TECHNICAL MANUAL

UNSURFACED ROAD MAINTENANCE MANAGEMENT

HEADQUARTERS, DEPARTMENT OF THE ARMY
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UNSURFACED ROAD MAINTENANCE MANAGEMENT

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CHAPTER 1

INTRODUCTION

1-1. Purpose

This manual describes an unsurfaced road maintenance management system for use on military installations. This system is available in either a manual or computerized mode (Micro PAVER). The maintenance standards prescribed should protect Government property with an economical and effective expenditure of maintenance funds commensurate with the functional requirements and the planned future use of the facilities. Because of limited maintenance funds, timely and rational determinations of maintenance and repair (M&R) needs and priorities are very important factors. These factors can be determined by using the system as described in this manual. The use of the unsurfaced road maintenance management system by personnel who have the responsibility for unsurfaced road maintenance should ensure uniform, economical, and satisfactory unsurfaced area maintenance and repair. When information in this publication varies from that contained in the latest issue of Federal or military specifications, the specifications shall apply. Reference to Federal, Military, or other specifications is to the current issues of these specifications as identified by their basic number(s). It is intended to be used by all Army elements responsible for maintenance and repair (M&R) of unsurfaced roads, streets, parking lots, tank trails, and range roads.

1-2. Scope

The system presented in this manual consists of the following components.

a. Network identification. The process of dividing installation unsurfaced road networks into manageable segments for conducting surface inspection and determining M&R requirements and priorities (chap 2).

b. Surface condition inspection. The process of inspecting installation unsurfaced roads to determine existing distresses and their severity, and to compute the Unsurfaced Road Condition Index (URCI)-a rating system that measures the surface integrity and operational condition (chap 3).

c. M&R determination. The process of establishing M&R requirements and priorities based on inspection data, URCI, and other relevant information, such as traffic, loading, and structural composition (chap 4).

d. Data management. Data may be handled by any one of three methods.

(1) A stand alone manual system that is fully described in chapter 5 of this manual.

(2) A stand alone automated system using Micro PAVER, which is briefly described in chapter 6.

(3) A dual automated system using Micro PAVER for both unsurfaced roads and paved networks.

e. System description. Micro PAVER is fully described in TM 5-623.

1-3. References

Appendix A contains a list of references used in this manual.

1-4. Implementation of the unsurfaced road management system

The level of implementation is a function of the installation size, existing road conditions, and available manpower and money resources. The highest level of implementation would be the inclusion of all unsurfaced roads on the installation and use of the automated system. The lowest level would be use of the URCI as the basis for project approvals and establishment of priorities. A gradual implementation may be practical for many installations. Technical advice concerning any procedures outlined in this manual may be obtained from U.S. Army Center for Public Works, ATTN: CECPW-ER, 7701 Telegraph Road, Alexandria, VA 22310-3862.

CHAPTER 2

UNSURFACED ROAD NETWORK IDENTIFICATION

2-1. General

Before the unsurfaced road maintenance management system can be used, the installation's unsurfaced roads must be divided into components. This chapter defines the process.

2-2. Components

a. Unsurfaced road. An installation's unsurfaced road network consists of all unsurfaced areas that provide accessways for ground traffic, including roadways, parking areas, storage areas, tank trails, and range roads.

b. Brunch. A branch is an identifiable part of the unsurfaced road network that is a single entity and has a distinct function. For example, individual roads, parking areas, tank trails, and range roads are separate branches of an unsurfaced road network.

c. Section. A section is a division of a branch; it has certain consistent characteristics throughout its area or length. These characteristics are as follows.

(1) Structural composition (thickness and materials).

(2) Construction history.

(3) Traffic.

(4) Surface condition.

d. Sample unit. A sample unit is an identifiable area of the unsurfaced road section; it is the smallest component of the unsurfaced road network. Each unsurfaced section is divided into sample units for the purpose of a condition inspection. For unsurfaced roads, a sample unit is defined as an area of approximately 2,500 square feet (±1,000 square feet) (230 square meters [±90 square meters]).

2-3. Guidelines for unsurfaced road identification

a Dividing the unsurfaced road network into brunches. The first step is to identify the unsurfaced road branches. The easiest way to identify these branches is to use the installation's existing name identification system.

(1) For example, Boot Hill Road in figure 2-1 would be identified as a branch. Areas such as parking lots and storage areas that do not have names already assigned can be given descriptive names that associate them with their area.

(2) In addition to descriptive names, branches are assigned a unique code to help store and retrieve data from the files. This code has five characters that are numbers or letters given to the branches using any logical order. The first letter of the code will identify the type of branch, as shown in table 2-1. For example the parking lot 321 shown in figure 2-2 is given the code P0321. The code P0321 is derived from P representing parking lots and 0321 representing the nearest building to the parking area. Since the building number has less than four digits, a zero is used on the left to provide the required characters.

Table 2-1. Branch codes

Type of branch	*First letter in branch code*
Installation road	I
Parking lot	P
Motor pool	M
Storage	S
Tank trail	T
Range road	K
Other	X

b. Dividing branches into sections.

(1) Since branches are large units of the unsurfaced road network, they rarely have consistent or uniform characteristics along their entire length. Thus, for the purpose of unsurfaced road management, each branch must be subdivided into sections with consistent characteristics. As defined in paragraph 2-2c, a section must have uniform structural composition, traffic, and the same construction history.

(2) After each section is initially established, surface condition, drainage, and shoulders within the section can be used to subdivide it into other sections if a considerable variation in condition is encountered. For example, a section containing part of a two-lane road that has one lane in a significantly different condition than the other lane should be subdivided into two sections. Unique situations such as those that occur at roadway intersections should also be placed in separate sections. However, it must be remembered that the major section's structure usually carries through an intersection. The structure should be checked if there is doubt as to which

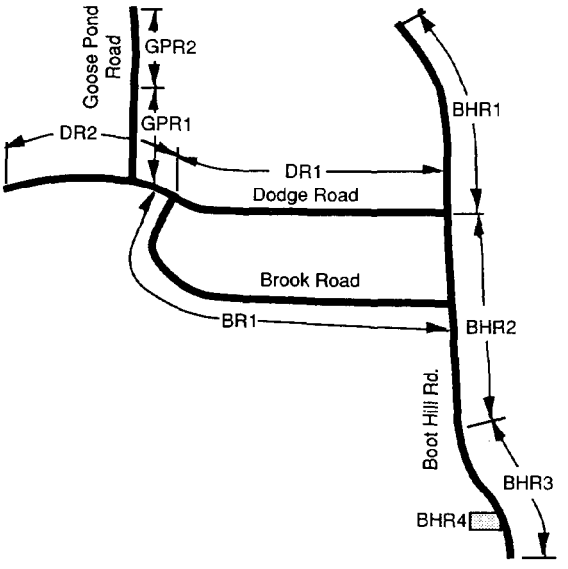


Figure 2-1. Typical road sections

surface would continue through the intersection. Some guidelines for dividing unsurfaced network branches into sections are as follows.

(a) Structure. Structure is one of the most important criteria for dividing a branch into sections. Structural information is not always available for all branches of an unsurfaced road network. To collect structure information, available construction records can be searched and repairs can be observed. In addition, test pits or coring programs can be developed to determine the structural composition of remaining road sections or to verify existing information.

(b) Traffic. The volume and load intensity of traffic should be consistent within each individual section.

(c) Construction history. All portions of a section should have been constructed at the same time. Roads constructed in intervals should be divided into separate sections corresponding to the dates of construction. Areas that have received major M&R work should also be considered as separate sections.

(d) Unsurfaced road rank. Unsurfaced road rank can also be used to divide a branch into sections. If a branch changes along its length from second class to third class, a section division should be made. If a branch becomes narrower along its length, a separate section should be defined.

(e) Drainage facilities and shoulders. It is

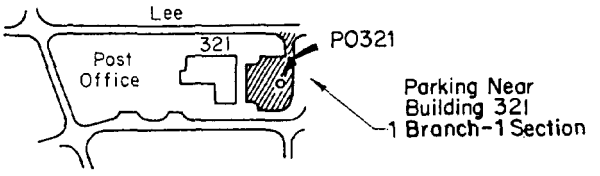


Figure 2-2. Installation map showing a way of identifying a parking area branch.

recommended that shoulder type and drainage facilities be consistent throughout a section.

(f) Test areas. An area where materials have been placed for testing should be identified as a separate section.

(3) By using the criteria in subparagraphs (2)*(a)* through *(f)* above, the unsurfaced road branches can be divided into sections. Sections are numbered beginning with one at the north or west end of the branch. The numbers then increase in a southerly or easterly direction. Each section should be identified on the installation map.

(4) To identify a section on the installation map, place an arrow at the starting point and ending point of each section as shown in figure 2-3. Sample units should be numbered in ascending order from the beginning of each section.

(5) Subparagraphs (2)*(a)* through *(f)* above that apply to roadways may also be applied to branch types, such as parking areas, storage areas, tank trails, range roads, etc. These branch types are usually considered one section, but may be subdivided. For example, a parking lot could be divided into more than one section; if the parking lot's drive areas were well defined, each drive area should be identified as a separate section.

(6) An example of dividing a parking area into sections is shown in figure 2-4. The area is very large and defined as one branch with five sections. The basic division of sections is based on traffic patterns and use. Field observations of these types of branches will help in the decision of how to divide such an area into sections.

c. Dividing a section into sample units. A sample unit is the smallest component of the unsurfaced road network and is used for inspection purposes to determine existing surface distress and condition. This is where the actual measurements will be made.

(1) The sizes of the sample units are described in paragraph 2-2*d*. For unsurfaced roads, a sample unit may vary in size from approximately 1,500 to

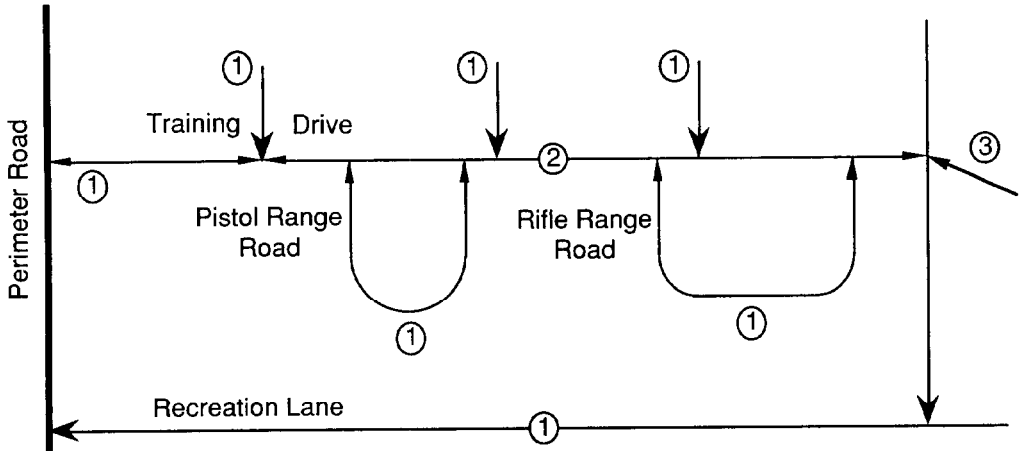


Figure 2-3. Sections identified on an installation map

3,500 square feet (140 to 325 square meters), with a recommended average of 2,500 square feet (231 square meters). In general, sample units are 100 feet (30 meters) long. If the road is narrower than 15 feet (4.5 meters), the length should be increased. If the road is wider than 35 feet (10.5 meters), the length should be shortened (see figure 2-5).

(2) Some judgment is needed in selecting the sample units. Try to choose a sample unit that is typical of the whole section. For example, if the section has drainage problems along part of its length, try to include some of that in the sample unit. The idea is to choose sample units so that the measurements will give a fair estimate for the entire section.

(3) If a small part of the section has particularly severe problems, make that part a special sample unit. (Make sure to note this on the inspection sheet, and don't use the rating for this unit when you calculate the average for the section.)

(4) In general, only two sample units per mile (per kilometer) are needed. If the road is less than 1/2 mile (0.8 kilometer) long, one sample unit should be sufficient.

(5) It is important to make a map showing the sizes and locations of the sample units so that you can find them again. Also, mark the field sites with permanent markers, i.e., wood stake, pipe, re-bar, etc.

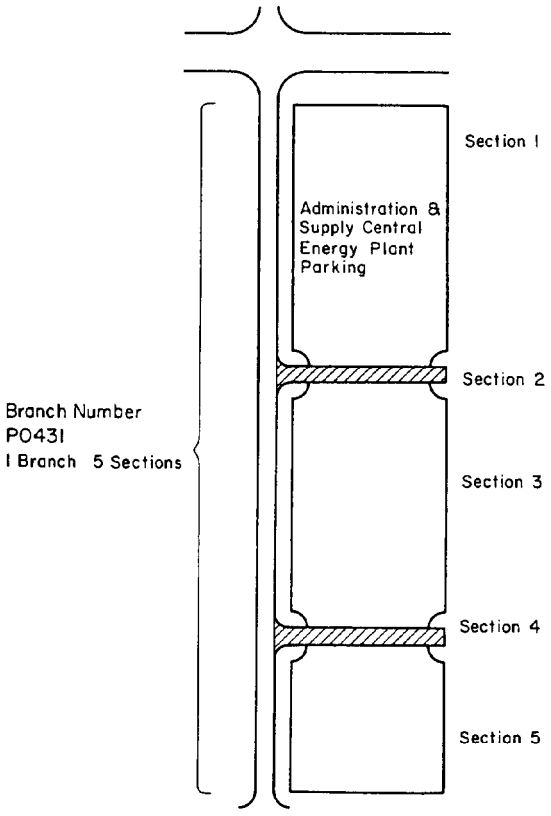
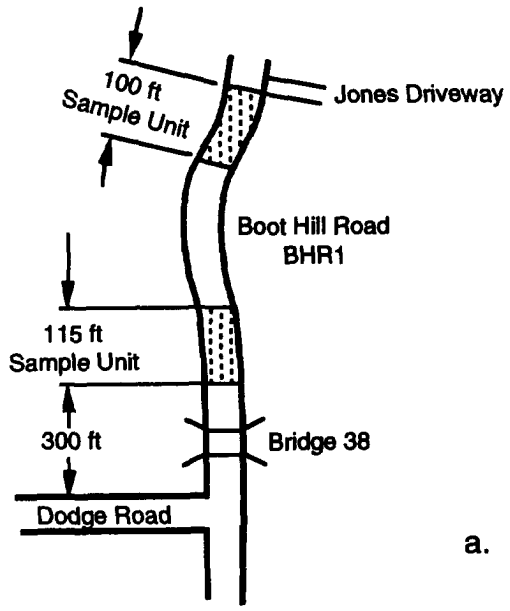


Figure 2-4. Large parking area divided into several sections.



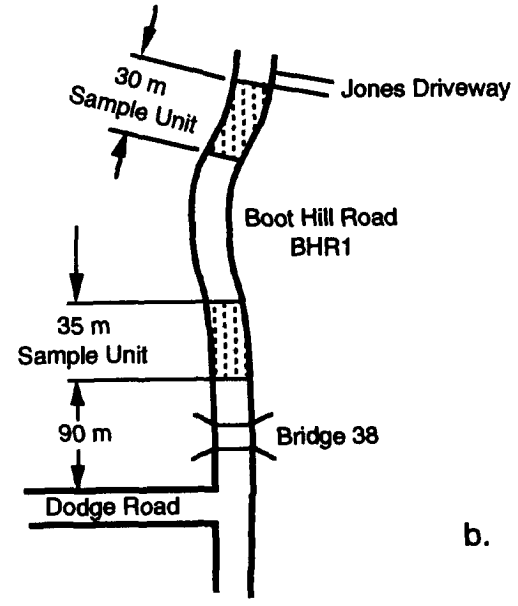


Figure 2-5. Examples of road with sample units (English and metric units).

CHAPTER 3

UNSURFACED ROAD CONDITION SURVEY AND RATING PROCEDURES

3-1. General

This chapter explains how to conduct a condition survey inspection and how to determine the Unsurfaced Road Condition Index (URCI). It is essential to have a thorough working knowledge of the URCI and condition survey inspection techniques. An important component of the unsurfaced road maintenance management system is the surface condition survey and rating procedures. Data obtained from these procedures are the primary basis for determining M&R requirements and priorities.

3-2. Unsurfaced road condition rating

Surface condition is related to several factors, including structural integrity, structural capacity, roughness, and rate of deterioration. Direct measurement of all these factors requires expensive equipment and highly trained personnel. However, these factors can be assessed by observing and measuring the distress of the surface.

a. URCI. The unsurfaced road condition index is a numerical indicator based on a scale of 0 to 100. The URCI indicates the road's integrity and surface operational condition. Its scale and associated ratings are shown in figure 3-1 and is identical to the Pavement Condition Index (PCI) for surfaced roads.

b. Determination. of URCI. The URCI is determined by measuring surface distress. The method has been field tested and has proven to be a very useful device for determining M&R needs and priorities.

3-3. Unsurfaced road inspection

Before an unsurfaced road network is inspected, it must be divided into branches, sections, and sample units as described in chapter 2. Once this division is complete, survey data can be obtained and the URCI of each section determined.

a. Inspection procedures for unsurfaced roads. There are two methods of inspections. The first is a quick survey done from a moving vehicle. The second involves detailed measurements of distresses in the sample units.

(1) To do the "windshield inspection," drive the full length of the road (or branch) at 25 miles per hour (40 kilometers per hour). (The speed may be higher or lower depending on road conditions, local practice or speed limits).' Note any surface or drainage problems along the road. If the local area has times of the year when unsurfaced roads need regular maintenance to keep them usable, such as the spring "mud season" in New England, keep track of where the maintenance was done so that those areas can be inspected during the windshield survey. These inspections should be made four times a year-once each season. The results can be used for estimating maintenance needs and priorities.

(2) The detailed sample unit measurements necessary to compute the ratings should be conducted annually. Always make these measurements at the same time of year-when the roads are in their best and most consistent condition. To make the measurements, the inspector will need to recognize certain kinds of problems, which are called *distresses.* The seven distress types for unsurfaced roads are as follows.

(a) 81-Improper cross section.
(b) 82-Inadequate roadside drainage.
(c) 83-Corrugations.
(d) 84-Dust.
(e) 85-Potholes.
(f) 86-Ruts.
(g) 87-Loose aggregate.

(3) The descriptions and severity levels for each are given in appendix B. Since the URCI is based on these descriptions, it is imperative that the inspector follow appendix B closely when doing an inspection. The distresses are numbered 81-87, as those are the numbers assigned in Micro PAVER.

(4) The equipment needed to do a survey is a hand odometer (measuring wheel), used to measure distress lengths and areas, a straight edge, and a ruler to measure the depths of potholes, ruts, or loose aggregate, and the URCI distress guide (appendix B).

(5) DA Form 7348-R, (Unsurfaced Road Inspection Sheet) should be used to record inspection data for each sample unit. (A copy of DA Form 7348-R is available at the back of this manual. It will be locally reproduced on 8 1/2- by 11-inch paper.) The sample unit shown in figure 3-2 has 100 feet (30 meters) of medium severity improper cross section (distress 81), 200 feet (61 meters) (both ditches) of high severity inadequate roadside drainage (distress 82), low severity dust (distress 84), 490 square feet (45.5 square meters) of medium severity rutting (distress 86), and 910 square feet (84.5 square meters) of high severity rutting

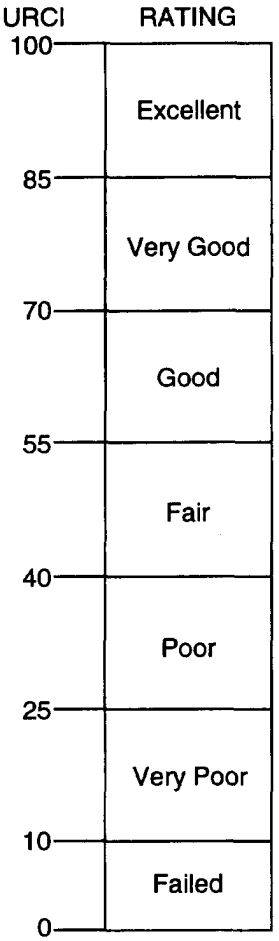


Figure 3-1. URCI scale and condition rating.

(distress 86). The units of measure are shown in parentheses after each distress type listed on the top part of the sheet. The total distress data are used to compute the URCI for the sample unit. That computation is explained in paragraph 3-4.

b. Remarks.

(1) For unsurfaced roads, it is important that each sample unit be identified precisely so that it can be located for reinspections. A stake, pin, or other permanent marker should be placed behind the ditch line at one of the four sample unit corners and distance noted to the nearest permanent marker (culvert, bridge, etc.) or intersection. A sketch of each section should also be made to show sample unit locations.

(2) It is imperative that the distress descriptions listed in appendix B be used when doing inspections. If these definitions are not followed, an accurate URCI cannot be determined.

(3) Make notes about anything unusual at the site-for example, if two distresses occur together, such as ruts and potholes, or if there is standing water in a ditch line.

(4) If two or more distresses occur together, measure each one separately. If it is hard to determine what distress is being observed, make a reasonable estimate-the system is flexible enough to calculate an accurate rating.

3-4. Calculating the URCI From inspection results

a. General. The distress measurements are used to calculate the Unsurfaced Road Condition Index (URCI), based on deduct values. A deduct value is a number from 0 to 100, with 0 meaning that the distress has no impact on the road condition and 100 meaning that the road has completely failed.

b. Calculating sample unit URCI. This calculation is made in four steps. Following is an example using figure 3-3.

(1) *Step 1.* Calculate the density for each distress type (except dust).

$$\text{Density} = \frac{\text{Amount of Distress}}{\text{Area of Sample Unit}} \times 100\% \quad \text{(eq. 3-1)}$$

In this example the density of each distress and severity level is based on a sample unit of 1,800 square feet (167.4 square meters).

(a) For 100 linear feet of improper cross section (distress type 81), the density is

$$\frac{100}{1{,}800} \times 100 = 5.6 \quad \text{(eq. 3-2)}$$

(b) For 30.5 linear meters of improper cross section (distress type 81), the density is

$$\frac{30.5}{167.4} \times 100 = 18.2 \quad \text{(eq. 3-3)}$$

(c) For 900 square feet of corrugations (distress type 83), the density is

$$\frac{900}{1{,}800} \times 100 = 50.0 \quad \text{(eq. 3-4)}$$

(d) For 83.7 square meters of corrugations (distress type 83), the density is

$$\frac{83.7}{167.4} \times 100 = 50.0 \quad \text{(eq. 3-5)}$$

(e) No density calculation is needed for dust (distress type 84).

(f) For 160 linear feet of loose aggregate (distress type 87), the density is

$$\frac{160}{1{,}800} \times 100 = 8.8 \quad \text{(eq. 3-6)}$$

(g) For 48.8 linear meters of loose aggregate (distress type 87), the density is

$$\frac{48.8}{167.4} \times 100 = 29.2 \quad \text{(eq. 3-7)}$$

(2) *Step 2.* Using the deduct value curves, find the deduct values for each distress type and severity level. The deduct value curves are in appendix C .

(a) For improper cross section at low severity, locate on figure 3-4 (English units) the density of 5.6 on the horizontal axis, go vertically upward to the low severity curve, then go left horizontally to the y-axis intersection, which gives a value of 13 (English units). Similarly, for the metric system, locate on figure 3-4 (metric units) the density of 18.2 on the horizontal axis, which gives a value of 13.

(b) For corrugations at medium severity, the deduct value is 29 (fig C-3).

(c) For dust at medium severity, the deduct value is 4 (fig C-4).

(d) For loose aggregate at medium severity, the deduct value is 18 (fig C-7).

(3) *Step 3.* Find the Total Deduct Value (TDV) and the *q* value. Calculate the TDV by adding up all the deduct values. The *q* value is the number of individual deduct values greater than 5.0.

(a) TDV = 13 + 29 + 4 + 18 = 64 (which is the same in English and metric).

(b) The *q* value is 3 because three deduct values are greater than 5.0.

(4) *Step 4.* Find the Unsurfaced Road Condition Index (URCI) from the URCI curve. (NOTE: Slightly higher URCIs may result from manual computations.)

(a) From figure 3-5, the TDV is 64 and *q* is 3, so the URCI curve shows that the URCI is 59. From figure 3-1, the rating is “good.”

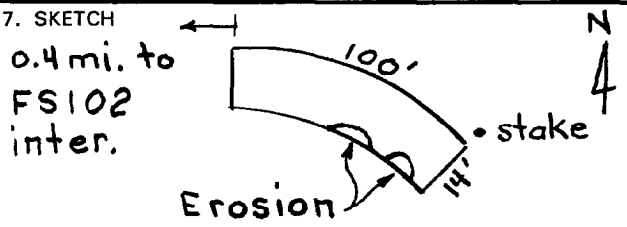
(b) This is the rating for this sample unit. The rating for the section is the average of the ratings from all the sample units in the section. For example, URCIs of 63, 59, and 67 in a section would give an average URCI of 63 for the whole section.

UNSURFACED ROAD INSPECTION SHEET

For use of this form, see TM 5-626; the proponent agency is USACE

1. BRANCH	2. SECTION	3. DATE
FS 144	1	7 Nov 94
4. SAMPLE UNIT	**5. AREA OF SAMPLE**	**6. INSPECTOR**
1	1400 ft²	R. Eaton

7. SKETCH



DISTRESS TYPES

81. Improper Cross Section *(linear feet)*
82. Inadequate Roadside Drainage *(linear feet)*
83. Corrugations *(square feet)*
84. Dust
85. Potholes *(number)*
86. Ruts *(square feet)*
87. Loose Aggregate *(linear feet)*

8. DISTRESS QUANTITY AND SEVERITY

TYPE		81	82	83	84	85	86	87
QUANTITY AND SEVERITY	L				✓			
	M	100					490	
	H		200				910	

9. URCI CALCULATION

DISTRESS TYPE a	DENSITY b	SEVERITY c	DEDUCT VALUE d
81	7.1	M	19
82	14.3	H	36
84	–	L	2
86	35.0	M	31
86	65.0	H	44

10. REMARKS

Erosion into road; standing water in ditches in several areas.

e. TOTAL DEDUCT VALUE	f. q =	g. URCI	h. RATING =
132	4	25	Poor

DA FORM 7348-R, NOV 94

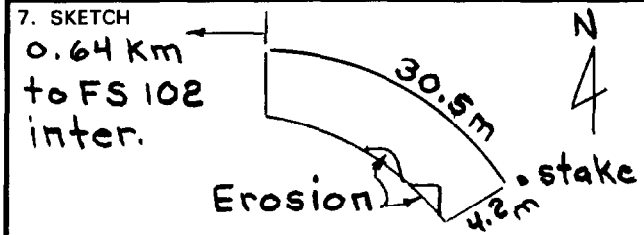
Figure 3-2. Example of completed inspection sheet (English units).

UNSURFACED ROAD INSPECTION SHEET

For use of this form, see TM 5-626; the proponent agency is USACE

1. BRANCH	2. SECTION	3. DATE
FS 144	1	7 Nov 94
4. SAMPLE UNIT	**5. AREA OF SAMPLE**	**6. INSPECTOR**
1	130 m²	R. Eaton

7. SKETCH



DISTRESS TYPES

81. Improper Cross Section *(linear feet)*
82. Inadequate Roadside Drainage *(linear feet)*
83. Corrugations *(square feet)*
84. Dust
85. Potholes *(number)*
86. Ruts *(square feet)*
87. Loose Aggregate *(linear feet)*

8. DISTRESS QUANTITY AND SEVERITY

TYPE		81	82	83	84	85	86	87
QUANTITY AND SEVERITY	L				✓			
	M	30.5					45.5	
	H		61.0				84.5	

9. URCI CALCULATION

DISTRESS TYPE *a*	DENSITY *b*	SEVERITY *c*	DEDUCT VALUE *d*
81	23.5	M	19
82	46.9	H	36
84	—	L	2
86	35.0	M	31
86	65.0	H	44

10. REMARKS

Erosion into road; standing water in ditches in several areas.

e. TOTAL DEDUCT VALUE	f. q =	g. URCI	h. RATING =
132	4	25	Poor

DA FORM 7348-R, NOV 94

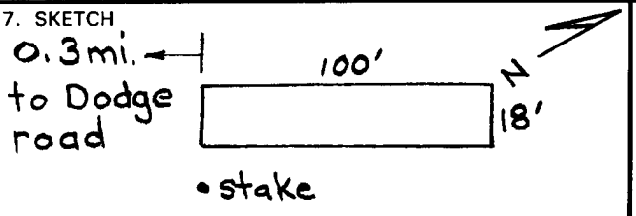
Figure 3-2. Example of completed inspection sheet (metric units).

UNSURFACED ROAD INSPECTION SHEET

For use of this form, see TM 5-626; the proponent agency is USACE

1. BRANCH	2. SECTION	3. DATE
FS 101	1	7 Nov 94
4. SAMPLE UNIT	**5. AREA OF SAMPLE**	**6. INSPECTOR**
2	1800 ft²	R. Beaucham

7. SKETCH



DISTRESS TYPES

81. Improper Cross Section *(linear feet)*
82. Inadequate Roadside Drainage *(linear feet)*
83. Corrugations *(square feet)*
84. Dust
85. Potholes *(number)*
86. Ruts *(square feet)*
87. Loose Aggregate *(linear feet)*

8. DISTRESS QUANTITY AND SEVERITY

TYPE		81	82	83	84	85	86	87
QUANTITY AND SEVERITY	L	100						
	M			900	✓			160
	H							

9. URCI CALCULATION

DISTRESS TYPE *a*	DENSITY *b*	SEVERITY *c*	DEDUCT VALUE *d*
81	5.6	L	13
83	50.0	M	29
84	–	M	4
87	8.8	M	18

10. REMARKS

e. TOTAL DEDUCT VALUE	f. q =	g. URCI	h. RATING =
64	3	59	Good

DA FORM 7348-R, NOV 94

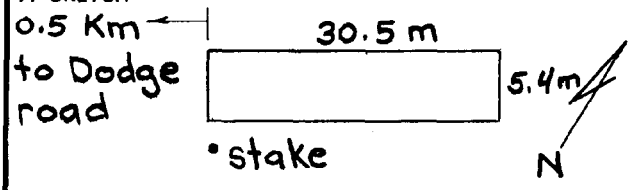
Figure 3-3. Example for calculating density of distresses (English units.).

UNSURFACED ROAD INSPECTION SHEET

For use of this form, see TM 5-626; the proponent agency is USACE

1. BRANCH	2. SECTION	3. DATE
FS 101	1	7 Nov 94
4. SAMPLE UNIT	**5. AREA OF SAMPLE**	**6. INSPECTOR**
2	167 m²	R. Beaucham

7. SKETCH



DISTRESS TYPES

81. Improper Cross Section *(linear feet)*
82. Inadequate Roadside Drainage *(linear feet)*
83. Corrugations *(square feet)*
84. Dust
85. Potholes *(number)*
86. Ruts *(square feet)*
87. Loose Aggregate *(linear feet)*

8. DISTRESS QUANTITY AND SEVERITY

TYPE		81	82	83	84	85	86	87
QUANTITY AND SEVERITY	L	30.5						
	M			83.7	✓			48.8
	H							

9. URCI CALCULATION

DISTRESS TYPE *a*	DENSITY *b*	SEVERITY *c*	DEDUCT VALUE *d*
81	18.2	L	13
83	50.0	M	29
84	–	M	4
87	29.2	M	18

10. REMARKS

e. TOTAL DEDUCT VALUE	f. q =	g. URCI	h. RATING =
64	3	59	Good

DA FORM 7348-R, NOV 94

Figure 3-3. Example for calculating density of distresses (metric units).

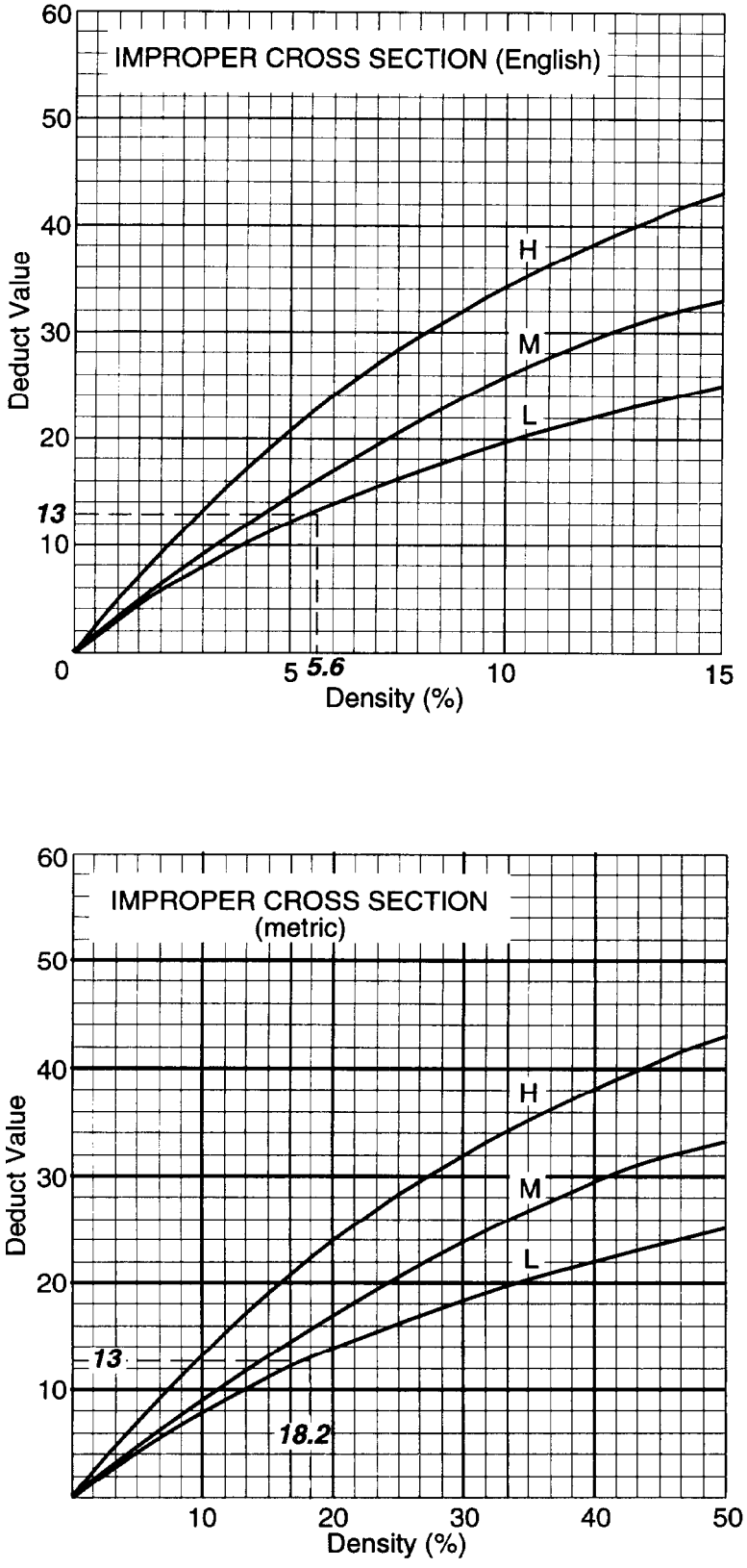


Figure 3-4. Distress 81-improper cross section deduct values curves (English and metric units).