

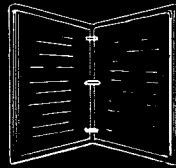
Letter

**ENGINEERING
TECHNICAL
INFORMATION
SYSTEM**

FIELD NOTES • TECHNICAL REPORTS • TEXTS
DATA RETRIEVAL • CURRENT AWARENESS

VOLUME 7 NUMBER 10

Field



Notes

Distribution of Culvert Camber Joints

Visual Aids for Compaction Control

Bridging the Wet Spots

Advanced Technical Training Program

Washington Office Engineering News



FOREST SERVICE

OCTOBER 1975

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 the 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. Because of the type of material in the publication, all engineers and engineering technicians should read each issue; however, this publication is not intended exclusively for engineers.

This monthly newsletter is published for distribution to employees of the U.S. Department of Agriculture—Forest Service and its retirees only. The Department of Agriculture assumes no responsibility for the interpretation or use of this information by other than its own employees.

The use of trade, firm, or corporation names is for the information and convenience of the reader. Such use does not constitute an official evaluation, conclusion, recommendation, endorsement, or approval of any product or service to the exclusion of others which may be suitable.

DISTRIBUTION OF CULVERT CAMBER TO THE JOINTS

Jim Rousey
Engineering Technician
Siuslaw National Forest
Region 6

When placing culverts under high fills, it is normally necessary to "camber" the culvert to allow for future settlement of the foundation and to prevent a sag in the flow line. Since corrugated metal pipe (CMP) has a limited bending capability, the camber must be applied to produce a gentle curve in the culvert, with approximately equal amounts of bend at each banded joint.

Obtaining camber during construction can be difficult, especially when the culvert is long. Merely "eye balling" the culvert bed is often inadequate, frequently resulting in most of the camber being applied at only one or two joints. The bands at such joints must often be quite loose to allow for the required "bend", which can contribute to leakage at those joints, and possible failure of the fill.

RnR or CW?

The following chart has been developed to uniformly proportion the total camber to each of the culvert joints. It can be used on any installation in which the culvert joints are approximately the same distance apart. It is recommended that the individual culvert sections not differ in length by more than four feet.

CAMBER FACTOR

No. of Sec's of CMP	Outlet	At Upper End of CMP Section								
		1	2	3	4	5	6	7	8	9
2	0.00	1.00	0.00							
3	0.00	1.00	1.00	0.00						
4	0.00	0.75	1.00	0.75	0.00					
5	0.00	0.67	1.00	1.00	0.67	0.00				
6	0.00	0.56	0.89	1.00	0.89	0.56	0.00			
7	0.00	0.50	0.83	1.00	1.00	0.83	0.50	0.00		
8	0.00	0.44	0.75	0.94	1.00	0.94	0.75	0.44	0.00	
9	0.00	0.40	0.70	0.90	1.00	1.00	0.90	0.70	0.40	0.00

INSTRUCTIONS

1. Determine total rise of CMP from outlet to inlet.
2. Divide by no. of sec's, of CMP & compute rise at end of each section.
3. Determine total amount of camber (engineer's judgement).
4. Multiply camber by factor for upper end of each section to determine camber for that section.
5. Add camber for section to rise for that section to determine cambered rise for that section.

The total amount of camber is determined by engineering judgement based on consideration of the flow line gradient, height of fill, compressive characteristics of the supporting soil and depth to rock or supporting stratum. The total camber is generally not less than 1/2 of 1% of the total length of culvert above the straight line connecting inlet and outlet.

The following example shows how the chart is used.

1. Rise of culvert from outlet to inlet = 10 feet.

2. Number of sections of culvert = 5

a. Rise per section = 10 feet ÷ 5 sections = 2 feet per section

<u>Culvert Section</u>	<u>Rise From Outlet to Upper End of Section</u>
1	2 feet
2	4 feet
3	6 feet
4	8 feet
5	10 feet

3. Total Camber = 1 foot

<u>Section</u>	<u>Total Camber</u>		<u>Camber Factor</u>		<u>Camber Rise</u>
1	1	x	0.67	=	0.67
2	1	x	1.00	=	1.00
3	1	x	1.00	=	1.00
4	1	x	0.67	=	0.67
5	1	x	0.00	=	0.00

<u>Culvert Section</u>	<u>Rise from Outlet to Upper End</u>		<u>Camber Rise</u>		<u>Total Rise from Outlet to Upper End Incl. Camber</u>
1	2.00	+	0.67	=	2.67
2	4.00	+	1.00	=	5.00
3	6.00	+	1.00	=	7.00
4	8.00	+	0.67	=	8.67
5	10.00	+	0.00	=	10.00

VISUAL AIDS FOR COMPACTION CONTROL

Leland W. Sperry
Materials Engineering Technician
Allegheny National Forest
Region 9

Compaction of soils has long been a critical factor in highway construction. In 1933, Mr. R. R. Proctor showed that there is a definite relationship between the soil moisture content and the degree of dry density to which a soil may be compacted. He also showed that, for a specific amount of compactive effort applied to the soil, there is one moisture content (optimum) at which maximum density is obtained. Mr. Proctor's findings are applied by, first, making a standard laboratory compaction test on the soil, and second, making a field density test after compaction. The ratio of field density to laboratory density is termed "relative compaction" and is always given as a percentage.

The original "standard" Proctor test is now defined by AASHTO Spec. T99-74 and ASTM Spec. 698-70. Several modifications of this test have been developed in recent years, but the same principle has been utilized with each modification.

Since the optimum moisture content of a soil may vary several percent from the natural moisture content of the soil in the field, a problem has always been encountered in visually identifying that optimum moisture value during construction. Here on the Allegheny National Forest, the natural moisture contents of the soils may exceed the optimum by ten percent or greater. This difference has always presented a major problem for our inspection personnel and the involved contractor's personnel. Much time and effort have been wasted attempting to compact materials that were just too wet.

Many of our soils on this Forest have a different appearance at optimum moisture than they do when they are excessively wet or dry. False identifications have been observed and improper control values have been used unwarily. Many construction problems have occurred because of this deficiency.

For the past 1-1½ years, a new method for identifying "ideal" moisture content has been successfully used on the Allegheny. During the laboratory preparation of the moisture-density control curve for a soil, a sample of the known moisture content has

been retained in a transparent, moisture-proof plastic bag for future reference. This sample was purposely "bagged" at near optimum moisture content level. Although optimum moisture is desired in the field, slightly above optimum will generally be the contractor's choice. The bagged sample has been taken to the field by our inspection people and used to make a visual comparison of the field moisture with that moisture content necessary for easy compaction. The experienced, as well as the inexperienced, person can quickly identify workable moisture contents with the transparent bag sample and select proper moisture-density control curves.

The moisture-proof plastic bags used in this procedure have been 18-oz. bags marketed by "Nasco" of Fort Atkinson, Wisconsin under the brand name of "Whirl-Pak". This bag has double wires and tape framing the opening. After the bag is approximately half full with the soil, it is whirled several times to form a moisture-proof seal. We have retained samples prepared in this manner for several months, and the moisture loss has been very slight when the bags are used and stored properly (steel cabinet at room temperature when not being used in the field). Some care has to be taken when handling the samples, because sharp-edged fragments may puncture the plastic bag, allowing the moisture to escape.

Twelve percent of our samples have been monitored for moisture loss, and the maximum loss detected has been 4.5% after fourteen months. This loss may have been caused, however, by an improper seal in the initial preparation. Contrasting with this sample, another sample monitored for ten months has lost only 0.4%. Most of the samples monitored have shown a loss of less than 2%. Since polyethylene is not absolutely moisture-proof, a slight moisture loss can be expected to occur over a period of time. With more monitoring experience, a definite loss rate may be established. It does appear that the loss is affected by several characteristics that are common to each sample. The soil composition, the initial moisture content, the method of storage and handling, the size of the sample, and the initial seal of the bag, all can have an influence upon the moisture loss. The moisture loss is minimized if these characteristics are properly managed.

The loss of moisture can easily be monitored by weighing and recording the initial weight of the bag sample, and its weight at any future time; therefore the moisture loss is never a significant problem. An equal weight of water may be added to the bag to attain the original moisture content (let stand 24 hours for uniformity), or the new moisture content of the sample can be readily calculated and used if desired.

Considering both inspection and contractor's operations, the sample bags have been quite useful. From the inspector's viewpoint, they help in making the decision as to "where and when" to test. In most cases, this ensures a much more uniform and economical end result. To the contractor, it means better information on "how and when" to do this compaction. Both parties have a quick, more accurate means to accomplish their work. In some instances, the samples have answered the question

“should we try to construct embankment today?” The Forest has successfully convinced contractors, without testing, that the specified density can or cannot be obtained, simply on the basis of comparing material in sample bags to that on the construction site.

Generally, the sample bags are prepared in advance of construction for purposes of project control. If actual construction has begun and it becomes necessary to evaluate a sample not previously encountered on a specific project, the bag samples become very helpful in identifying the new soil.

This is not an endorsement for “Nasco” or “*Whirl-pak*,” but a description of its use in the field. A similar plastic bag of equal quality would produce the same results.

BRIDGING THE WET SPOTS

Durray Dalley
Forest Engineer
Sierra National Forest
Region 5

Trail crossings through high mountain meadows and other areas with a high water table have always been a problem to hikers and trail maintenance crews. These moist areas quickly turn into mudholes under repeated use by horse and foot traffic (see fig. 1). The result is erosion, water pollution, and damage to protective vegetation. The standard way to avoid these problems has been to construct walkways of natural materials above the wet zones. These structures are expensive to build and cannot be easily transported from the construction site to where they will be used.

Several years ago, Donald Housley and Jim Wise (who were, respectively, Forest Engineer on the Bridger National Forest and Trail Coordinator for Region 4) developed a better idea. The two men designed a trail liner made of fiberglass that would provide a dry trail tread without impeding the natural flow of water through boggy areas.

The first trial was made near Elkhart Park on one of the main access trails into the Bridger Wilderness in the Bridger National Forest. This test proved that the fiberglass liners were an effective and economical method for constructing trails through wet areas. They have withstood five years of use without needing to be replaced. The fiberglass trail liners are fabricated in sections 3½ feet wide and 6 feet long. A pack animal can transport 80 to 100 linear feet of the liners without difficulty. The liners consists of a flat section which lies on top of the trail surface, and curved ridges on both sides (see fig. 2). Log poles are set under the ridges to hold the liners in place (see fig. 3). Then, two to three inches of soil is placed on top of the flat portion of the liner, as shown in figure 4.

Only the ridges are exposed to the trail user's view (see figs. 5 and 6). The liners can be manufactured in a variety of colors to blend in with different soil types. Last year, the Sierra National Forest negotiated with a local fiberglass fabricator to manufacture some beige-color trail liners. The cost was \$35 for each six-foot section, including the cost of the original mold. (See figure 7, detailed drawing of fiberglass trail corduroy.) The sections were installed on several trails leading into the John Muir and Miarets Wildernesses. This summer, Forest Service employees will observe trail users

crossing the test sections to determine if the wet spots on the trails are eliminated by the liners, and to determine the reaction of trail users to the new method.

If the fiberglass liners pass these tests, they will be installed widely along wilderness trails as a means of eliminating wet and muddy trails and reducing erosion. It is anticipated that unit costs for the trail liner sections will be significantly reduced by ordering them in larger quantities.



Figure 1.—Site selected for liner to be installed.

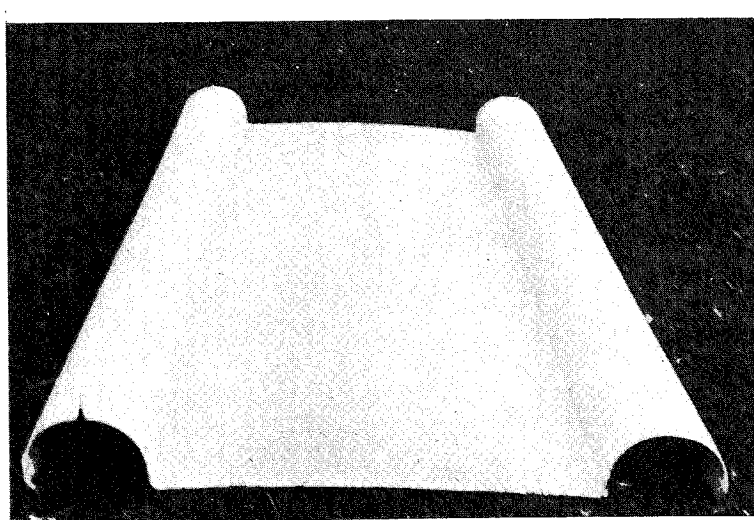


Figure 2.—Fiberglass trail tread liner.

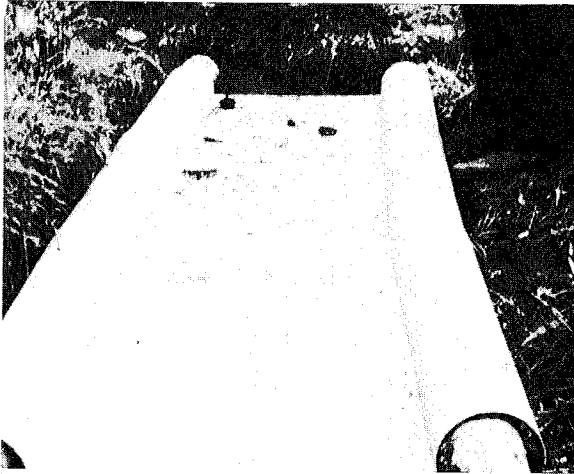


Figure 3.—Fiberglass trail tread liner installed and ready for placing of two- or three-inch cushion.



Figure 4.—Cushion placed on flat part of liner.



Figure 5.—Completed section ready for use.

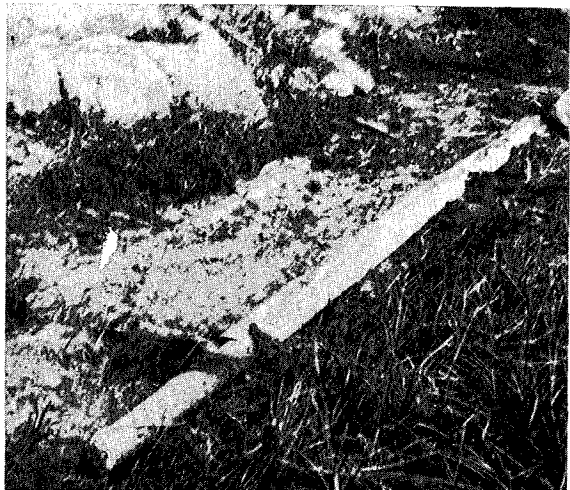


Figure 6.—In time vegetation will grow up against outside edge making installation almost unnoticeable.

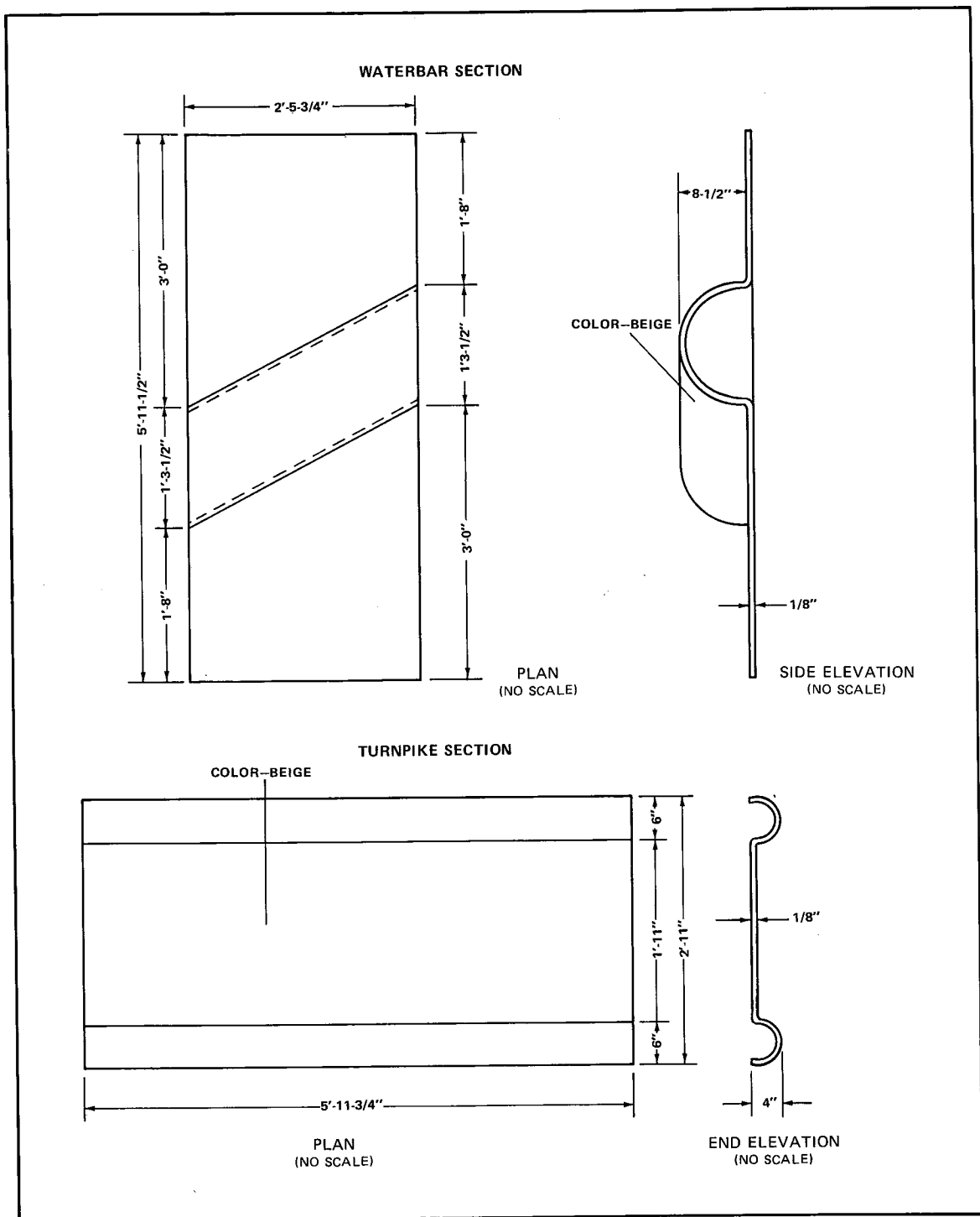


Figure 7.—Detailed drawing of fiberglass trail corduroy.

ADVANCED TECHNICAL TRAINING PROGRAM

R. Deleissegues
Technical Recruitment and Development Engineer

This year, the number of candidates selected for the Transportation Systems Analysis Program and the Logging Systems Planning and Layout Program was substantially increased in order to meet the increasing demand for personnel with skills in these fields.

The Transportation Systems Analysis Program is offered at the University of California, at Berkeley. The Program includes two options; the first is Transportation Analysis, and the second is Traffic Operations Engineering. Both study options have "core subjects" that included: Traffic Stream Characteristics, Systems Analysis, Transportation Engineering, Concepts of Probability, Transportation Policy and Planning, and Wildland Resource Economics and Planning.

In addition to the core, alternative subjects within the major options are available. With *Transportation Analysis*, there are Operations Research and Program Budgeting, City and Regional Planning, and Statistics. With *Traffic Operations Engineering*, there are Operations Research and Program Budgeting and Civil Engineering. It is recommended that our candidates follow the Transportation Analysis option, unless an individual's previous education and training has included significant preparation in that field. Course work in the core subjects is essentially the same for both options, in order to maintain the objectives of the program. Changes in these programs that are proposed by the students will be considered according to their previous experience and undergraduate courses.

The candidates that enrolled in September for the *Transportation Systems Analysis Program* are: Ted Berkebile, Alfred Clapham, and Bob Sutton from Region 5; Dave Nordegren from Region 6; and Charlton Lewis from Region 8.

The Logging Systems Planning and Layout Program at Oregon State University in Corvallis, Oregon, concentrates on strengthening skills in logging engineering, developing the role of the logging engineer in accomplishment of silvicultural objectives, and studying the impact of logging practices on other forest values. Basically, this is a two-year program consisting of nine months of formal graduate-level studies and fifteen months of planned on-the-job development. The actual length of the total training program will vary for each participant, depending upon the needs of his sponsoring Region, his past training and experience in logging systems, and the requirements of the Forest Service.

The objective of this Program is to develop the participant's capabilities (1) to solve logging systems problems on planned and existing sales; (2) to develop guidelines for starting sales programs with differing logging systems; (3) to prepare guidelines for application of these systems, using the latest technology to do the job efficiently; (4) to understand cost and production relationships; and (5) to train others and develop their skills.

The "core subjects" in the academic portion of the program consist of Logging Systems Mechanics, Transportation Systems, Forest Road Design, Advanced Technology in Forest Engineering Analysis, and Advanced Forest Hydrology.

This September, the following candidates enrolled in the *Logging Systems Planning and Layout Program*: Bob McRae and Ed Stryker of Region 1; Bob Ohmstede from Region 2; Tom Ortman from Region 4; Jim Benson of Region 5; and Ron Iff of Region 6.

Academic Accreditation is available under both programs, as a special student or as a graduate student; however, either enrollment can lead to graduate credit toward an advanced academic degree, or to an undergraduate degree in Forest Engineering.

Those interested in applying as candidates for either of these programs for the 1976 Fall semester are urged to do so. A Vacancy Announcement will be distributed to the Regions — probably in late October — which provides brief descriptions of course content and instructions for applying. For further information, contact the coordinators of these programs:

Transportation Systems Analysis Program

Transportation Analysis Group
Attn: Wm. Odendahl
USFS - PO Box 245
Berkeley, California 94701

Tel: (415) 486-3624 (FTS)

Logging Systems Planning & Layout Program

Forest Sciences Laboratory
Attn: John Sessions
3200 Jefferson Way
Corvallis, Oregon 97331

Tel: (503) 752-4420 or -4206 (FTS)

WASHINGTON OFFICE ENGINEERING NEWS

OPERATIONS

Harold L. Strickland
Assistant Director

ENGINEERING CERTIFICATION PROGRAM

Representatives of the Regions and the Washington Office met in Denver, Colorado, August 24 - 29 to review the Engineering Certification Program.

The discussion emphasized the need to reduce the man-hours presently used in scoring the examinations, and, as a result, written examinations will be prepared this year in multiple-choice format. A standard answer sheet that can be graded rapidly either by template or by machine methods will be used.

The examinations that are held most often will be the first ones rewritten to accommodate multiple-choice answers. These are: Roads, Administration, Asphalt, Sampling and Testing, and Aggregate Base and Surfacing.

Job Performance Requirements (JPR) will be reviewed and clearly described for the above categories. This information will be issued as a supplement or revision to the current JPR book (EM-7115-1). Examination questions will be keyed to the JPR. For the written examinations, a passing score will be 75 percent of the maximum possible; oral examinations will be scored as either "Pass" or "Fail." Based on review of the examinations at the Region, Forest Supervisors will be given information on the JPR material for which additional study is required, with recommendations for strengthening performance based on the oral examinations. This information will be provided for those who pass the examinations, as well as for those who fail.

Training is the responsibility of the employee's immediate supervisor. When performance deficiencies are noted, remedial action is scheduled by the supervisor; this may include on-the-job training, formal classroom courses, special details and assignments, and similar programs.

An Employee Career Development Plan (Form 6100-2) is required for each employee.
The Forest Supervisor uses that plan to schedule in an orderly manner the training and education that will contribute to the employee's career and enhance his value to

the Forest Service. The results of the Certification Program examinations will become an important part of the data the Supervisor uses in constructing the Employee Career Development Plan.

Forests may request assistance in developing training plans when such needs cannot be met at the Forest level. The Washington Office will coordinate training program development, and each Region will develop a Service-wide training plan in an assigned Certification category. This plan will include the lesson plan, references, and lists of available training courses and other materials.

PRECONSTRUCTION CERTIFICATION

These Regions are developing JPR material for preconstruction certification. The categories are basically the items recommended by a task force which met in the Washington Office during the week of May 20. The category on which each respective Region is working is provided below:

Category	Primary Responsibility	Assistance and Support
Route Location	Region 10	Regions 3 and 6
Surveying	Region 5	Region 8
Basic Road Design	Region 1	Region 9
Advanced Road Design	Region 9	Region 1
RDS (Computer System Application)	Region 2	Region 4

The JPR are scheduled for completion by April 30, 1976 and will be forwarded to all Regions for review. Those Regions that develop preconstruction certification programs prior to the completion and implementation of such a Service-wide program will use the new JPR material and the existing certification process to establish their Regional program. This process will ensure a smooth transition of new material into the Service-wide preconstruction certification program.

ENGINEERING SKILLS INVENTORY PROGRAM

An Engineering Skills Inventory Program, which is now operational, has been developed in Region 2 by Jim Hogan and Al Groven. Input to this system will be provided by Forests and Regions, and, hopefully, it will include *all* Engineering personnel.

In addition to providing a means of keeping records for the various certification programs, this Inventory will permit improvement in manpower planning, development of skills, and recruiting within the Forest Service.

The Regional Offices will furnish the necessary forms and instructions to the Forests to facilitate development of necessary input to the Inventory Program.

TECHNOLOGICAL IMPROVEMENTS

Heyward T. Taylor
Assistant Director

In the April 16, 1975, issue of the Federal Register, the Department of Health, Education and Welfare (HEW) published a proposal outlining requirements for certification of industrial sound level meters by the National Institute of Occupational Safety and Health (NIOSH). Under the plan, NIOSH would test the sound level meters for accuracy and reliability according to criteria for such meters contained in American National Standards Institute (ANSI), specification ANSI S1.4-1971.

Rob Harrison of the San Dimas Equipment Development Center (SDEDC) reported that meters on the proposed NIOSH certification list may not meet Forest Service needs because they only have to meet minimum NIOSH requirements, such as requiring only that the meter have an "A" weighted "slow" response meter characteristic. A meter with only the NIOSH characteristics is not suitable for assessing vehicle noise under accepted Society of Automotive Engineers, Inc. (SAE) and proposed Forest Service test methods. The terms "fast" and "slow" as used with the sound level meters are more than mere descriptors; they are precise requirements for instrument response times. The use of a meter on "slow" response will grossly undermeasure noise levels of vehicles.

The SDEDC is preparing a list of sound level meters that will be acceptable for all general purpose Forest Service field needs. This list will be sent to the field as soon as it is available.

CONSULTATION & STANDARDS

C. R. Weller

We have obtained copies of the DOT/FAA Advisory Circular, "Utility Air Access to National Transportation," (AC No. 150/5300-4B), dated June 24, 1975; ten copies will be distributed to each Regional Office.

This book contains pertinent and current information on airfields, and it should be a valuable reference for the Forest Service. It is being converted to microfiche format and will be available in the Washington Office Technical Information Center.

