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Field **Notes**

Volume 5 Number 12 December 1973

Road Obliteration

**Metrickation-Surveying Conversion Factors
by the International System of Units**

**Washington Office Division
of Engineering News**



FOREST SERVICE • U.S. DEPARTMENT OF AGRICULTURE

ENGINEERING FIELD NOTES

This publication is a monthly newsletter published to exchange engineering information and ideas of a technical or administrative nature among Forest Service personnel. The text in this publication represents the personal opinions of the respective author and must not be construed as recommended or approved procedures, mandatory instructions, or policy, except by FSM references.

This publication is not intended to be exclusively for engineers. However, because of the type of material in the publication, all engineers and engineering technicians should read each issue.

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Material submitted to the Washington Office for publication should be reviewed by the respective Regional Office to see that the information is current, timely, technically accurate, informative, and of interest to engineers Service-wide (FSM 7113). The length of material submitted may vary from several sentences to several typewritten pages. However, short articles or news items are preferred. The Washington Office will edit for grammar only. All material submitted to the Washington Office should be typed double-spaced, and all illustrations should be original drawings or glossy black and white photos.

Each Region has an Information Coordinator to whom field personnel should submit both questions and material for publication. The Coordinators are:

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Coordinators should direct questions concerning format, editing, publishing dates, etc., to Fran Owsley, Editor, Division of Engineering, Forest Service, USDA, Washington, D. C. 20250.

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FIELD NOTES

ROAD OBLITERATION

By Larry Pearson

Civil Engineering Technician, Wallowa-Whitman National Forest, Region 6

When an existing road is reconstructed, segments of the old road remain outside of the new prism. Some treatment of these "scars" must be made for aesthetics and to enable the land to be put back into productive use.

The Wallowa-Whitman National Forest work has included the obliteration of paralleling old facilities in public works contracts for road reconstruction. Costs have ranged from \$400 to \$1000 per mile. The best results have been obtained when the specifications call for restoring the ground to nearly original cross section.

This article contains samples of road-obliteration plans and specifications, and photographs of our procedures and field results (Figs. 1 through 8). Obviously, the extent of the work to be done in each individual case must be dependent on the area, its use, and visual management needs.

Old existing embankments may be used as a borrow source and removed as part of the reconstruction design. The embankments are removed to the original ground line and a natural condition is restored. In some instances the reverse procedure can be used — material can be hauled from the new construction and used to fill in cuts in the old roads.

Obliteration involves a rather minor amount of work in most instances. It can result in completely reclaiming the land and enhancing aesthetic values. It does require creative thought and planning. Figure 1 shows the results of obliteration work. The cut and fill shoulders have been pulled into the old ditch line. Reseeding and fertilizing was done just prior to the time this photo was taken.



Figure 1. — Result of Obliteration Work

An example of removing a fill in the old road and using the material in constructing the new facility is shown in Figure 2. The dashed lines in the photo indicate the approximate location of old road. This photo was taken just after the embankment was removed.

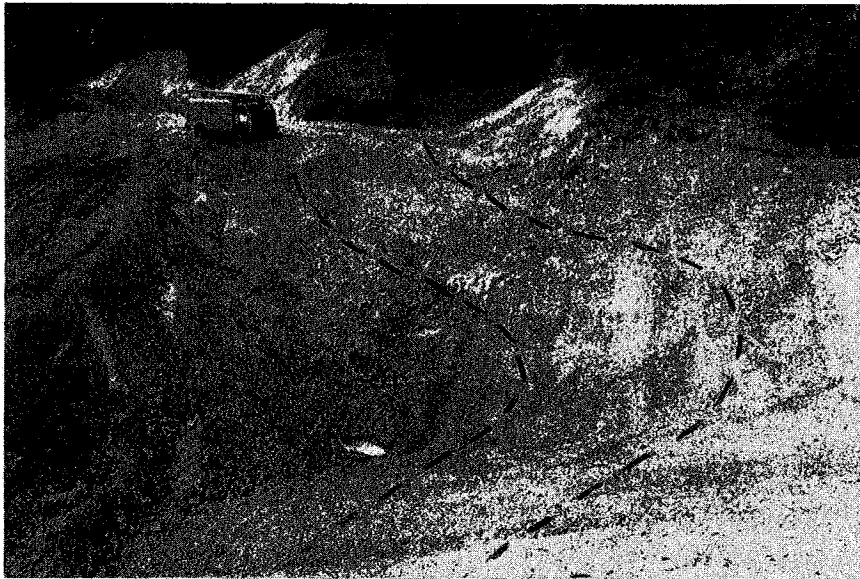


Figure 2. — Removed Fill in the Old Road

Material from the new road construction was used to fill in a cut area in the old road. The area now appears as a flat cut slope for the new road (Fig. 3). Dashed lines in the photo indicate the approximate location of old road.



Figure 3. — Results of Filling in a Cut in the Old Road

Figure 4 shows the results of using the excess material from the cut shown on the left side in the photo to fill in the old roadbed. The new road prism now appears as a through cut. The dashed lines in the photo indicate the approximate location of the old roadbed.



Figure 4. — New Road Prism

Figure 5 shows the aesthetic value in obliterating the old road. The material from new roadway was utilized to fill in old roadbed to original ground level. The dashed lines indicate approximate location of old road.



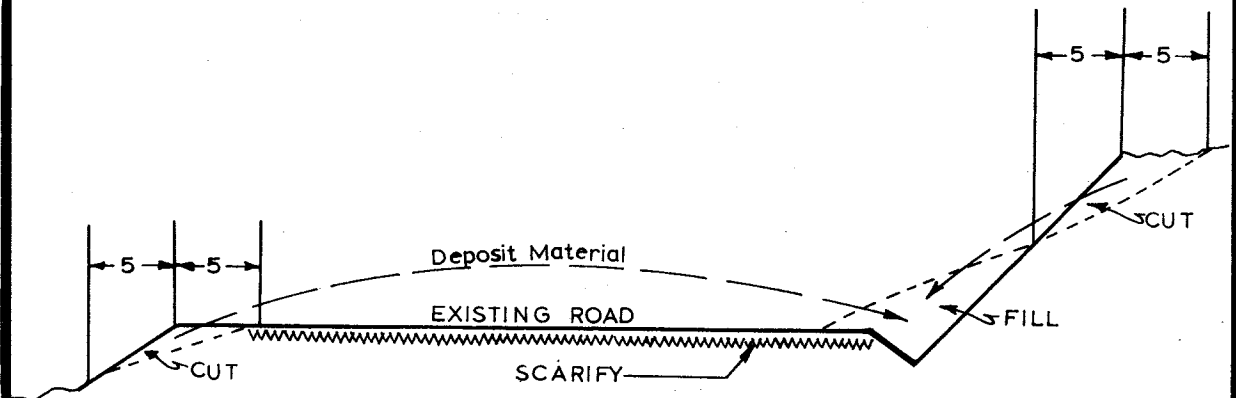
Figure 5. — The Scar of the Old Road Obliterated

Figure 6 shows a process used to remove the old roadbed from view at a point of a hill by extending the cut bank across the old roadbed with material from the new road construction. The dashed lines indicate where the cut bank was extended. The same process was used at the other end of the through cut.



Figure 6. — Extension of a Cut Bank to Block the View of Old Roadbed

TYPICAL SECTION



NOTE:

- (1) Warp around all trees and boulders over 3' Dia.. Dimensions shown are maximum distances. Reduce them when ordered by the Engineer.
- (2) Scarification will be done on all sections of the old roadbed not overlaid by the new construction, as shown on the plans.
- (3) Remove and dispose of culverts in existing roadway as directed by the Engineer. This work is considered incidental to obliteration.

Figure 7. – Sample of Typical Road Obliteration Plan

ROAD OBLITERATION

The existing road shall be obliterated as shown on the plans and staked on the ground. The old roadbed shall be scarified for the full width and to a depth sufficient to loosen the surface, but in no case to a depth less than three inches. Drainage dips shall be placed at intervals of 100 to 300 feet as staked by the engineer. Dips shall be full width of road, skewed between 20° and 30° off centerline, and constructed as shown on the plans.

Payment for this item shall include both scarification and drainage dips and will be on a per mile basis.

Figure 8. — Sample of a Typical Specification



METRICATION — SURVEYING CONVERSION FACTORS BY THE INTERNATIONAL SYSTEM OF UNITS (SI)

By B. W. Hostrop
Civil Engineer, Washington Office

INTRODUCTION

All units recorded for engineering work should show the English units followed by the preferred metric (SI) units in parenthesis. In addition, standard engineering notation by exponential powers of ten (both plus and minus) should be employed in tables of conversion factors. For additional information please refer to ASTM E380-72 titled, "Metric Practice Guide."

Those conversions normally employed in surveying are tabulated here for the convenience of the user. Not only the American Society for Testing Materials, but the American Society of Civil Engineers, American Congress on Surveying and Mapping, and American Society of Photogrammetry require that all units be expressed in both the English and the SI systems for all future publications. Consideration is being given to include these conversions as optional measurements in the Forest Service Directives System.

DEFINITIONS

Only those units common to the surveying profession are included.

<u>Quantity</u>	<u>Unit</u>	<u>SI Symbol</u>	<u>Formula</u>
Length	metre	m	—
Mass	kilogram	kg	—
Time	second	s	—
Temperature	kelvin	K	—
Plane Angle	radian	rad	—
Pressure	pascal	Pa	N/m ²
Area	square metre	—	m ²
Volume	cubic metre	—	m ³

INTERMEDIATE UNITS

A partial listing, by recommended preference, of permissible alternative non-SI units follows:

- Time — use seconds whenever possible, alternative units are minutes, hours, days, etc.
- Temperature — the use of the Celsius scale is permissible in Engineering in lieu of the Kelvin scale.
- Angles — when the radian is not a convenient unit for plane angles the only permissible alternative is the arc degree and its decimal submultiples (not minutes and seconds).

PREFIXES (SI APPROVED)

Approved prefixes for use are listed here.^{1/}

<u>Multiplication Factors</u>	<u>Prefix</u>	<u>SI Symbol</u>
1 000 000 000 000 = 10 ¹²	tera	T
1 000 000 000 = 10 ⁹	giga	G
1 000 000 = 10 ⁶	mega	M

^{1/} Previously other prefixes or units were in common use in the United States engineering and scientific communities. The more popular are hecta (10⁴), hecto (10²), deka (10¹), deci (10⁻¹), centi (10⁻²), micron (10⁻⁶), and angstrom (10⁻¹⁰). The continued use of these prefixes and units should be avoided.

<u>Multiplication Factors</u> cont'd.	<u>Prefix</u>	<u>SI Symbol</u>
1 000 = 10 ³	kilo	k
0.001 = 10 ⁻³	milli	m
0.000 001 = 10 ⁻⁶	micro	u
0.000 000 001 = 10 ⁻⁹	nano	n
0.000 000 000 001 = 10 ⁻¹²	pico	p
0.000 000 000 000 001 = 10 ⁻¹⁵	femto	f
0.000 000 000 000 000 001 = 10 ⁻¹⁸	atto	a

FACTORS

<u>Length</u> (From)	(To)	(Multiply by)
Foot (1960—CGPM)	metre (m)	3.048 000* ^{4/} E-01
Foot (US Survey) ^{2/}	metre (m)	1200/3937* E+00
Inch (1960—CGPM)	metre (m)	2.540 000* E-02
Chain (1960—CGPM)	metre (m)	2.011 680* E+01
Link (1960—CGPM)	metre (m)	2.011 680* E-01
Mile (1960—CGPM)	metre (m)	1.609 344* E+03
Rod (1960—CGPM)	metre (m)	5.029 200* E+00
Yard (1960—CGPM)	metre (m)	9.144 000* E-01
Vara (Florida) ^{3/}	metre (m)	8.476 488* E-01
Arpent, side of (Arkansas) ^{3/}	metre (m)	5.867 400* E+01

<u>Mass</u> (From)	(To)	(Multiply by)
Grain (Avoirdupois)	kilogram (kg)	6.479 891* E-05
Pound (Avoirdupois)	kilogram (kg)	4.535 924 E-01
Ounce (Avoirdupois)	kilogram (kg)	2.834 952 E-02
Ton (Assay)	kilogram (kg)	2.916 667 E-02
Ton (Long, 2240 lbm)	kilogram (kg)	1.016 047 E+03
Ton (Short, 2000 lbm)	kilogram (kg)	9.071 847 E+02

^{2/}The United States Survey foot value given is that based on the legal (15 U.S. Code 6) definition previously in use in the United States. All other values are the new legal ratios that will be employed. The Geodetic Control Net still has to be recomputed for the new foot meter value.

^{3/}Other legal values for the vara and arpent exist. Check local legislation.

^{4/}An asterisk following a conversion factor indicates that all subsequent digits are zero.

<u>Pressure</u> (From)	(To)	(Multiply by)
Inch of mercury (60F)	newton/metre ² (N/m ²) ^{5/}	3.376 85 E+03
PSI	newton/metre ² (N/m ²)	6.894 757 E+03

<u>Temperature</u> (From)	(To)	(Multiply by)
Degree Celsius	Kelvin (K)	$t_k = t_c + 273.15^*$
Degree Fahrenheit	degree Celsius	$t_c = (t_f - 32)/1.8^*$
Degree Kelvin	degree Celsius	$t_c = t_k - 273.15^*$

<u>Time</u> (From)	(To)	(Multiply by)
Hour (Mean solar)	second (s)	3.600 000 E+03
Hour (Sidereal)	second (s)	3.590 170 E+03
Minute (Mean solar)	second (s)	6.000 000 E+01
Minute (Sidereal)	second (s)	5.983 617 E+01
Second (Sidereal)	second (s)	9.972 696 E-01

<u>Plane Angles</u> (From)	(To)	(Multiply by)
Degree (angular)	radian (rad.)	1.745 329 E-02
Minute (angular)	radian (rad.)	2.908 882 E-04
Second (angular)	radian (rad.)	4.848 137 E-06
Grad (angular)	radian (rad.)	1.570 796 E-02
Minute (angular)	degree (angular)	1/60* E+00
Second (angular)	degree (angular)	1/3600* E+00
Grad (angular)	degree (angular)	9.000 000* E-01

<u>Area</u> (From)	(To)	(Multiply by)
Arpent (Arkansas) ^{3/}	metre ² (m ²)	3.442 638 E+03
Acre ^{6/}	metre ² (m ²)	4.046 856 E+03

^{5/}The unit pascal (Pa) will be substituted for newton/metre² (N/m²) in the near future.

^{6/}The exact value is 4.046 856 422 E+03.

<u>Area</u> (From) cont'd.	(To)	(Multiply by)	
Hectare $\mathcal{Z}$	metre ² (m ²)	1.000 000*	E+04
Foot ²	metre ² (m ²)	9.290 304*	E-02
Inch ²	metre ² (m ²)	6.451 600*	E-04
Mile ²	metre ² (m ²)	2.589 988	E+06
Chain ²	metre ² (m ²)	4.046 856	E+02
Section	metre ² (m ²)	2.589 988	E+06
Township	metre ² (m ²)	9.323 957	E+07
Rod	metre ² (m ²)	2.529 084	E+01
Yard	metre ² (m ²)	8.361 274	E-01

<u>Volume</u> (From)	(To)	(Multiply by)	
Acre-Foot	metre ³ (m ³)	1.233 482	E+03
Board-Foot	metre ³ (m ³)	2.359 737	E-03
Foot ³	metre ³ (m ³)	2.957 353	E-05
Gallon (U. S. Liquid)	metre ³ (m ³)	3.785 412	E-03
Yard ³	metre ³ (m ³)	7.645 549	E-01
Liter	metre ³ (m ³)	1.000 000*	E-03

<u>Flow</u> (From)	(To)	(Multiply by)	
Foot ³ /second	metre ³ /second (m ³ /s)	2.831 685	E-02

<u>Miscellaneous</u> (From)	(To)	(Multiply by)	
Fathom	metre (m)	1.828 800*	E+00
Cable	metre (m)	2.194 560*	E+02
Mile (nautical)	metre (m)	1.852 000*	E+03
Palm	metre (m)	7.620 000*	E-02
Hand	metre (m)	1.016 000*	E-01
Span	metre (m)	1.524 000*	E-01
Cubit	metre (m)	4.572 000*	E-01
Cubit (Biblical)	metre (m)	5.537 2	E-01
Pace (Military)	metre (m)	7.62	E-01

$\mathcal{Z}$ Since the SI System recommends prefixes for the exponential values of ten that are multiples, plus or minus of three; the hectare like the angstrom is not used. For larger areas, use kilometer² (Km²) or megameter² (Mm²).

EXAMPLES

The factor for converting 1 inch to 1 metre is listed as 2.540 000* E-02. This factor equals 2.54×10^{-2} exactly or 0.0254 exactly. Rules for mathematics regarding accuracy, precision, significant digits, rounding, and notation can be found in greater detail in ASTM E380-72.



WASHINGTON OFFICE DIVISION OF ENGINEERING NEWS

OPERATIONS

Harold L. Strickland
Assistant Director

Visible But Not Seen

Yes, they are there, but how much attention did you pay to them? What? The National Forest boundaries and the geographic names on that map you recently used.

How about some of those Forest Economics and Marketing Research publications, "Outlook for Timber in the United States" (formerly "Timber Trends") and "Demand and Price"?

There are write-ups of special studies, too; like wild and scenic rivers, conversion of primitive areas to wilderness areas, roadless area review, eastern wilderness studies, etc., all of which have graphs, charts, and illustrations. Perhaps you have been involved in the preparation of some of these.

Before long, there will be a new poster-and-small-metal-sign catalog with illustrations of all Forest Service signs.

Have you ever considered the need for accuracy in the portrayal of the Forest Service boundaries or the geographic names shown on the maps we publish or how those graphics came to be in the report?

The Cartographic unit in the WO Division of Engineering, Operations group, represents the Department of Agriculture on the Board of Geographic Names to insure that geographic names shown on our maps are accurate and to provide the Board with information concerning correct geographic names.

The Cartographic unit maintains the official atlases showing each National Forest boundary and boundary changes. Before all Forest Series maps are published, they are edited for general format, National Forest boundaries, and geographic names by personnel in this unit. Records are also maintained by this unit for the publication, "Establishment and Modification of National Forest Boundaries."

The Cartographic unit also prepares special maps for members of Congress showing Forest Service conditions. They also prepare charts, graphs, covers, maps, botanical drawings and other special illustrative material for the publications mentioned earlier as well as for the publications of the WO Divisions of Timber Management Research, Lands, Fire Management, Cooperative Forest Fire Control, and others.

Lew Glover heads this Cartographic unit. His principal assistant, Ed Marshall, is responsible for boundaries and atlas maintenance. Robert Driskell is the representative to the Board of Geographic Names. Hazel Hartman, Monroe Weston, Josephine Davis, and Marjory Herfurth add their special talents to complete the illustrations needed for publications like those mentioned above.

TECHNOLOGICAL IMPROVEMENTS

Heyward T. Taylor
Assistant Director of Engineering

Computer Generated Graphics

Resource managers, planners, interdisciplinary teams and private citizens will probably all agree with Confucius that one picture is worth a thousand words. Computer programs are now available on the UNIVAC 1108 for displaying a perspective view of a section of a roadway on a photograph. This procedure will help diverse groups of people visualize the relationship of a proposed road to the terrain. These computer-generated perspective plots on photographs are highly effective information sources. This procedure will help the user understand how the proposed road, or an improvement to an existing road, will affect nearby resources. For example, one can actually see how close the proposed road will be to an eagle's nest, a group of aspen trees, a meadow, a salmon spawning ground or a barn. By using computer-generated graphics for these situations there are ample opportunities for locating changes well in advance of any construction staking.

EDITOR'S NOTE: Our display board outside the Directors's Office is ready for a change! Do you have a display of an engineering project which you would be willing to loan us for awhile?

We have many visitors to the Division, including some from foreign countries. This display would be an excellent opportunity for you to visibly introduce your favorite project.

If you have a display you would like shown, please let us know.

