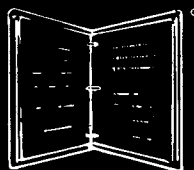


**ENGINEERING
TECHNICAL
INFORMATION
SYSTEM**

FIELD NOTES • TECHNICAL REPORTS
DATA RETRIEVAL • MANAGEMENT
PROFESSIONAL DEVELOPMENT

VOLUME 10 NUMBER 8

Field



Notes

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Washington Office News



FOREST SERVICE

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FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
Washington, D.C. 20013

USE OF PHOTOGRAPHS IN CONSTRUCTION PLANS

Paul Branchfield

Geologist, Umpqua National Forest

R-6

Although photographs can be an effective and accurate means of transmitting information, they are not used to any extent in the production of construction plans--where accurate transmittal of data is extremely important. Generally, orthographic drawings are relied on to provide the essential details in the plans. Photos can be used in construction plans to show rock pits, slides, bridge sites, or other features. Often, the photo image is more effective than drawings or written descriptions, and ink can be used to mark the image to define development areas or special points of interest.

In Region 6, illustrating small rock pits has been the primary use of photos on construction plans. The system permits us to rapidly and economically draft a plan that shows the contractor the development limits, crusher and stockpile sites, and areas of the pit which may require special attention.

One reason, probably, that photos have not been used more frequently is the basic differences in the methods of reproducing the construction plans and photographs. Copies of construction plans usually are reproduced by the "ozalid copy" method, which is not suitable for pictures recorded photographically unless a special technique--the "halftone method"--is used. Because the halftone techniques are not widely known outside the printing industry, photographs are seldom used on construction plans--even in those instances when they would be the most effective means of transmitting certain required information to the contractor.

However, there is a simple mechanical technique for successfully reproducing a quality photographic image on ozalid copies, and the materials are readily available to any unit that wants to use photos to display information in the construction plans. This technique involves use of a positive transparency that is fastened to a vellum plan sheet.

Ordinary black-and-white photo negatives can be processed to produce positive-image transparencies; usually, this can be done locally. The low cost and quick processing factors make it feasible to use photos more often in

production of our construction plans. Orthophotographs (such as aerial photos with superimposed elevation contours) on transparent film are available from commercial photo labs, but they are considerably more expensive than the positive transparencies used or needed in our method.

OZALID PRINTING TECHNIQUE

In ozalid printing, a positive master copy is placed over a sheet of treated paper, and the print is then exposed to a bright light. The light passing through the master copy alters the chemicals on the treated paper, except for areas that are protected or shielded from the light by dark areas on the master. After this exposure, faint lines can be seen on the treated paper that correspond to lines on the original positive image. The special chemical in the unshielded areas (where the master was blank) has been transformed by the intense light.

The treated paper is then exposed to strong ammonia fumes, and the chemical reaction causes the residual traces of the photosensitive chemical to darken, usually to blue or black. This produces the familiar print used for most construction plans.

The special photosensitive chemicals of the ozalid paper have a fairly wide tonal range. This factor allows prints to be made lighter or darker by using different exposure times, and it also allows monochromatic photographs to be reproduced. Monochromatic photographs (such as common black-and-white photographs) depend on differing shades of the same color to make up the image. To reproduce a photograph on an ozalid print, a positive transparency is required, since the ozalid is a direct reproduction (i.e., black area on the master results in black area on the print); further, the positive must be the size desired on the ozalid print, as most ozalid printers do not enlarge or reduce the image of the master.

MAKING A POSITIVE FILM TRANSPARENCY

The technique for producing a positive transparency is easy and inexpensive; if an in-house photographic darkroom is available, 8" x 10" (20.32 cm x 25.4 cm) prints cost about \$.60 each. The only special item required is positive film sheets, such as 8" x 10" (20.32 cm x 25.4 cm) *Kodak Fine Grain Positive Film #7302*, which is an adequate size for most construction plan photographs. The 8" x 10" (20.32 cm x 25.4 cm) film is packaged in boxes of 25 sheets, and the present cost is about \$13.00 a box. Any photographic darkroom that is equipped to produce the usual black-and-white photographs can process the film; in fact, this film can be handled in the same way as standard enlarging paper, since the major difference is the "backing," which is transparent film instead of opaque paper. The positive film can be handled in the darkroom with either an OA or No. 1A safelight that is kept at least 4 feet (1.22 m) away from the film.

Since the *Kodak Fine Grain Positive Film #7302* is a special professional type product, it is not available through most hobby or amateur dealers, and it may be necessary to contact the local Eastman Kodak Company to find a convenient source. Many photo labs may have alternative continuous-tone films which will do the same job.

Exposing the Film. A standard black-and-white negative of the subject is used; it is preferable to place the negative in the enlarger upside down, so that the normal view shows on the reversed image on the enlarging easel. The enlarger is adjusted and focused for the desired size and shape of the photo. The continuous-tone film is placed in the easel *emulsion side up*, so that the negative image is reversed; but when the transparent print is made and affixed to the plan sheet with the emulsion side down, the picture will be correctly oriented. Using this method, additional details can be inked on or blocked out of the image on the non-emulsion side of the film without disturbing the fragile emulsion coating (fig. 1).

Getting the best exposure on the continuous-tone positive film may require some trial-and-error experimentation. The best results seem to be obtained when the exposure is about the same as that used for *Kodak Kodabromide F-2* paper, a common black-and-white enlarging paper. The finished photographic image must be dense enough to carry all of the required details on to the ozalid print, but cannot be too dense or ink lettering on the picture may be obscured. Since diazo machines vary widely in wattage

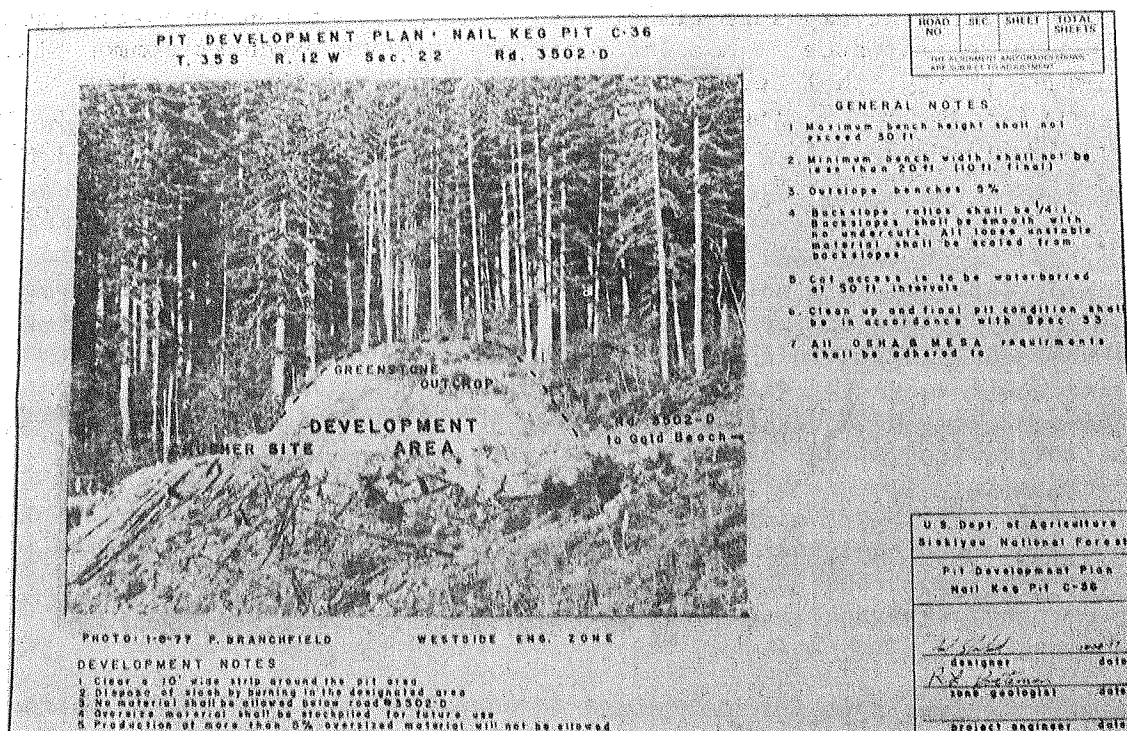


Figure 1.--Construction plan with continuous-tone photograph printed on vellum. Note detail added with black ink to describe features.

output, a sample positive should be given to the photo lab so that the best diazo prints can be made.

Processing the Film. Processing of the exposed positive film is done in the same way as for standard black-and-white enlarging paper; *Kodak D-76*, *Dektol*, or *D-11* developers will work. We have been using *Dektol*, and developing the exposed print 2 to 4 minutes. After developing, the positive transparency should be rinsed in acid stop-bath solution for 30 seconds and fixed with either regular or rapid fixer for 2 to 4 minutes; if possible, use a fixer containing a hardening agent. After fixing, wash the film with running water for at least 20 minutes. After washing, rinse the film in a wetting solution, such as *Kodak Photo-Flo*, to reduce water spotting during drying; then, hang the film to dry in a dust-free area.

MAKING THE COMBINATION PLAN PRINT

To attach the film to a plan sheet, the film should have a clear 1/4" (.64 cm) margin around the image. Cut out the area on the plan where the picture will go so that the margin of the picture overlaps the cutout in the vellum sheet. Any transparent adhesive suitable for splicing vellum should be suitable for attaching the film in place on the plan sheet; usually, only the top edge of the film is taped to permit the film and vellum sheet to travel through the ozalid machine without wrinkling.

OTHER CONSIDERATIONS

Since the commercial lab production is more expensive and the positive film is not generally a common on-hand item, some advanced planning should be done before the method described is tried the first time. A unit planning to do some of this type of work should locate the source for purchasing the film, and might send some to the photo lab along with the negatives to be printed; details would have to be worked out with the lab doing the work. Another way to get the processing done would be to find a local amateur who would be willing to do some of this work, or find a darkroom and make arrangements to do the work yourself. Often, Regional Offices or Supervisor's Offices have darkrooms available where work of this nature can be done for individual units.

Alternative Methods. Alternative methods are available--that involve little or no additional cost and effort--to produce a good printed photo image in the plan, and incorporate the halftone dot (screen pattern) mentioned in the opening paragraphs, and thereby improve the quality of the finished plan copies.

One alternative is to purchase *Kodak Autoscreen Ortho Film #2563*, which is a "pre-screened" film; it costs about \$18 per box of 25 sheets of 8-1/2" x 11" (21.6 cm x 27.9 cm) film. This product is handled in exactly the same manner as the continuous-tone monochromatic film.

Another approach is to use a patterned material that will break up the continuous tone of the original photo negative; actually, this is doing the same thing that a lithographer does when he prints a book. Figures 2 and 3 were made by inserting a sheet of *ZIPTONE* material between the original negative and the unexposed positive film before making the exposure. One was made with a line pattern, and the other with a dot; both are effective for the purpose described. In the examples, the wax was not removed from the *ZIPTONE* sheets.

Other materials that can be used to obtain the same effect are cheese cloth, or silk screening sheets (used in making signs and similar items), or similar sharply-patterned items.

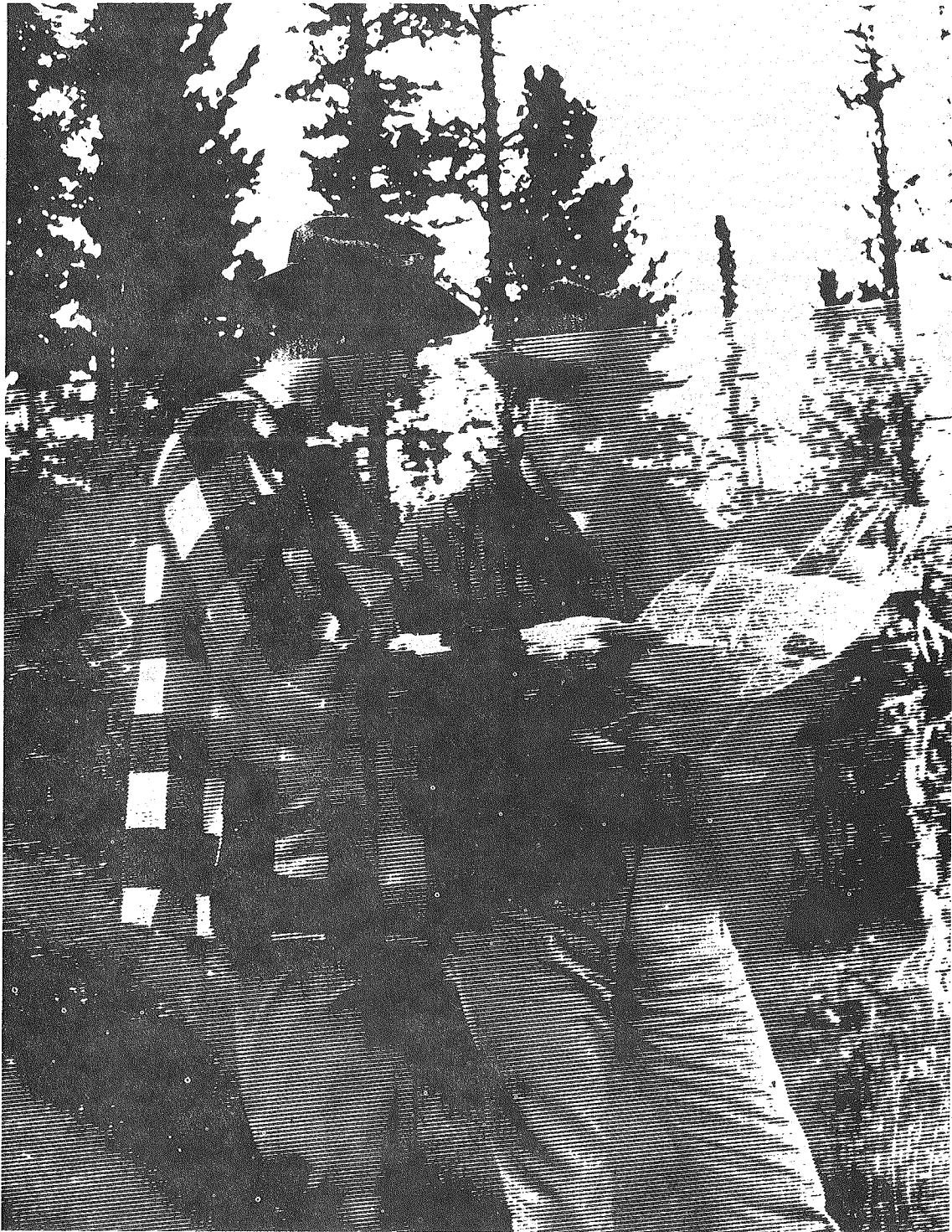


Figure 2.--Line-patterned print section made with ZIPTONE sheet that is available from most art and graphics materials suppliers.



Figure 3.--Dot-patterned print section made with ZIPTONE sheet that is available from most art and graphics materials suppliers.

DESIGNATION OF WATER RESOURCES

Leon Lehr
Sanitary Engineer

Bill Opfer
Sanitary Engineer

Consultation and Standards (WO)

There has been considerable interest and controversy concerning the degree and extent of information that shall be provided to the public about the safety of water sources on National Forest land.

A revision to FSM 7421 is being printed that addresses many of the issues and concerns relating to the requirements for potable water and the signing of unsafe drinking water sources. The new FSM 7421 reads, in part:

" . . . Any water offered as intended for human use, whether for drinking, cooking, or washing, is considered potable. To furnish water by any means of development that indicates physical protection is given, by design and construction features, must be considered as evidence of intent of human use.

Water sources in areas where compliance with the *National Interim Primary Drinking Water Regulation (NIPDWR)*, State regulations and manual standards is physically impossible (i.e., Wilderness Areas and cross-country trails, etc.), must be maintained in an undeveloped condition that clearly indicates the water source is unprotected.

When providing the public with information about these water sources through trail guides, brochures, or maps, a warning statement as to the potability of the water must be included. Any modifications to these unprotected sources must be limited so as not to mislead users into thinking the water is protected and safe. Water sources where a potential for chemical contamination poses a threat to public health should not be identified on maps and brochures. . . .

Water provided for range and wildlife water developments and firefighting is not intended for human use and shall be considered non-potable water. Requirements of this chapter will not apply to range and wildlife or firefighting developments unless its design and construction features clearly provide for

human use through fixtures such as faucets and drinking fountains or it is an integral part of a potable water system. Such integral systems must meet all requirements for potable water and shall additionally provide suitable cross-connection for the potable portion."

This direction was developed as a result of several recommendations and opinions provided by the Office of the General Counsel (OGC) concerning possible tort liability for signing water sources. The OGC concluded that in areas where particular lands are open for intensive public use, a user is an invitee on public land and the Government owes the user a duty to exercise ordinary care and prudence in rendering the area of intense use safe and to warn of unknown dangers.

As applied to water sources, the Government should disclaim the potability of water by signs, and by warnings on maps and other printed information. However, in areas of dispersed use there is generally no duty to sign water sources found on public lands, unless these sources are expressly or implicitly held out to the public as potential drinking water, and are so located that a reasonable person might believe they were sources of drinking water (such as a spring in a campground), or constitute an extraordinary risk to health or safety. There does not have to be a sign at every water source disclaiming potability, nor does there have to be a disclaimer posted each time that the name of a historical or landmark site includes reference to water (e.g., "Oaken Bucket Spring," or "Silver Spring," or "Butler's Wells"). The relevant factors to consider before placing disclaimer signs are (1) the extent and purpose of the public use, and (2) the amount of risk involved.

For an area of intense public use (such as a component of the National Trails System or a highly-developed campground), even though there is, generally, no *affirmative* duty to sign or indicate potable water sources, once the Government assumes that job, it assumes the duty to do it correctly. Merely indicating the location of a water source on a map or sign without referring to its purity implies that it is safe to drink. The principal purpose of the trail or campground is to provide a recreation experience, and the public is invited and encouraged to participate in that activity. In the context of a heavily-used hiking trail or campground, signing the location of water sources could reasonably be construed as an implied warranty that such water is for drinking purposes; therefore, a reasonable person hiking the trail or using the campground could construe the sign as indicating a drinking water source. Generally, a higher standard of care should be exercised in areas of intense public use than is required for other general purpose lands, because of the high intensity of use over a relatively small land area.

With respect to drinking water, an area of much greater significance lies not with springs or streams or other open sources, but with developed sources, such as hand pumps in campgrounds, wells, and pipes. Where those

facilities exist, the system must be monitored to insure that the water is safe, or that the system is closed to public use. Signing is not appropriate where the water is pumped or passes through manmade facilities. There need not be signs disclaiming potability at *every* ground water emergence point, nor is it necessary to remove existing signs at those points. Failure to sign--except where water may be poisonous or contaminated--does not raise inordinate risks of liability. A disclaimer statement on maps and brochures that provides information relative to the safety or purity of water sources should be sufficient to protect the Government from most potential liability claims.

CURVE WIDENING

Rick Nelson

Civil Engineer, Willamette NF

R-6

For several years, the Forest Service has followed the practice of adding extra surface width to roadway curves in order to make operating conditions on curves comparable to the conditions on tangents.

Extra width is needed on road curves because, in rounding a curve:

(a) the rear wheels generally track inside the path of the front wheels, and the truck--or other vehicle--requires a greater width of road surface as a result of this difference in tracking paths; and

(b) the driver experiences difficulty in steering the truck so as to hold the truck in the center of the lane.

The following formula generally has been useful to compute the extra width required for a curve:

$$\text{Curve widening to be added} = 400/\text{radius of curve}$$

This is a compromise formula; it is adequate for log trucks on long curve lengths; but tends to produce extra width that may be somewhat excessive on short curve lengths. Further, the formula may be inadequate for computing curve widths to accommodate vehicles that are appreciably longer than normal.

In October, 1976, Leonard Della-Maretta and Michael Cisneros of the San Dimas Equipment Development Center (SDEDC) published *Trailer Tractrix Equations and Computer Program for Curve Widening*. That publication has been revised and reprinted recently; copies are available from SDEDC. Using the equations presented in that publication (the most recent one we have on this subject), it is possible to develop design curves from which we can determine the curve widening values necessary to accommodate the tracking variations of vehicles of any size that are traveling on a curve of any radius and deflection angle.

Figure 1 shows the geometry of "offtracking." The outside offtrack is determined easily. If R is the curve radius, and L is the tractor length, the offtrack is $(L/\sin(\cos^{-1}(L/R)))-R$.

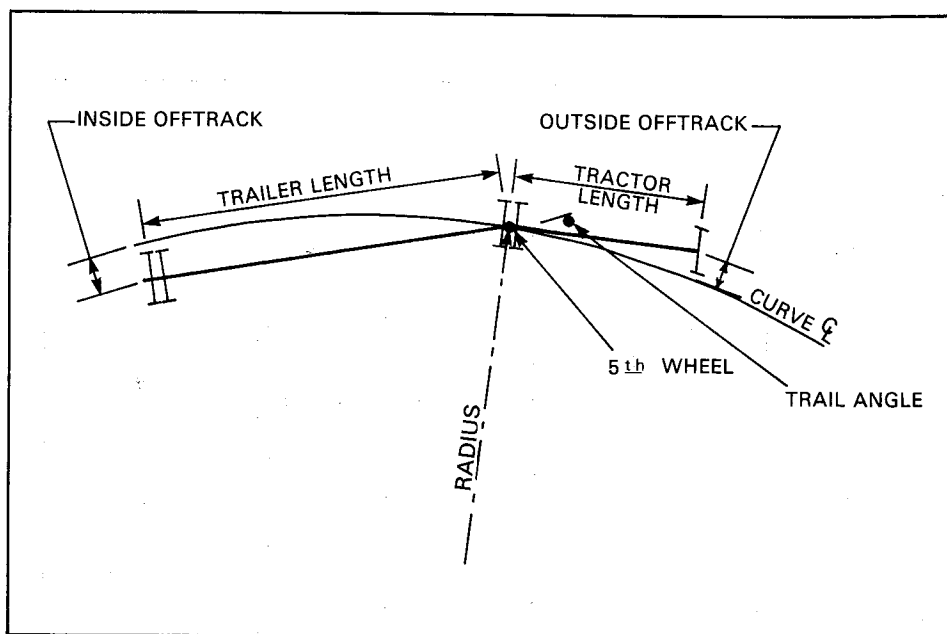


Figure 1.--Geometry of offtracking

Design curves for the inside offtrack can be developed by using a computer program to calculate the maximum offtrack for a specific trailer length and varying the radius and deflection angle. Figures 2 and 3 show curves that have been developed for 40- and 55-foot (12.19 m-16.76 m) trailers. To find the inside offtrack, go up from the deflection angle at the bottom until you intersect the curve representing the radius; then, read the off-track from the scale at the left. Then, the inside roadway width from the centerline is just the offtrack plus one-half the vehicle width. For instance: a 40-foot (12.19 m) trailer on a 100-foot (30.48 m) radius curve with a deflection angle of 80° will have an offtrack of 7.8 feet (2.38 m). If the vehicle is 8-feet (2.44 m) wide, the inside roadway width will be 11.8 feet (3.6 m).

The *Tractrix Program* may also be used to design bridge approaches and critical intersections. Figure 4 is a copy of the *Tractrix Program* print-out on a HP 9830A. The PI of the curve is set at Station 100; the first two columns are the station and the offtrack of the rear of the trailer, and the third column is the station of the fifth wheel. The wheel track of the inside rear wheel can then be plotted as shown, and this plot can

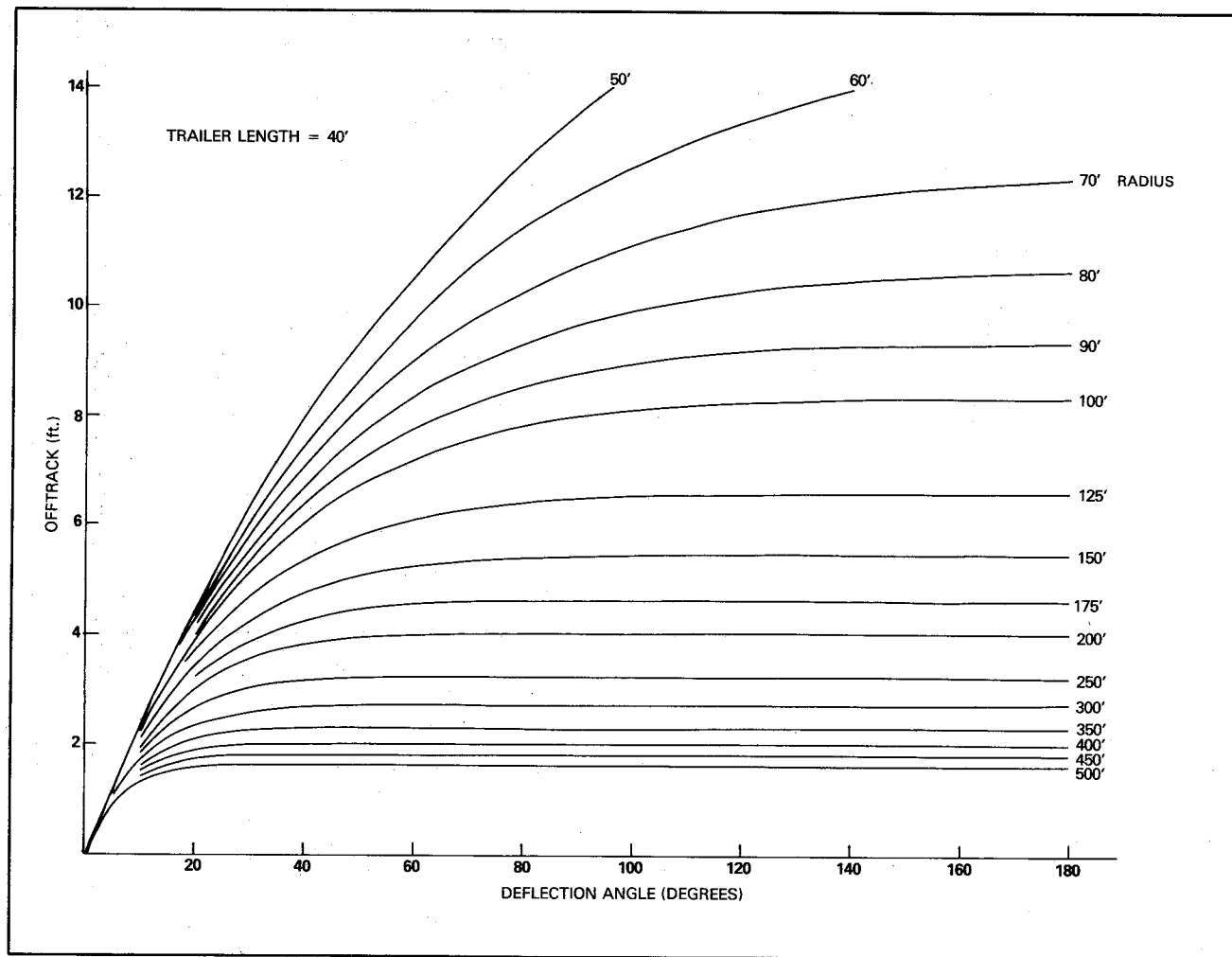


Figure 2.--Design curve for 40 ft. (12.19 m) trailer

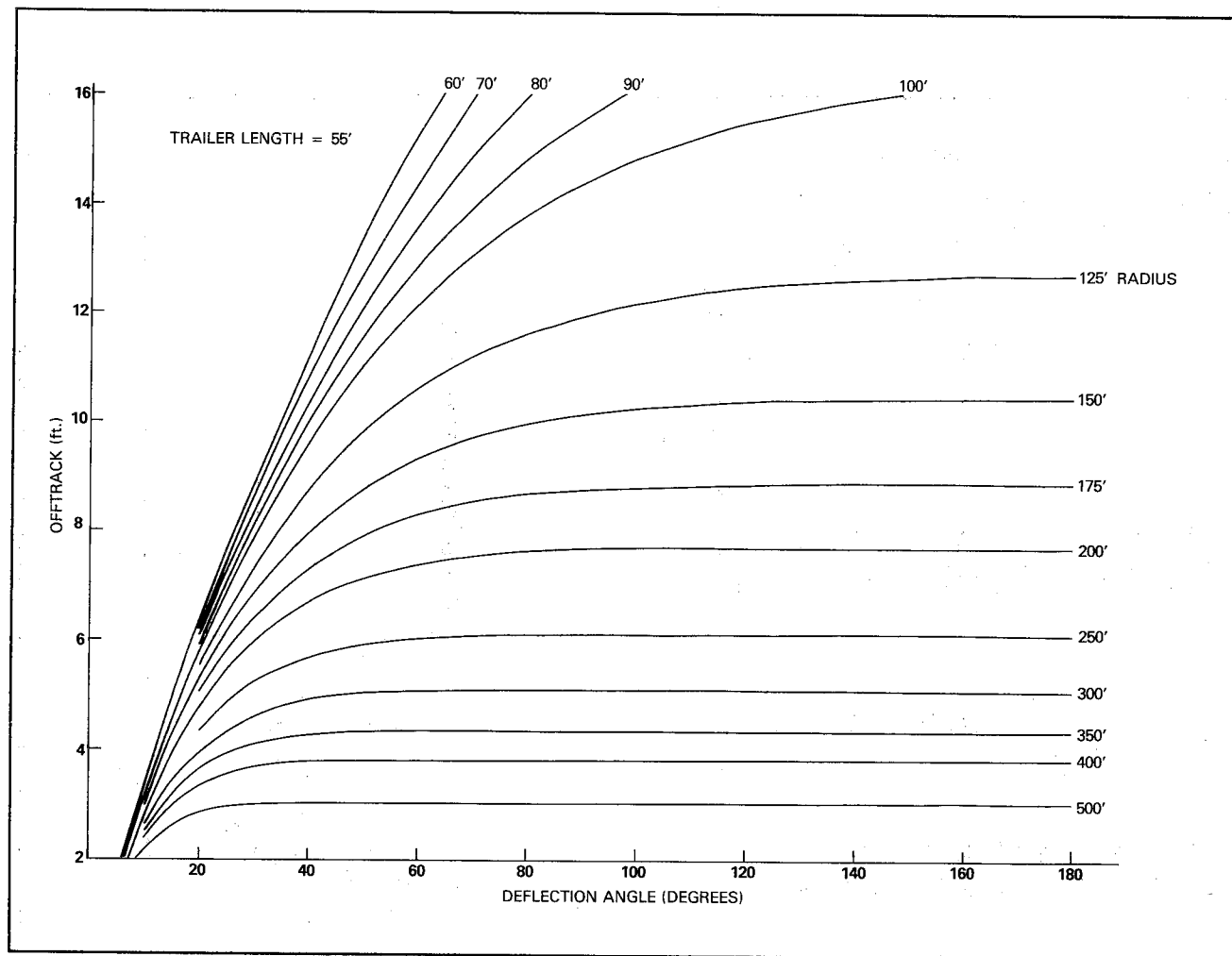


Figure 3.--Design curve for 55 ft. (16.76 m) trailer

R= 80 DEF= 80 TRAILER L = 55				
STATION OFFTRACK	OFFTRACK DISTANCE	STATION ANGLE	TRAIL ANGLE DEGREES	RADIUS OFFTRACK
35.00	0.00	90.00	0.0	INFINITY
45.00	0.00	100.00	0.0	INFINITY
58.98	0.04	110.00	6.5	INFINITY
66.77	0.27	120.00	12.0	INFINITY
75.06	0.87	130.00	16.6	INFINITY
83.75	1.94	140.00	20.4	INFINITY
92.73	3.57	150.00	23.7	INFINITY
101.95	5.78	160.00	26.4	80.00
111.35	7.95	170.00	28.8	80.00
120.89	9.81	180.00	30.7	80.00
130.53	11.42	190.00	32.4	80.00
140.26	12.80	200.00	33.9	80.00
150.05	13.99	210.00	35.2	80.00
151.72	14.18	211.70	35.4	80.00
173.96	15.18	221.70	29.8	80.00
181.85	15.86	231.70	25.0	80.00
190.33	15.98	241.70	20.9	80.00
199.25	15.34	251.70	17.5	80.00
208.49	13.82	261.70	14.6	80.00
217.95	11.64	271.70	12.2	INFINITY
227.57	9.74	281.70	10.2	INFINITY
237.31	8.14	291.70	8.5	INFINITY
247.12	6.80	301.70	7.1	INFINITY
256.99	5.68	311.70	5.9	INFINITY
266.91	4.74	321.70	4.9	INFINITY
276.84	3.95	331.70	4.1	INFINITY
286.80	3.30	341.70	3.4	INFINITY
296.77	2.75	351.70	2.9	INFINITY
306.75	2.29	361.70	2.4	INFINITY

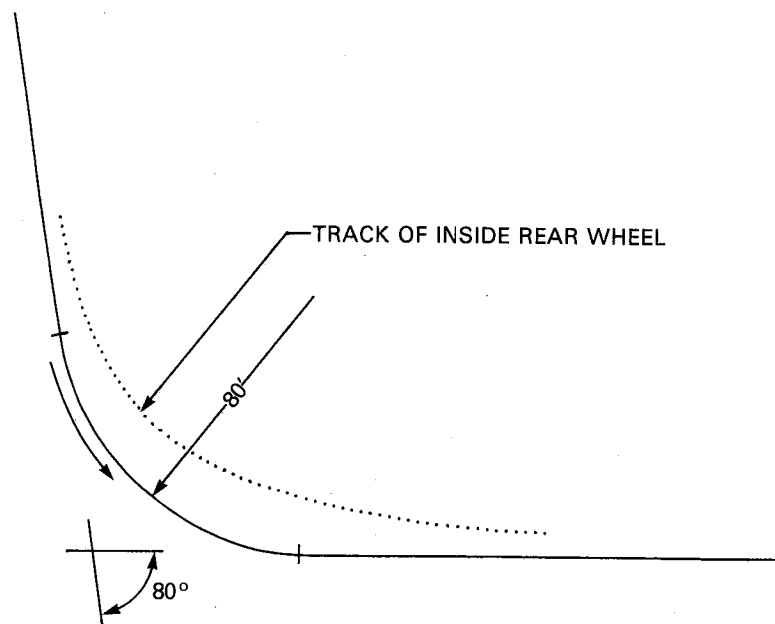


Figure 4.--HP 9830A printout and diagram of inside rear wheel tracking

then be used to design the intersection or bridge approach to handle the design vehicle. This technique may also be used to plot the path of the front overhanging portion of a yarder.

A powerful tool in an area that had previously been mostly guesswork, the *Tractrix* equations make it possible to actually determine what curve widening is necessary and the proper dimensions to bridge approaches and intersections.

WASHINGTON OFFICE NEWS

OPERATIONS

Harold L. Strickland
Assistant Director

ENGINEERING CERTIFICATION PROGRAM

Representatives of the Regions and the Washington Office will meet in Denver, Colorado, during the week of August 21-25, 1978, to share information on Service-wide problem concerning the *Certification and Technical Data Systems Programs*, and to develop recommendations for corrective action.

One of the recent changes in the program in the WO provides for the WO technical staff specialist in Consultation and Standards to work directly with the Regions to keep the Certification Examinations and associated training material current in their specific specialty area. The Technical Recruitment and Development Engineer will continue to function, however, as the program coordinator in accordance with FSM-7115.04a. Technical Staff Specialists in the WO will work with their Regional counterparts to determine the extent of training (by quantity and skill level) needed to correct any skill deficiencies, and to develop recommendations for methods and/or programs to assure satisfactory job performance.

PRECONSTRUCTION CERTIFICATION

In development of the *Preconstruction Certification Program*, the WO Preconstruction Engineer in Consultation and Standards will be working with a small task force assigned to follow up on the Regions' earlier work in the Preconstruction categories.

TRANSPORTATION ANALYST TRAINING COURSE

According to recent audits and reviews, the visible process of relating the transportation system to resource management is deficient on many Forests.

To correct this problem, a modular instruction program has been developed through a cooperative agreement with the University of California at Berkeley. Many Forest Service personnel assisted the University in development of course content.

In addition to enhancing the skills of Forest Transportation Analysts, the program is designed to provide the techniques necessary for (1) completing the Forest Service *Land Management Plans* (with related transportation and other considerations) by 1985, as required by the *National Forest Management Act*; and (2) meeting Forest Service needs in the *Small Area Planning* efforts. The modular concept used in the pre-testing and training allows each person to be trained in *only* the particular aspects of transportation planning for which he has a job performance need.

Prototype courses were given at Fort Collins, Colorado, by which training material was validated. Of special concern was its relevance to the development of skills necessary for Transportation Analysts to perform the work at the Forest level.

A course development steering committee will evaluate the results of the prototype module training sessions prior to final preparation of the program modules. The steering committee is comprised of:

1. An Assistant Director of Engineering (WO);
2. Several Regional Directors of Engineering and Assistant Regional directors;
3. A Forest Supervisor;
4. A District Ranger;
5. Personnel from Engineering Training and Development; and
6. Staff Specialists in Transportation Planning from Regional Offices and the Washington Office.

We expect to have the course material available for distribution early in FY 79.

SELF-STUDY COURSE BOOKS

In the *Engineering Certification Program Self-Study Course*, we still have available for distribution several copies of *Basic Mathematics* (EM 7710-1) and *Measurements* (EM 7710-1a).

Construction Inspection, Parts 1 and 2 (EM 7710-1b and 1c) are out of print. Revised editions of these will be available within 6 months; the revisions will include the most recent versions of the *Forest Service General Provisions and Specifications for the Construction of Roads and Bridges* (EM 7720-100).

CONSULTATION AND STANDARDS

*Walter E. Furen
Assistant Director*

A Service-wide *Sanitary Engineering Workshop* is scheduled for March 5-9, 1979. The general purpose of this workshop is to evaluate past water and sanitation system designs with respect to water pollution abatement and public health protection. This type of workshop is especially pertinent now because of recent amendments to the *Acts* controlling *Safe Drinking Water* and *Clean Air*, as well as the promulgation of several regulations authorized by the *Resource Conservation and Recovery Act*.

It is anticipated that these dialogues will present an opportunity for the exchange of technical ideas, design features, and program management concepts. Field personnel are encouraged to contact their Regional Sanitary Engineers with suggestions for workshop topics and/or presentations that may be of particular interest or concern as related to the direction, requirements, and limitations of existing programs.

TECHNOLOGICAL IMPROVEMENTS

Heyward T. Taylor
Assistant Director

STEEP-SLOPE SEEDER DEVELOPED

The San Dimas Equipment Development Center (SDEDC) has designed and fabricated a series of successively-refined prototype seeders for attachment to a telescoping boom crane (see fig.1) The seeder is used on steep slopes that need revegetation, for instance, in order to stabilize the surface after road construction, and to correct ski area or mining land disturbances. Initially, the members of the Steep Slope Stabilization Workgroup of the multi-agency *Vegetative Rehabilitation and Equipment Workshop*, plus additional key people, developed criteria to make sure the seeder would be as economically feasible as possible.



Figure 1.--SDEDC seeder, mounted on hydraulic telescoping boom machine, operating on littered cut bank on Willamette National Forest, Oreg.

The current seeder's design incorporates individually spring-loaded scarifier tynes. Seed and fertilizer are spread behind the tynes by two dc motor-powered broadcast seeders. In "loose" soils, the seed is covered by dirt drags pressed down by spring-loaded tynes that have an upward shaped opening. In "hard-packed" soils, the drag assemblies can be inverted, so that the tynes provide additional soil loosening, while also covering much of the seed with dirt. Then the soil is compacted by spring-loaded, terrain-following wheels.

Carriers capable of holding and positioning the seeder are limited to a few telescoping-boom hydraulic cranes. Other cranes proved inadequate because they could not elevate and depress through the angles required, or because they could not reach out very far. Knuckle-boom cranes were eliminated because their knuckle joints could not be subjected to the side loads imposed on the boom.

In 1976, the first SDEDC prototype seeder was tested on the Boise National Forest, (R-4). These tests were aimed at comparing effectiveness of the new device with several current methods of planting roadside slopes, i.e., (hydroseeding with Silva fiber mulch, broadcast seeding, broadcast seeding with straw mulch held in place with jute netting). All test sites were along one road near Idaho City, Idaho. The fill slopes were generally 1 1/2:1; most of the cut banks were measured at 3/4:1. The soil is coarse-textured granitic sand. Germination, survival, and growth rates for the seed planted by the SDEDC seeder were very impressive and surpassed those of seed planted by the other three methods.

Table 1.--Comparison of methods for planting roadside slopes

Seeding method	No. of plants per sq. meter plot	Percent plant cover attained
Hydroseed	30	20
Broadcast	42	37
Broadcast w/ straw mulch and net	60	31
SPEDC seeder	80	43

The cost of hydroseeding the test sites was estimated at \$400 to \$600 per acre; no costs were gathered for the two broadcast approaches. The cost of operating the seeder ran about \$100 per acre; unless the amount of slash on the site caused difficulties for the operators, then costs were about \$180 per acre. After the tests on the Boise National Forest, SDEDC engineering work was aimed at making the seeder more durable without increasing its weight beyond the capacity of existing hydraulic cranes.

This spring, an improved SDEDC steep-slope seeder was evaluated on the Willamette National Forest (R-6). The purpose of the Willamette trials was to evaluate mechanical reliability and to ascertain operating costs. Just under 25 acres (10.12 hectares) of roadside slopes were seeded in 5 days; some additional time was spent seeding a recreation site and training two operators.

The seeder/crane combination showed that it was capable of seeding 2 acres (.81 hectares) per hour; but this rate couldn't be sustained because of long travel times between sites, etc. The cost of the operation, not including seed and fertilizer, was approximately \$59 per acre; this includes hourly boom crane (Gradall) use rate, two wage-grade equipment operators, a swamper, and a pickup truck. The total cost per acre was \$92, which includes 40 pounds (18.14 kg) of seed per acre and 160 pounds (72.58 kg) of fertilizer per acre. This cost compares with typical Region 6 costs of \$400 to \$600 per acre for hydroseeding; \$40 per acre for broadcast seeding; and \$3,200 per acre for broadcast seeding followed by straw mulching and jute netting. The SDEDC seeder performed reliably and was operated on both cut banks and fill slopes. Most fill slopes were mild; however, cut banks ran as steep as 3/4:1. Both cuts and fills were littered with rock, stumps, limbs, etc. The seeder adapted well to the terrain and its operation was not seriously affected by the litter.

As a result of the Willamette National Forest trials, the development of the SDEDC seeder is considered completed. Final drawings are now being produced and will soon be available from SDEDC.

INVITATION TO READERS OF *FIELD NOTES*

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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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