A Method for Rating Unsurfaced Roads

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A method for rating the surface condition and drainage of unpaved roads has been developed, and a field manual has been prepared to assist county, municipal, military, and township highway agencies in managing the maintenance of such roads. Types of distress found in unpaved roads are categorized and listed in the manual. For each type of distress listed there is a description of the type and the level of severity, an illustration, and a measurement method. The manual also includes instructions on how to inspect unsurfaced road conditions, a field inspection worksheet, and a family of deduct-value curves for the distress types and associated severity levels. The curves were validated using data gathered during seven field surveys throughout the United States. The surface and drainage rating method and maintenance management strategies can be used alone, or they can be adapted for use with any existing computerized pavement management system (PMS). The rating method and strategies are compatible with the PAVER PMS developed by the U.S. Army Corps of Engineers and the American Public Works Association. With appropriate software modifications, an unsurfaced roads component of the PAVER PMS will be available for use to provide local highway agencies with a more comprehensive roadway management system.

About two-thirds of the highway systems in the United States and 90 percent of all roads worldwide are unsurfaced or lightly surfaced low-volume roads. No single, recognized management system is being used to effectively maintain these roads. The U.S. Army Corps of Engineers, the American Public Works Association, and others have developed pavement management systems (PMSs) for use on paved roads. These PMSs cannot currently be used for unsurfaced roads. An unsurfaced road component that can stand alone or be used with any of these PMSs would provide local highway agencies with a comprehensive roadway management system that would be more suitable for their needs.

The research effort to develop a method for rating and managing the maintenance of unsurfaced roads has been divided into three phases: Phase I, field manual development; Phase II, field validation and deduct-value model development; and Phase III, method implementation and development of PMS software-compatible packages. Only Phases I and II are addressed in this paper.

Phase I consisted of the development of a field manual for rating the condition of unsurfaced low-volume roads. Maintenance management practices employed by townships, the military, and municipal, county, and state governments were used to develop this rating system. The effort also focused on reviewing past and current maintenance practices, and identifying and conducting field surveys of unsurfaced road distress types.

Phase II consisted of a series of field surveys that were directed at validating the field manual. These surveys provided the information required to define and describe the distress types and their associated severity levels. In addition the surveys provided the data needed to develop the deduct-values associated with each distress and severity level. This phase was conducted through the cooperative efforts of the Federal Highway Administration (FHWA); U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory, Construction Engineering Research Laboratory, and Waterways Experiment Station; U.S. Army Forces Command; U.S. Army Training Command; U.S. Army Facilities Engineering Support Agency; U.S. Army Engineer District, Tulsa; Town of Hanover, New Hampshire; State of New Hampshire Department of Transportation; Hardin County, Kentucky; Long County, Georgia; Ft. Knox, Kentucky; Ft. Stewart, Georgia; Ft. Chaffee, Arkansas; Ft. Irwin, California; Ft. Lewis, Washington; and State of Alaska Department of Transportation. The CRREL Special Report "Unsurfaced Road Distress Measurement Field Manual" provides more detail about Phase I.

PROJECT BACKGROUND

The Phase I development of the unsurfaced roads field condition rating method and manual was funded through the FHWA Rural Technical Assistance Progam (RTAP). The research study work has been conducted as "RTAP Project No. 29: Revising the PAVER Pavement Management System for Use on Unpaved Roads." A concise description of the RTAP program and how the study originated follows.

The U.S. Congress appropriated funding for RTAP beginning in 1982. The program is focused on roads, bridges, and public transportation in rural areas. It is mainly aimed toward county, municipal, and local agency personnel. Under the program, several RTAP centers were established, primarily at institutions of higher learning. Through these centers, local agency training is completed and transfer of new technology by various other means is also accomplished.

The PAVER PMS was developed by an unsurfaced roads component of the U.S. Army Corps of Engineers (COE) and the American Public Works Association (APWA). It was suggested to FHWA by the Vermont Local Roads Program (VLRP), which is the RTAP center at St. Michael's College in Winooski, Vermont. The VLRP RTAP center had been assisting local agencies with implementation of the COE-APWA PAVER PMS, and found that it, as well as others, did not include provisions for unpaved roads. Several local agencies indicated that having an unpaved roads component in the PAVER system would be helpful because this category of roads constitutes a major portion of the roadway system they were responsible for maintaining. They also agreed to work on a

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project to develop this component. Based on the VLRP suggestion and evidence of local agency need and support for such a project, the Phase I effort to develop a method and manual for rating the field condition of unpaved roads was initiated in cooperation with the COE. To ensure compatibility of the developed method and manual with the COE-APWA PAVER PMS, the COE Construction Engineering Research Laboratory (CERL), which originally developed the PAVER system, was also asked to participate in the study. A prototype rating method and manual were developed, and the need to validate them under actual field conditions was recognized.

As a result of the Phase I study, the Phase II field validation effort was approved and initiated. The Phase II work was jointly funded through an extension of RTAP Project No. 29 and by contributions from several U.S. Army agencies. An executive steering committee was formed by the principal funding agencies to coordinate the work activities in Phase II. This committee included representatives from the U.S. Army's Facilities Engineering Support Agency, Forces Command, Office of the Chief of Engineers, Training Command, and Corps of Engineers research laboratories (CERL, CRREL, and WES), and the Federal Highway Administration. A representative of the Vermont Local Roads Program, RTAP Center, was also a liaison member. The actual field validation was performed at military installations and nearby areas. The selected sites represented the varying unpaved road soil and surface aggregate conditions, environmental conditions, and degrees of maintenance provided. The sites were located in Kentucky, Georgia, Oklahoma, Arkansas, New Hampshire, Vermont, California, Washington, and Alaska. Field condition rating panels consisting of representatives of the military installations and local areas have used the Phase I prototype method and manual to ensure that the unpaved road distress types, severity levels, and deduct-value curves are accurate and repeatable. A final field manual, including final curves, is being published as the CRREL Special Report mentioned earlier. The COE Army Technical Manual 5-623, *Pavement Maintenance Management*, published in 1982, will be modified to include unsurfaced roads.

STATEMENTS AND DEFINITIONS

The following are the statements and definitions used in the development of the manual:

- *Pavement Management*: Differences exist between paved roads and unpaved or gravel roads. This is primarily because of the short life span of gravel roads compared to paved roads. Long-term planning for a paved road would be 5 to 15 years, whereas for a gravel road it would be 1 to 2 years.
- *Unsurfaced Road Management*: An unsurfaced road is any road that does not have Portland cement concrete, asphalt concrete, or any other surface treatment. The normal maintenance of unsurfaced roads consists of blading with a road grader. Unsurfaced road management is based on a dynamic situation in which road conditions change significantly between one grading or blading and the next. Blading or grading should be conducted three or four times a year, and planning or scheduling should be done on an annual basis.
- *Distress*: Distress signifies any undesirable condition of an unsurfaced road. Use of this term maintains compatibility with PAVER.
- *Roughness*: This term refers to the ride quality of an unsurfaced road.
- *Unsurfaced Road Condition Index (URCI)*: This index is a numerical indicator, based on a scale of 0 to 100, that measures the road's operational condition; it corresponds to the PCI (pavement condition index) in the PAVER management system.
- *Inspection*: As used in this manual, "windshield" inspections consist of driving the full length of an unsurfaced road at 25 mph (the speed may be higher or lower depending on road conditions or local practice) in a pickup truck to determine the overall surface and drainage conditions four times a year (once each season). Relative surface condition ratings and drainage problems can be noted for all unsurfaced roads within the military installation, town, county, or city limits. General estimates of maintenance needs and priorities can be made from this initial inspection.
- *Measurements*: Measurements are the collection of detailed data on the roadway's surface and drainage conditions by highway personnel. After the initial inspection ride, a representative 100-ft section of road is selected in which actual measurements of distresses are taken. The measurements are needed to develop the numbers for the URCI. The section should be permanently marked so that future measurements will be taken in exactly the same location.
- *Deduct-Values*: As used in PAVER, the deduct-value is a number from 0 to 100, in which 0 indicates that a particular distress has no impact on road conditions, and 100 indicates an extremely serious distress that causes the road to fail. Deduct-values for each distress and severity level are presented in this paper.
- *Delphi Panel*: A Delphi panel is a group of experts on a subject who are brought together to discuss and document an area of concern.

FIELD MANUAL DEVELOPMENT

The field condition rating manual was developed by accomplishing the following tasks:

- Conducting an extensive literature search on the design, construction, operation, and maintenance of unsurfaced roads;
- Convening a series of workshops using the Delphi panel technique, in which the panel is predominantly composed of unsurfaced road experts from New England;
- Conducting discussions with local, state, federal, and university personnel; and
- Conducting a number of on-site field trips to survey unsurfaced road distress problems, how these problems manifest themselves, and what maintenance strategies are used to combat them.

First, an extensive review was conducted of available published information on operations and maintenance practices, maintenance management systems, construction and design, and traffic volumes and loads of unsurfaced low-volume roads. The literature search included a thorough review of documents, reports, manuals, and fact sheets prepared by a wide spectrum of organizations, including the Transportation Research Board, the Federal Highway Administration, the U.S. Department of Agriculture Forest Service, the U.S. Army Corps of Engineers

Construction Engineering Research Laboratory, the New Hampshire Department of Transportation, the U.S. Army Facilities Engineering Support Agency, the American Public Works Association, and the Vermont Local Roads Program. These documents provided a good background for the Delphi panel workshops and ensured that the rating and maintenance management system developed for unsurfaced roads was compatible with existing methods, procedures, and systems. Based on this review, it became apparent that this effort was not duplicating previous or ongoing efforts, and that it was worthwhile.

Three Delphi panel workshops were held with New Hampshire and Vermont local and state highway agency personnel. The purpose of the workshops was to prepare a preliminary draft of the distress rating and identification manual to be used in the Phase II field validation work. The Delphi technical panel accomplished this task, and the results of its efforts were documented in an interim, unpublished project report. In addition, the panel brought up and discussed many other topics related to construction, operation, and maintenance of unsurfaced roads. These three workshops provided the major contributions to the manual. They provided the background information on how unsurfaced roads are currently being maintained; identified and categorized the unsurfaced road distresses; identified some economic, political, and social problems; and outlined the information that should be in the manual.

Another major goal of the workshops was to present the information so that it could be readily understood by highway personnel and help them maintain their roads and conduct their budget reviews.

UNSURFACED ROAD DISTRESSES

The Phase I field manual identified six unsurfaced road distresses and two drainage-related distresses, each with a separate index. As a result of the Phase II field validation, the manual was modified by combining the two indices so that it currently lists the following seven distresses:

- Improper cross-section,
- Roadside drainage,
- Corrugations,
- Dust,
- Potholes,
- Rutting, and
- Loose aggregate.

Each of the following sections is structured to provide a description of the type of distress, definitions of its severity levels, and instructions on how to measure both the distress and its severity level. The accompanying figures depict the deduct-curves for each of the seven distresses.

Improper Cross-Section

Description

Improper cross-section is the result of the road surface not being properly shaped or maintained to carry water to the ditches. This condition is evidenced by water ponding on the road surface, water draining or running along the road surface, lack of a crown on the road, or road surface erosion caused by water runoff.

Severity Levels

L—Small amounts or evidence of ponding water on the road surface or a completely flat road surface (no cross-slope), or both.
M—Moderate amounts or evidence of ponding water on the road surface or a bowl-shaped road surface, or both.
H—Large amounts or evidence of ponding water on the road surface or severe depressions in the wheel paths on the road surface, or both.

Measurement

Improper cross-section is measured in linear ft per 100-ft section from outside shoulder break to outside shoulder break. Different severity levels can exist within the 100-ft sample unit. A maximum of 100 linear ft can be measured.

The deduct-values are shown in Figure 1.

Roadside Drainage

Description

Poor drainage causes water to pond. Drainage problems occur when ditches and culverts are not in the proper condition to adequately direct and carry runoff water. This condition is evidenced by overgrown or debris-filled ditches, ditches that have not been properly shaped or maintained, water running across or down the road, and areas in which the ditches have begun to erode into the roadway.

Severity Levels

L—Small amounts of:
- Ponding water or evidence of ponding water in ditch, and
- Overgrowth or debris in ditch.

M—Moderate amounts of:
- Ponding water or evidence of ponding water in ditch,
- Overgrowth and debris in ditch, and
- Evidence of erosion of ditch into shoulder or roadway.

H—Large amounts of:
- Ponding water or evidence of ponding water in ditch,
- Water running across or down road,
- Overgrowth and debris in ditch, and
- Erosion of ditch into shoulder or roadway.

Measurement

Drainage problems are measured in linear ft per 100-ft section parallel to the road centerline, from the outside shoulder break perpendicular to and away from the road. It is possible to have a maximum of 200 linear ft of roadside drainage distress.

The deduct-values are shown in Figure 2.

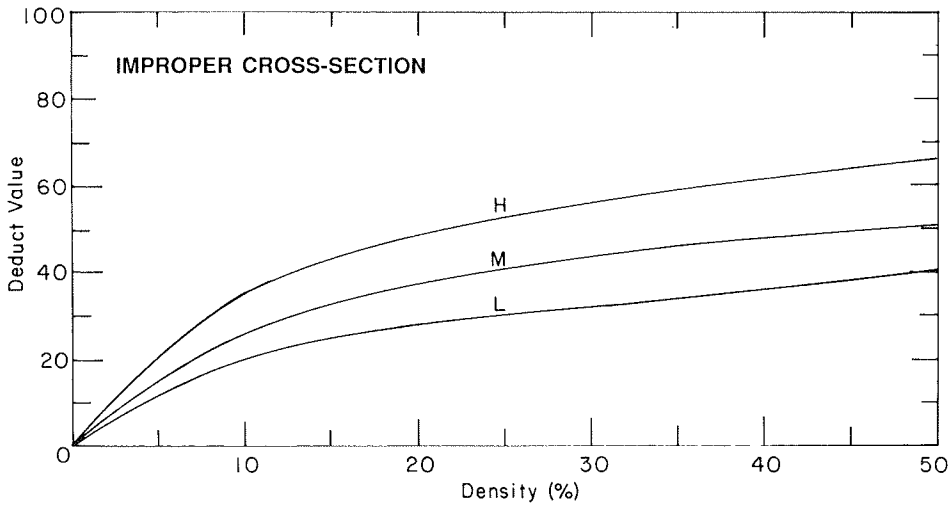


FIGURE 1 Deduct-value curves for improper cross-section.

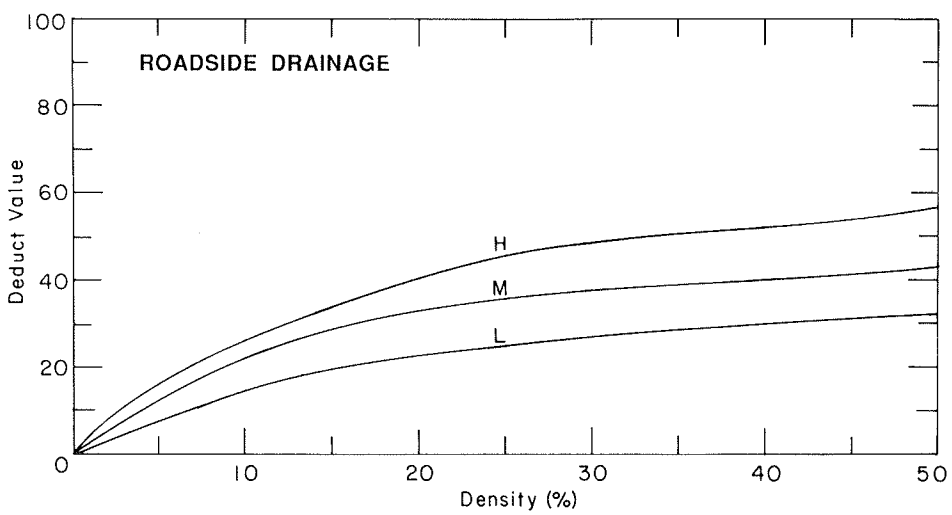


FIGURE 2 Deduct-value curves for roadside drainage.

Corrugations

Description

Corrugation, also known as washboarding, is a series of closely spaced ridges and valleys or ripples that occur at fairly regular intervals. The ridges are perpendicular to the traffic direction. This type of distress is usually caused by traffic action and loose aggregate. These ridges usually form on grades or curves, in areas of acceleration or deceleration, or in areas in which the road is soft or potholed.

Severity Levels

L—Corrugations less than 1 in deep or low-severity roughness, or both.
M—Corrugations 1 to 3 in deep or medium-severity roughness, or both.
H—Corrugations deeper than 3 in or high-severity roughness, or both.

Measurement

Corrugation is measured in square feet of surface area per 100-ft-long section. It must not exceed the total area of the 100-ft-long section.

The deduct-values are shown in Figure 3.

Dust

Description

The abrasive action of traffic on unsurfaced roads eventually loosens the larger aggregate particles from the soil binder. As traffic passes, dust clouds create a danger to trailing or passing vehicles and cause significant environmental problems.

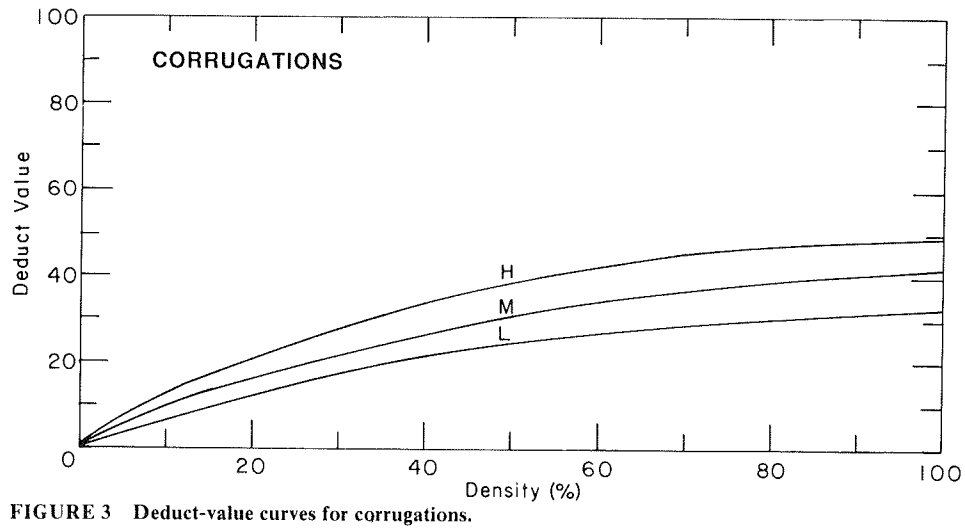


FIGURE 3 Deduct-value curves for corrugations.

Severity Levels

Normal traffic produces the following levels of severity:

L—Thin dust that does not obstruct visibility,
M—A moderately thick cloud that partially obstructs visibility and causes traffic to slow down, or
H—A very thick cloud that severely obstructs visibility and causes traffic to significantly slow down or stop.

Measurement

Dust is measured by driving a vehicle at 25 mph and observing the dust cloud; the dust is estimated to be thin, moderately thick, or very thick.

Dust is not rated by density. The severity of the distress is determined by the size of the dust cloud generated by traffic and the reduction in visibility caused by the dust.

The deduct-values for the levels of severity are as follows:

Low	2 points
Medium	5 points
High	15 points

Potholes

Description

Potholes are small, bowl-shaped depressions in the road surface that are usually less than 3 ft in diameter. Their growth is accelerated by free moisture collection inside the hole. Potholes are produced when traffic abrades small pieces of the road surface. The road then continues to disintegrate because of loosening surface material or weak spots in the base or subgrade.

Severity Levels

The levels of severity for potholes under 3 ft in diameter are based on both the diameter and the depth of the pothole according to the following table:

	Average Diameter			
Maximum Depth	*< 1 ft*	*1-2 ft*	*2-3 ft*	*> 3 ft*
1/2-2 in	L	L	M	M
2-4 in	L	M	H	H
4 in +	M	H	H	H

If the pothole is over 3 ft in diameter, the area should be determined in square feet and divided by 5 ft^2 to find the equivalent number of holes.

Measurement

Potholes are measured by counting the number that are of low, medium, and high severity in a 100-ft-long section and recording them separately by severity level.

The deduct-values are shown in Figure 4.

Rutting

Description

A rut is a surface depression in the wheel path. Rutting is caused by a permanent deformation in any of the road layers or subgrade. It results from repeated traffic loads, especially when the road is soft. Significant rutting can lead to major structural failure of the road.

Severity Levels

L—Ruts less than 1 in deep or low-severity roughness, or both.
M—Ruts 1 to 3 in deep or medium-severity roughness, or both.
H—Ruts deeper than 3 in or high-severity roughness, or both.

Measurement

Rutting is measured in square feet of surface area in a 100-ft-long section. The total square feet of rutting must not exceed the total area of the 100-ft-long section.

The deduct-values are shown in Figure 5.

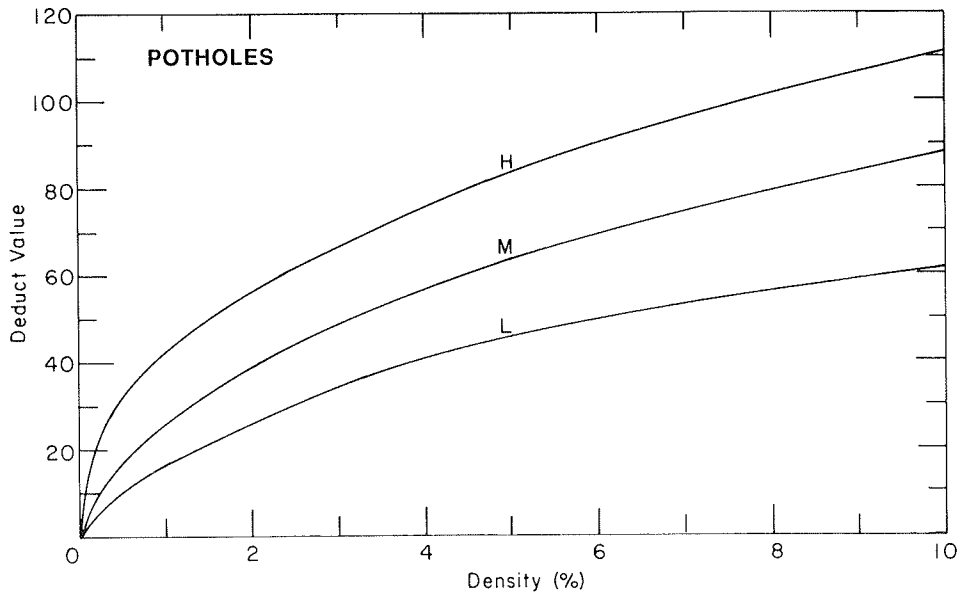


FIGURE 4 Deduct-value curves for potholes.

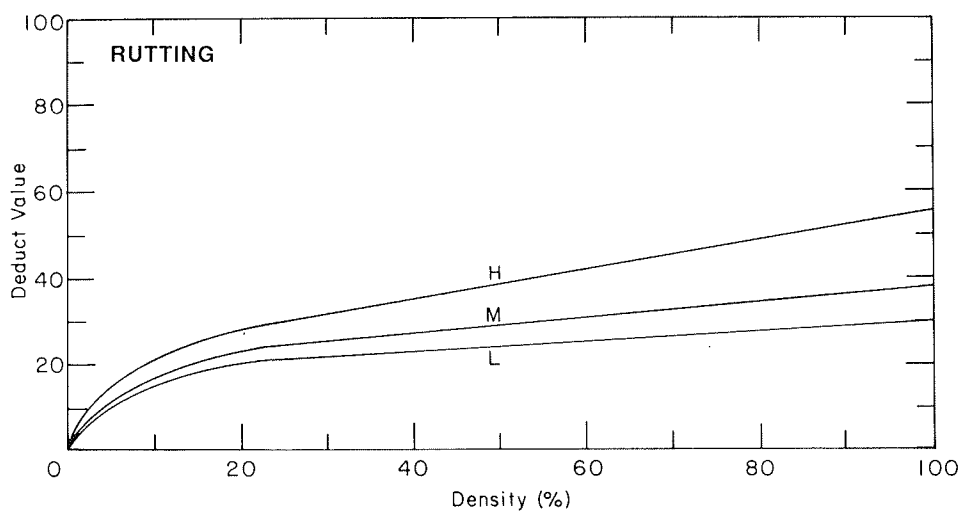


FIGURE 5 Deduct-value curves for rutting.

Loose Aggregate

Description

The abrasive action of traffic on unsurfaced roads eventually loosens the larger aggregate particles from the soil binder. This leads to base aggregate particles on the road surface or shoulder of the road. Traffic moves loose aggregate particles away from the normal road wheel path and forms berms in the center or along the shoulder of the roadway or less-traveled area, parallel to the road centerline.

Severity Levels

L—Loose aggregate on the road surface or an aggregate berm on the shoulder or less-traveled roadway area of less than 2 in, or both.

M—Moderate (2 to 4 in) aggregate berm on shoulder or less-traveled roadway area; excessive fines are usually found on the roadway surface.

H—Large (greater than 4 in) aggregate berm on shoulder or less-traveled roadway area.

Measurement

Loose aggregate is measured in linear ft in a 100-ft-long section parallel to the road centerline.

The deduct-values are shown in Figure 6.

FIELD VALIDATION SURVEYS

Based on the workshops, the relative importance of each type of distress was established. This information was used to develop

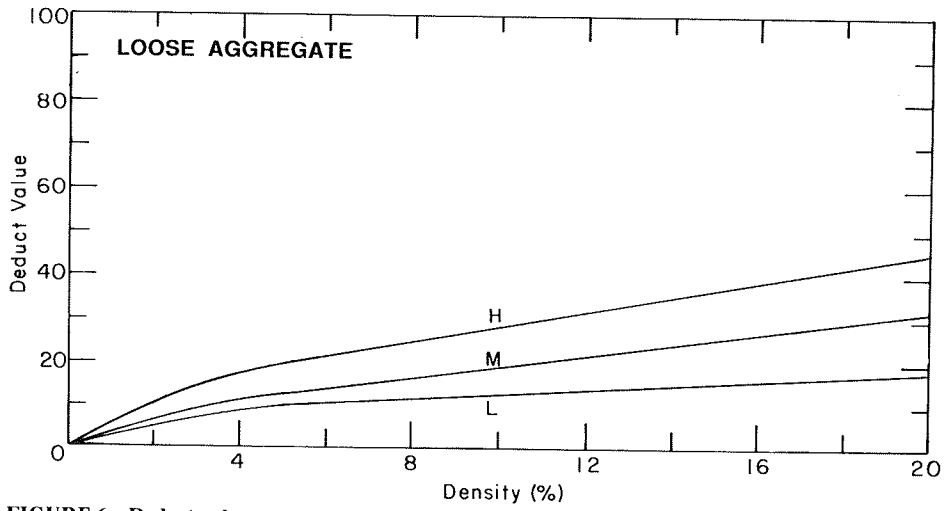


FIGURE 6 Deduct-value curves for loose aggregate.

the deduct-values for each type of distress and the associated severity levels for the initial field validation survey at Ft. Knox and Hardin County, Kentucky.

The initial field validation survey team was composed of eight members. Twelve 100-ft road sections were selected for evaluation and measurement. Each member of the team rated the section according to the Unsurfaced Road Condition Index (URCI) as follows:

0-25	Poor
25-50	Fair
50-75	Good
75-100	Excellent

Field evaluation surveys were then conducted at Ft. Stewart and Long County, Georgia; southeastern Oklahoma; Ft. Chaffee and northwestern Arkansas; central New Hampshire and Vermont; Ft. Irwin and southern California; Ft. Lewis, Washington; and central Alaska from Anchorage to Prudhoe Bay.

In addition to the original URCI estimate, each team member was required to assess the distresses in each section. These distresses were used to compute ratings based on the deduct-values. Based on both the ratings and the distress measurements, new adjusted deduct-values were developed that resulted in the least difference between the computed and estimated ratings.

These adjusted deduct-values were used to compute ratings at subsequent field validation surveys. The mean difference between the estimated and the computed ratings was -0.1 point. The average dispersion of any road section among the team members was approximately 6.0 points. These differences in the estimated and computed ratings are extremely small considering the significant differences in the locations, soil conditions, composition of the survey teams, and road conditions.

A sample of the inspection sheets that were developed to conduct the unsurfaced road measurement surveys is shown in Figure 7.

UNSURFACED ROAD INSPECTION AND DISTRESS MEASUREMENT PROCEDURES

The unsurfaced road network must be divided into branches, sections, and sample units before it is inspected and distresses are measured. If a pavement management system for paved roads is being used, the same procedures can be followed for unsurfaced roads. If the PAVER PMS is being used, the specifications in Army Technical Manual 5-623, mentioned earlier, should be followed. Once this has been accomplished, road condition data can be obtained and the URCI of each section can be determined.

A windshield inspection and detailed distress measurements are both performed for unsurfaced roads. A description of the recommended inspection and distress measurement procedures follows.

Unsurfaced road inspections should be made from inside the road agent's vehicle at 25 mph. The inspector should drive the full length of each unsurfaced road, and note any surface distresses and drainage problems. These inspections should be made four times a year, once during each season. However, detailed distress measurements necessary to compute the URCI are not required every year. These field measurements should be taken between 15 August and 15 September in order to compare ratings from one year to the next. This time period is based on conditions in New England and may vary for other parts of the United States. It is the time of the year in which roads in New England are in the best and most consistent condition from year to year.

Measurement sample units should be 100 ft long, and the number of samples measured per section depends on the length of the section. Two sample units per mile of unsurfaced road generally are sufficient.

Data collected during the distress measurements are used to calculate the URCI, which is based on deduct-values. As was previously stated, a deduct-value is a number from 0 to 100, in which 0 indicates that the distress has no effect on the road condition and 100 indicates that the road has completely failed.

The URCI of a sample unit can be calculated by the following simple, five-step procedure:

1. Each sample unit selected for distress measurements is inspected and distress data are recorded on the Unsurfaced Road Inspection Sheet (Figure 7).
2. The deduct-values are determined from the deduct-value curves for each distress type and severity level.
3. A total deduct-value (TDV) is computed by summing all individual deduct-values.

SARDIS LAKE, CLAYTON, OKLAHOMA

Branch POTATOE HILL CENTRAL — Section 1

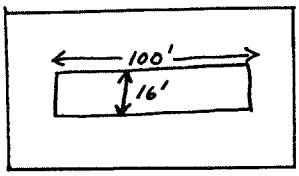
Date 07/15/86 — Sample Unit 1

Surveyed By R. EATON. — Area of Sample 100' x 16'

DISTRESS TYPE

1. Improper Cross-Section (linear feet)
2. Roadside Drainage (linear feet)
3. Corrugations (square feet)
4. Dust (table)
5. Potholes (number)
6. Rutting (square feet)
7. Loose Aggregate (linear feet)

SKETCH



EXISTING DISTRESS TYPE QUANTITY & SEVERITY

TYPE		1	2	4	5	7					
QUANTITY & SEVERITY		100LF	100LF	LOW	1 MED	25LF					
		LOW	HIGH		1 LOW	HIGH					
			100LF			100LF					
			MED			LOW					
TOTAL	L	100		✓	1	100					
	M		100		1						
SEVERITY	H		100			25					

URCI CALCULATION

DISTRESS TYPE	DENSITY	SEVERITY	DEDUCT VALUE
1	6.3	L	13
2	6.3	M	15
2	6.3	H	20
4		L	2
5	0.1	L	1
5	0.1	M	4
7	6.3	L	10
7	1.6	H	8
q = 5	TOTAL DEDUCT VALUE		73
CORRECTED DEDUCT VALUE (CDV)			36

URCI = 100 - CDV = 100 - 36 = 64

RATING = GOOD

REMARKS:

FIGURE 7 Unsurfaced road inspection.

4. Once the TDV is computed, the corrected deduct-value (CDV) can be determined from a correction curve (Figure 8). If any individual deduct-value is higher than the CDV, the CDV is set equal to the highest individual deduct-value.

5. The URCI is computed using the relation $URCI = 100 - CDV$.

The URCI for a section is computed by taking the arithmetic mean of all the individual URCIs of all sample units measured.

EXAMPLE OF URCI CALCULATION

A sample section called Potatoe Hill Central at Sardis Lake, Clayton, Oklahoma, was chosen to illustrate the determination of the URCI (Figure 7).

Based on the previously described procedures, the URCI of Potatoe Hill Central is calculated as follows.

Step 1. Each sample unit has been inspected and the distress recorded on an Unsurfaced Road Inspection Sheet (Figure 7).

Step 2. The deduct-values are determined from the deduct-value curves. The densities of each distress and severity level are based on a sample unit of 1,600 ft^2 (shown in Figure 7).

1. For 100 linear ft of a low-severity improper cross-section, the density equals

$$\frac{100}{1{,}600} \times 100 = 6.3.$$

2. For 100 linear ft of medium-severity roadside drainage, the density equals

$$\frac{100}{1{,}600} \times 100 = 6.3.$$

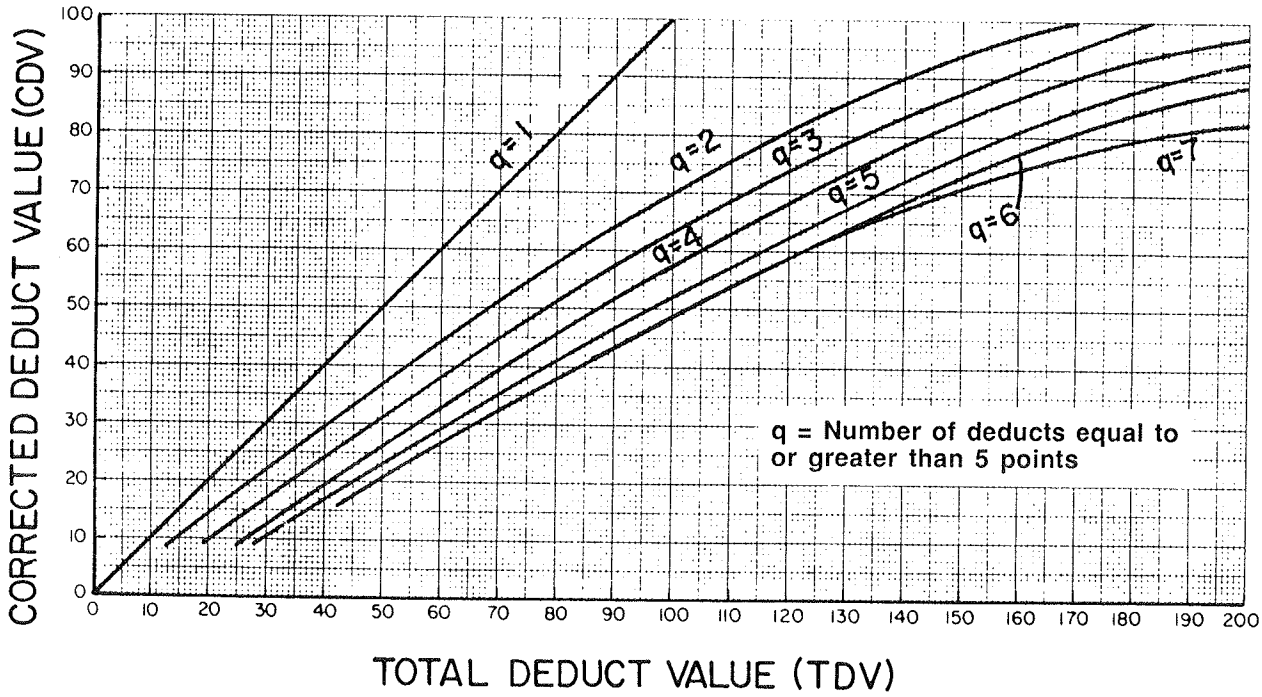


FIGURE 8 Correction curves.

3. For 100 linear ft of high-severity roadside drainage, the density equals

$$\frac{100}{1{,}600} \times 100 = 6.3.$$

4. Dust has been measured as low severity.

5. For one pothole at low severity, the density equals

$$\frac{1}{1{,}600} \times 100 = 0.1.$$

6. For one pothole at medium severity, the density equals

$$\frac{1}{1{,}600} \times 100 = 0.1.$$

7. For 100 linear ft of low-severity loose aggregate, the density equals

$$\frac{100}{1{,}600} \times 100 = 6.3.$$

8. For 25 linear ft of high-severity loose aggregate, the density equals

$$\frac{25}{1{,}600} \times 100 = 1.1.$$

Using the deduct-value curves, deduct-values can be obtained for all the densities computed above; these are shown in Figure 7.

Step 3. A TDV is computed for the sample unit. For example, in Step 2 the total deduct-value is 13 + 15 + 20 + 2 + 1 + 4 + 10 + 8 = 73.

Step 4. The CDV is computed. In the example in Step 2, the TDV was found to be 73. The value of q, the number of individual deducts the value of which is 5 or greater, is 5. Based on the corrected deduct-value curve in Figure 8, the CDV is 36.

Step 5. The sample unit URCI is computed using the relation $URCI = 100 - CDV$. In this example the URCI = 100 - 36 = 64; the rating is good. Note that if the section being rated had had only one sample unit, the section's URCI would also have been 64. But if two or more sample units had been rated, the section's URCI would have been the arithmetic mean of all of the sample units rated.

MAINTENANCE MANAGEMENT

The ratings obtained using this procedure can be used to effectively manage maintenance of unsurfaced roads. Each agency can establish critical URCI ratings that can be used to establish a maintenance strategy. For example, a rating of 50 on a road would require the development of maintenance action to restore the road to a rating of 75 or higher. This technique could be used as a stand-alone, or manual, pavement management system, or it could be used in conjunction with PAVER or any other automated PMS. The integration of this rating method into PAVER would provide procedures to divide the road into sections, conduct a road condition survey and rating, evaluate a road, determine rational maintenance and repair needs and priorities, perform life-cycle costing on feasible maintenance and repair alternatives, and develop manual or automated systems to store and retrieve data.

CONCLUSIONS

A method of rating unsurfaced roads has been developed and field-validated at seven test areas across the United States from New England to Alaska. This method can be used alone to rate unsurfaced roads, or it can be incorporated into automatic, computer-aided pavement maintenance management systems for paved roads, such as PAVER.

Manual or computer-aided PMS use of this rating method should provide the data necessary for optimum allocation of resources and maintenance of unsurfaced roads in the best possible condition for the least cost.

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Pavement Management for Low-Volume Roads

CAROL W. BLAIR, EDWARD G. BATES, JR., AND DAVID M. DREVINSKY

Pavement Management for Communities **is a manual for small road networks. Every road agency with maintenance responsibilities is experiencing the problem of escalating costs and deteriorating road conditions; pavement management is a solution. However, many smaller communities do not have the resources to implement the pavement management methods offered in an abundance of literature on the subject. Some methods require extensive data. Others require the use of a computer. Most involve a significant amount of time to understand the methodology and collect data, or a considerable investment in outside services. The goals of the manual discussed in this paper are to introduce local officials and highway superintendents to the concept and benefits of pavement management, and to distill the extensive work of others into a simplified approach to pavement management. The alternatives begin with a basic, stripped-down method, suitable for situations that demand a quick turn-around with a minimum of resources. The basic method is presented in detail and appropriate charts and forms are included. Possible refinements are then discussed and modifications are offered to include additional factors or to gain precision. Available information on pavement management software and consultants is included. Communities are encouraged to adapt these methods to best suit their particular needs and resources.**

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This paper is based on the premise that pavement management is important for low-volume roads. Although some jurisdictions may have adequate maintenance budgets, others regularly defer part of their maintenance program because of inadequate funding. The costs of deferring maintenance are significant and should be addressed in the process of budgeting for maintenance activities. Furthermore, ranking road maintenance projects systematically, with the goal of minimizing long-term maintenance expenditures, is essential in cases in which a budget shortfall exists. A description is provided of work performed by the Metropolitan Area Planning Council (MAPC) (Boston) in response to a need among member communities to formalize the pavement management process.

After it was recognized that limited resources were available for such an activity, a simplified manual was developed to demonstrate how to document maintenance needs and program needed improvements. The manual is based on the synthesis of existing pavement management manuals and the seasoned advice of a panel whose members were drawn from universities, consulting firms, and government. There are no new or global solutions to the problems of inadequate budgets and deferred maintenance, but the simple methods described offer the tools needed to justify increased funding and to effectively spend the funds that are available.

THE NEED FOR PAVEMENT MANAGEMENT

Pavement management is the process of overseeing the maintenance and repair of a network of roadways. Unfortunately,