to maintain the road surface in a snowpacked condition—or better if paved—by the use of assigned men, equipment, and materials suited to the conditions.

Note: On snowpacked gravel roads, raw chemicals shall not be used for snow and ice control.

2.3.1 This level of service applies to all highways having a winter ADT of less than 250 in southern Ontario and less than 200 in northern Ontario.

DISTRIBUTION OF A STANDARD

Various procedures were attempted in the distribution of standards. After the initial distribution, interviews with the field manager responsible for a specific section of the highway system revealed that in a number of cases the desired level of understanding had not been achieved and in other instances the standard had not even been read.

A new procedure was developed which, it was felt, would overcome these problems. Head office personnel who were thoroughly familiar with a specific standard held regional meetings with small groups of district supervisors. These small groups discussed the individual standards in detail. The district supervisors attending these meetings then held similar discussions with patrol supervisors who supervise four to six patrolmen. These patrol supervisors, in turn, had the responsibility for assuring that the individual patrolmen were fully informed of the standards.

A further refinement to the distribution procedures was made to eliminate the necessity for the initial discussion between head office and district personnel. Each district maintenance engineer receives standards as they are issued and then meets with his maintenance supervisor and patrol supervisors to examine and discuss the standard in detail. The patrol supervisors hold similar meetings with patrolmen under their jurisdiction.

FEEDBACK

Shortly after these meetings, a post-training test is presented to each patrolman. No restriction is placed on the use of the appropriate quality standard as a reference.
The test is designed to emphasize the key points of the standard and to amplify critical areas.

After completion of the test questionnaire, each patrolman is required to compare his answers with those on an answer sheet given to him by the patrol supervisor. He then corrects any wrong answers and discusses any points of misunderstanding with his patrol supervisor. The completed questionnaires are examined by the district maintenance engineer to insure that all of his patrolmen have completed the training. The questionnaires are then forwarded to the head office for analysis by the training group. Each patrolman inserts the answer sheet, which is identical to the questionnaire, in his quality standards manual for future reference. An example of the questionnaire for cable guide rail is given in Appendix B.

A detailed study of the completed questionnaires should indicate any part of a standard which requires clarification or modification. This type of feedback will insure the desired understanding with the result that realistic levels of service will be provided to the field forces.

MAINTAINING THE REQUIRED SERVICE LEVEL

The entire process is flexible so that there is always room for change. Revisions to a standard are easily made and disseminated to the field staff in a form which is readily understood.

This approach currently used in the preparation of a specific standard, the procedure followed in distribution, the post-testing of field personnel, and subsequent analysis of the results should insure that the objective of providing simple statements of policy to field forces will be met.

To insure that the required service levels are maintained, the department is training personnel and issuing operating instructions which will provide a step-by-step description of the best method of performing an activity. A reporting system is being devised which will require the full reporting of the actual level of accomplishment attained.

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**Appendix A**

TYPICAL EXAMPLE OF A QUALITY STANDARD

(sample pages follow)
1. **DESCRIPTION**

1.1 Cable Guide Rails consist of single rows of wooden posts supporting a single or double cable. They define the location of hazardous curves and high fills.

![Photo of correctly installed guide rails.](image)

These photos are examples of correctly installed guide rails.

2. **INSTALLATION, REMOVAL OR RECONSTRUCTION**

2.1 New installations, permanent removal or complete reconstruction of any section of Cable Guide Rail shall not be undertaken without the approval of the District Engineer.

2.2 All installations of Cable Guide Rails approved by the District Engineer shall be constructed in accordance with Department of Highways Standard DD-902 (attached).

![Photo of another installation.](image)

Note that tops of posts are not cut to the proper angle. See Std. DD-902.
3. INSPECTION AND REPAIR

3.1 All Cable Guide Rails shall be carefully inspected each Spring for the following defects; remedial action shall be taken by the Patrolman as required:

3.1.1 Check that supporting posts are not out of plumb by more than 3 inches in 3 feet. Realign if required.

3.1.2 Check that the post height above the ground-line is not less than 27 inches. Re-install or replace, if required.

3.1.3 Check that all cables are from 24 inches to 27 inches above the ground-line and are properly secured to the guide-posts with 6 inch spikes or 3 inch staples. Effect Repairs, as required.

3.1.4 Check that the tops of the posts are not out of alignment with the general line of the Guide Rail by more than 3 inches. Realign if required.
3.1.5  Check that all posts are sound and set solidly in the ground. Damaged or missing posts shall be replaced as soon as possible with permanent wooden posts or with temporary steel posts and delineators. Permanent repairs, including painting, shall be made as soon as weather and ground conditions permit.

Above photo shows remedial action to be taken if posts are damaged by accident.

3.1.6  Check that cables are not frayed or badly rusted. Replace if necessary.

3.1.7  Check that all cables are tight and secure. Tighten if necessary so that no cable sag is visible.

Above photo shows guide rail not meeting Standards 3.1.4, 3.1.6 and 3.1.7. Note tops of posts are of varying heights, and are not chamfered or cut to the proper angle.
3.1.8 Check that all reflective strips are clean and in good condition. Check that the location and position of the strips conforms to the requirements of Standard DD-902. Replace defective strips in accordance with Standard DD-902.

Does not meet Standard 3.1.8. Reflective strips are in wrong position. Note also that a double intermediate brace panel is missing. See Standard DD-902.

3.1.9 Check Guide Rail for gravel windrow. Remove windrow if present.

Note the result of leaving a gravel windrow. Washouts such as this can be avoided by removal of any windrow caused by grading of shoulders.
3.1.10 Check sections of Guide Rail that may need painting. If more than one-quarter of the Guide Rail paint is missing, it shall be completely repainted according to paragraph 4.1.

Does not meet Standard 3.1.10. Note also that cable is loose and tops of posts not at a uniform height.

4. **PAINTING**

4.1 Guide Rail posts shall be thoroughly clean and dry before painting. (Do not clean unless posts are to be painted within two weeks.)

4.1.1 All Guide Rail posts shall be painted with white paint. Central Stores Code No. 16-2-21-1. (Exception: Q.E.W.)

4.1.2 Paint each post down to the ground line. Reflective strips and cables shall not be removed or painted.

A freshly painted post that was not painted to the ground-line Standard 4.1.2.
Does not meet Standards:

3.1.5 - damaged posts
3.1.7 - cable not secure or tight
3.1.8 - reflective strip missing
3.1.9 - gravel windrow present
3.1.10 - posts need painting

5. DAMAGE TO CABLE GUIDE RAILS

5.1 The Patrolman shall report all damage to Guide Rails to the District Office. He shall also check with the local O. P. P. Detachment for details for the person(s) responsible for the damage and report this information to the District Office immediately on the appropriate form.

Guide Rail damage by an accident. Temporary repairs performed, missing posts to be installed as soon as conditions permit.
Appendix B

MAINTENANCE STANDARD QUESTIONNAIRE

1. Guide rail is checked visually every day as part of the routine road patrol. Guide rail is also checked thoroughly at a set time during the year. This is an on the ground, post by post, type of inspection.

Which of the following is correct?

This thorough inspection is carried out: -

- Every other day
- Once a year, in the spring [✓]
- Once a year, in the fall
- Twice a year, in the spring and fall
- Once a year, in the winter
- In the morning, on pay day
- The first working day of each month
- Twice each summer

2. Using the Quality Standard as a guide, list the things that should be checked during this major inspection. Use your own words. Add anything you think should be checked that is not shown in the Quality Standard. If more space is required, use the back page.

Check that posts are not out of plumb.
Check that posts are at least 27 in. high (above ground).
Check that cable is from 24 in. to 27 in. high (above ground).
Check that posts are not out of alignment.
Check that posts are undamaged and are solidly set in the ground.
Check that cable is tight.
Check reflectorized strips for location and condition.
Check for gravel, weeds.
Check to see if posts require painting.
3. In the following illustrations, the posts marked A and B require correction.

Mark which of the following answers are correct. If you do not know the answer, please do not guess:

- A is out of plumb  
- A is out of alignment
- B is out of plumb  
- B is out of alignment

4. Mark the following questions True or False:

- Reflectorized strips and cables should be removed from the posts before painting  
- Posts should be painted white right down to the ground  
- Posts should be at least 27" above the ground in height  
- Posts should be painted when more than 1/4 of the old paint has peeled or worn off  
- Temporary repairs should be made to damaged guide rail when permanent repairs cannot be made immediately  
- It is not necessary to clean a post before painting unless the post is obviously dirty  
- For 2 lane highways, the reflectorized strips on guide rail posts should be 15" by 4" in size
5. Besides making immediate repairs, what other action should be taken when guide rail is damaged by an accident.

(i) Report damage to District Office

(ii) Check with Ontario Provincial Police for details, particularly name and address of person responsible for damage.

6. Mark the following questions True or False.

The District Office must be notified:

- Before any work is done on guide rail: False
- Before new guide rail is installed: True
- Before any emergency work is done on guide rail: False
- After guide rail is damaged in an accident: True
- Before sections of guide rail are removed: True
- Before guide rail posts are painted: False
- Before any major re-construction of guide rail: True
7. Repairs to guide rail can be separated into two groups:

(i) Routine
(ii) Urgent

Urgent repairs should be carried out as soon as time and weather permit. Routine repairs should be scheduled throughout the season to take best advantage of staff and equipment.

On the following chart, check those items which you think are Routine and those which you think are Urgent.

<table>
<thead>
<tr>
<th>Item</th>
<th>Routine</th>
<th>Urgent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tighten loose cable</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Paint posts</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Replace broken posts</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Replace destroyed reflectorized strips</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Remove windrow</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Re-align posts</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Replace broken cable</td>
<td></td>
<td>✔️</td>
</tr>
</tbody>
</table>

8. What is Department of Highways Standard DD-902?

**DD-902 is the construction standard for post and cable guide rail.**

What is Department of Highways Standard M-606-1?

**M-606-1 is the maintenance quality standard for post and cable guide rail.**