

United States
Department of
Agriculture

Forest
Service

Engineering Staff

Washington, D.C.



Engineering Field Notes

Engineering Technical Information System

Rec'd 6/7/83
Volume 15
January - March
1983

Awards for 1981 *Field Notes* Articles

Wood-Fired Boiler Systems for Space
Heating—A Study Report Being Prepared
for Publication

The Use of Jersey Barriers as Ford Walls

Using the Laser Range Pole for Cadastral
Contract Inspection

Portable Potable Water Tanks & Water
Tank Fill Standard

Using Central Tire Inflation Systems to
Decrease Vehicular Damage to Forest
Roads

Nonplastic Surfacing Material Performance

Cost of Wastewater Facilities

Distribution of Documents for
Certification Program

Changes to *Engineering Field Notes* — Volume 14 - 1982



Engineering Field Notes

Administrative Distribution

- Professional Development
- Management
- Data Retrieval

This publication is an administrative document that was developed for the guidance of employees of the Forest Service—U.S. Department of Agriculture, its contractors, and its cooperating Federal and State Government Agencies. The text in the publication represents the personal opinions of the respective authors. This information has not been approved for distribution to the public, and must not be construed as recommended or approved policy, procedures, or mandatory instructions, except by Forest Service Manual references.

The Forest Service—U.S. Department of Agriculture assumes no responsibility for the interpretation or application of this information by other than its own employees. The use of trade names and identification of firms or corporations is for the convenience of the reader; such use does not constitute an official endorsement or approval by the United States Government of any product or service to the exclusion of others that may be suitable.

Please direct any comments or recommendations about this publication to the following address:

FOREST SERVICE—USDA
Engineering Staff—Washington Office
Att: Publications Specialist (Room 1112 RP/E)
P.O. Box 2417—Washington, D.C. 20013

Telephone: Area Code 703—235-8198

Awards for 1981 *Field Notes* Articles

We have completed our count of your ratings for 1981 Field Notes articles, and your selections are quite interesting.

To determine the award winners, we assigned a point value that reflects your rating for each article:

First choice--3 points
Second choice--2 points
Third choice--1 point

We then calculated the total number of points for each article and identified the following winners:

<u>Author</u>	<u>Title</u>
John Alexander Civil Engineer, R-1	"The Continuing Saga of Signs Versus Porcupines"
Allan Vanderpoel Civil Engineer, R-9	"Plastic Covering over a Glass Greenhouse"
Allan Vanderpoel	"Greenhouse Temperature Alarm System"

Our congratulations to the winners! Checks will be mailed out as soon as the papers are processed.

Field Notes' readers extend their thanks to the authors who took the time to write and submit articles, despite heavy workloads and slim staffing. We appreciate the cooperation of the readers who submitted rating sheets, thereby demonstrating that the authors' efforts are of value to engineers in the field.

Because of staffing shortages in the Washington Office (see Engineering Field Notes, Volume 14, Numbers 1-3), this award announcement is several months behind schedule. We are now more into the swing of things and are already preparing our tabulation for the 1982 Field Notes Articles Awards.

Begin preparing your article now for Field Notes (and the 1983 Field Notes Articles Awards)--let other Forest Service Engineers know how you accomplished a difficult job, that you found a better way of handling a problem, or why a particular experience was interesting and valuable to you. You could win \$100--that would be a valuable experience.

Wood-Fired Boiler Systems for Space Heating—A Study Report Being Prepared for Publication

We have had several inquiries regarding availability of the feasibility study cited in the Field Notes article "Some Considerations in Using Wood for Energy" (July-September 1982, Volume 14, Numbers 7-9).

This study report, which was prepared under a Forest Service contract with EKONO, Inc.,* of Bellevue, Washington, contains a detailed analysis of the potential for retrofitting six Forest Service facilities with clean-burning, cost-effective wood heating systems. The study is probably the first indepth evaluation of wood energy retrofit for providing "comfort heat" in the demand range of 0.25 to 3.0 million Btu/h. The term comfort heat describes the intermittent demand characteristics of applications commonly used in heating buildings.

ORGANIZATION

The first part of the report is a detailed text on design considerations for sizing and selecting wood-fueled heating systems. The second section contains the step-by-step evaluations made for the six sites that were selected to serve as models for future investigations.

APPLICATION

The data are intended for use by engineers and facility owners to develop their understanding of the characteristics of the material handling and combustion features that are required for the design and operation of these systems. There is a recognized need for this type of information, as well as for a more detailed method of evaluating the potential for wood energy in small commercial, institutional, and industrial facilities.

PUBLICATION SCHEDULE

The report is being prepared for printing, and distribution is planned for early April; it will be distributed to each Regional Office and Forest Supervisor's Office. A limited number of copies will be available from Regional Offices and the Washington Office on request.

*EKONO, Inc., is a U.S. branch of the international firm of the same name based in Helsinki, Finland.

The Use of Jersey Barriers as Ford Walls

*Rod Mendenhall
Civil Engineer
Tonto National Forest
Region 3*

The 1978-80 flood disasters severely damaged many low-water ford crossings on roads in Region 3 Forests. Many ford walls had to be extended or replaced. Previous repair methods involved constructing cast-in-place concrete walls in the downstream road shoulder to stabilize the ford crossings. Generally 2 to 3 feet high and 6 to 8 inches thick, these walls cost from \$100 to \$150 per linear foot. However, the Tonto, Prescott, and Kaibab National Forests are now using precast concrete median (Jersey) barriers as ford walls (see figures 1 through 4) for which bid prices have been \$40 to \$50 per linear foot, installed.

The barrier sections, which are 12 feet 6 inches long and weigh approximately 5,000 pounds, are placed in the stream by using a loader or a boom truck. Longer sections are available; however, the increased weight requires the use of even larger equipment.



Figure 1.--Precast concrete median (Jersey) barrier ready to be installed.

Not only are Jersey barriers cheaper, they also provide other benefits:

1. They can be installed in live streams without dewatering or diversion, as may be required for cast-in-place walls.
2. They are gravity structures, and if they should wash out, they can be reinstalled without damage.
3. They eliminate the need for transporting to remote locations and the problems associated with batching concrete and material testing.
4. They eliminate the need for a footing because of their wide base.

In the Tonto National Forest, 3/8-inch thick steel caps, as shown in figure 5, are used on walls that are installed in crossings where high water moves large boulders and resulting breakage on the top of the concrete wall is a problem. The additional cost of this modification is approximately \$100 per 12-foot-6-inch section.

The Tonto National Forest is also installing a modified version of the barrier, in which a block-out is cast into the top, allowing it to be used as a single-section installation. Used in minor ford crossings to prevent loss of shoulder material during runoff, this installation is particularly effective in light, erodible soils, such as decomposed granite.

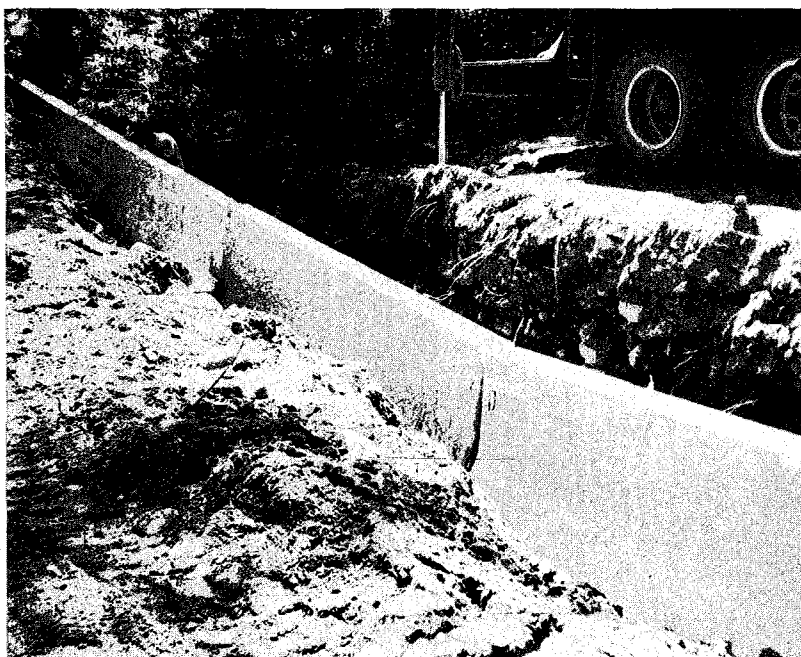


Figure 2.--In-place Jersey barrier.

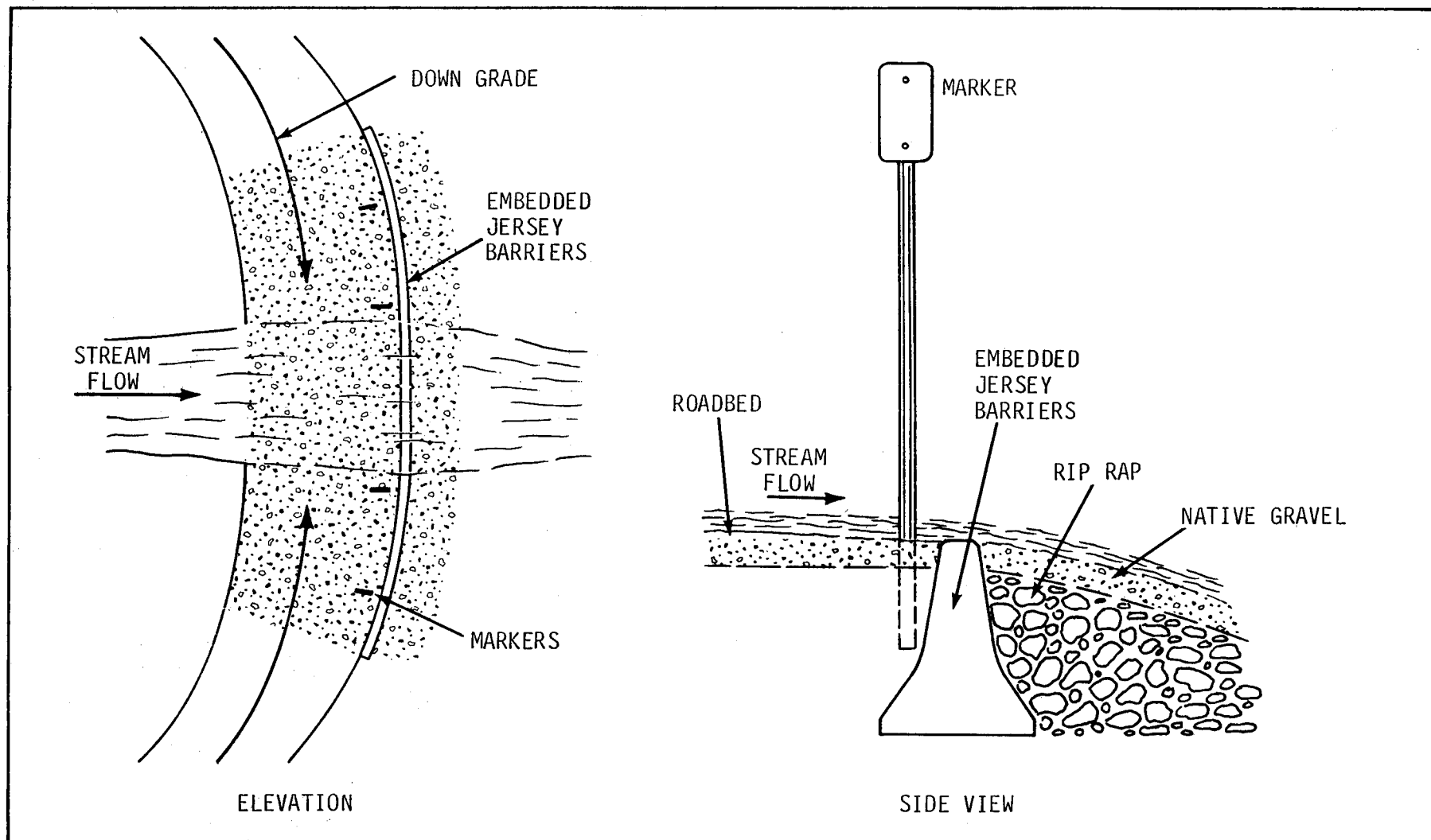
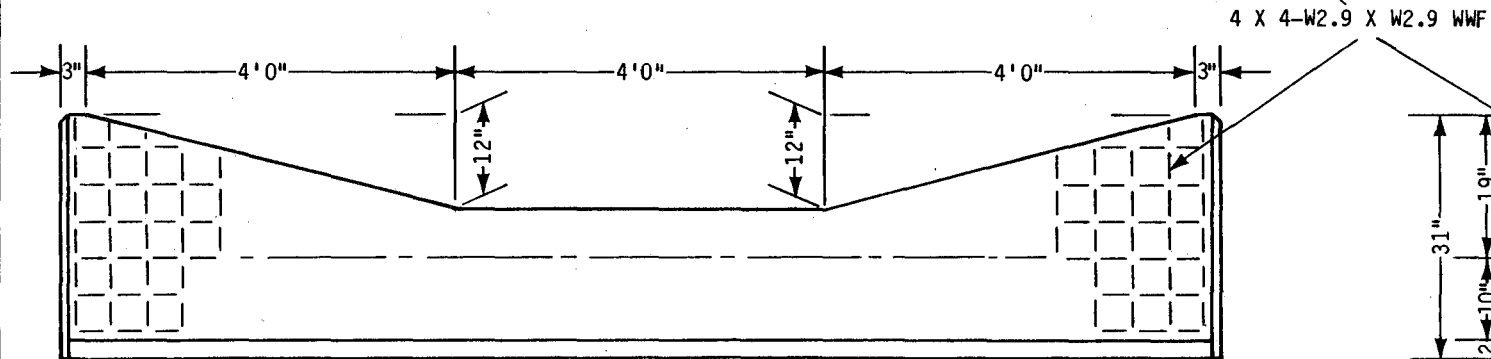
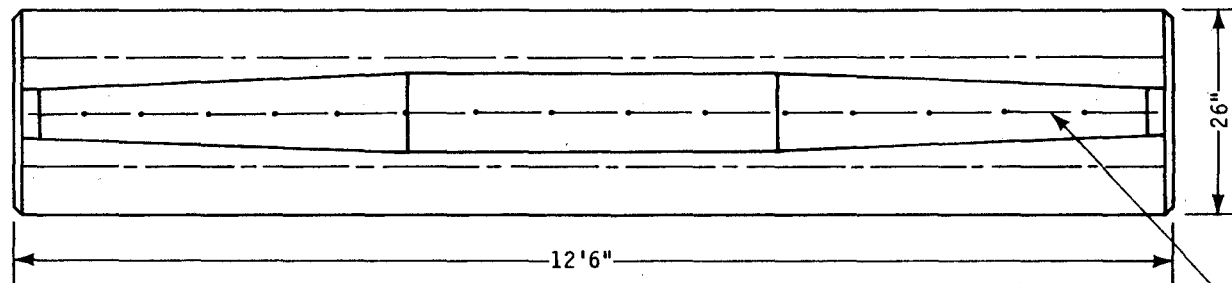


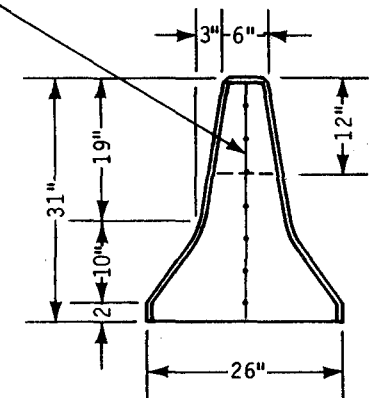
Figure 3.--Diagram showing location of markers for in-place Jersey barriers.

PLAN VIEW



ELEVATION

4 X 4-W2.9 X W2.9 WWF



END VIEW

REBAR SHALL BE GRADE 40. CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3,000 PSI AT 28 DAYS. CEMENT SHALL BE TYPE 1-11.

Figure 4.--Plan, elevation, and end views of Jersey barrier.

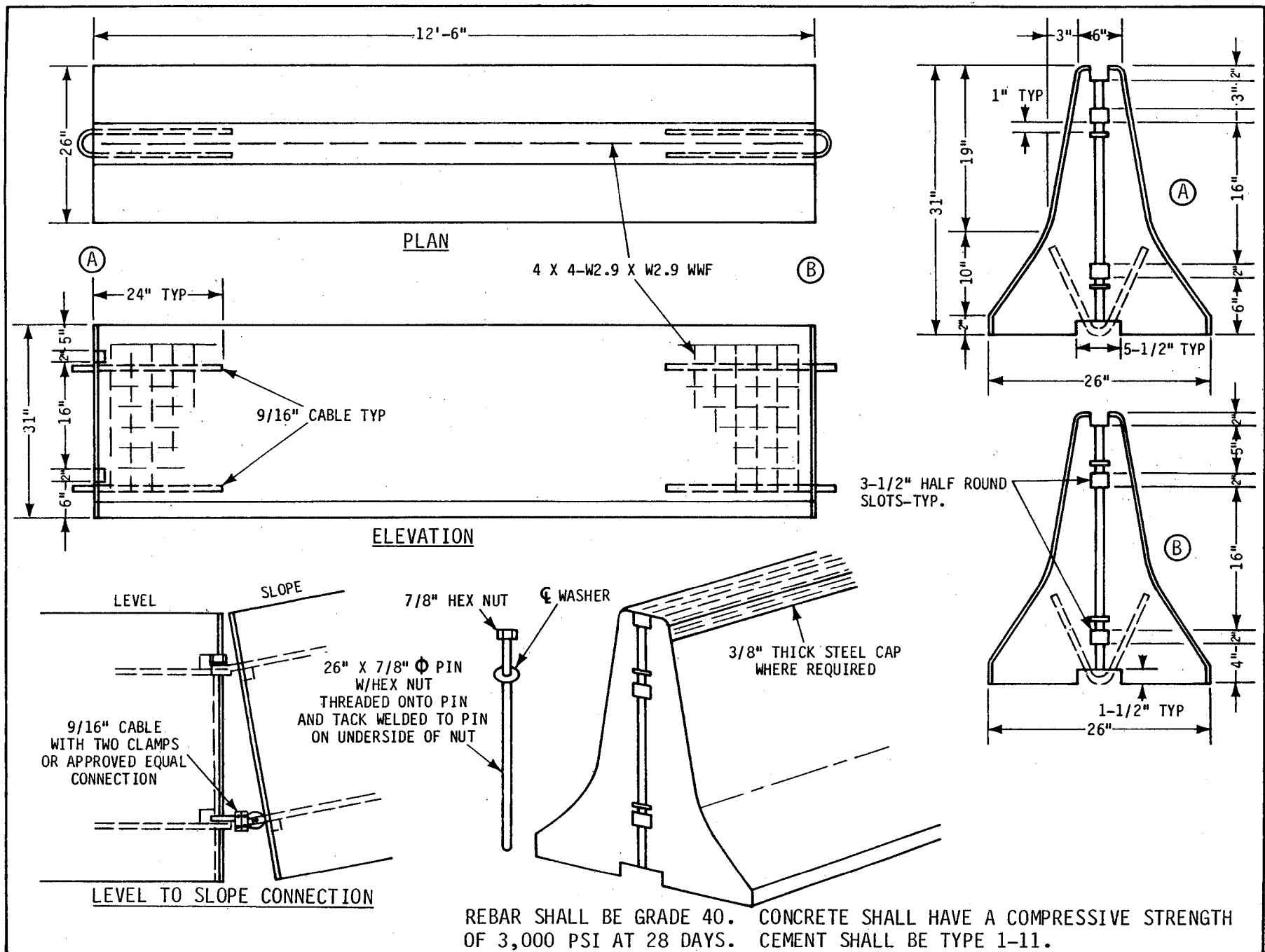


Figure 5.--Illustration of Jersey barrier connection devices.

Using the Laser Range Pole for Cadastral Contract Inspection

*Dennis J. Mouland
Supervisory Land Surveyor
Kaibab National Forest
Region 3*

INTRODUCTION

Because of various employment limitations placed on the Forest Service Land Line crews, it has become obvious that an increase in cadastral contracts is a good method for maintaining production. A recent productivity review for Land Line indicates that, in certain cases, contracting is a viable method for increasing productivity. However, an increase in contract administration and inspection can often severely overload the Forest Land Surveyor and reduce his productivity. This situation prompted us to find new ways for inspecting cadastral contracts.

EFFICIENT INSPECTION

Most Forests inspect a contractor's survey by randomly selecting some lines of the survey and checking distances. This check may even include taking a few solar observations throughout the project to verify compliance with the azimuth specifications. Then the contractor's notes, computations, and final plats are examined. Although these are necessary checks, verifying contract compliance is often quite costly. Of course, redoing the survey just to verify the contractor's work is far worse.

We must be very careful accepting contract work "carte blanche." Unless we are extremely confident of the contractor's abilities, some checks are essential. Even good contractors make honest mistakes, but before we accept work and pay for it with the public's tax dollars, we should make sure the work was performed properly. Indeed, after the Forest Service accepts a survey and uses the survey in various land management functions, there is some question about who may be liable for any error.

SIMPLE INSPECTIONS

The laser range pole (LRP) provides one solution to the problem. After reading an article entitled "Laser Triangulation," by Harold W. Grusing of the Bureau of Land Management (Montana State office), it became apparent that the LRP could be used for various types of inspection. After the contractor has established his subdivisional corners, Forest

Service crews can do some very simple inspecting without doing any computations, depending on the nature of the project, terrain, accessibility, etc.

In the example illustrated in figure 1, the private land in section 10 has been established by a contractor. The LRP receiver can be set up at S 1/4 corner, and the transmitter at the N 1/4 corner. Then the true direction of the line can be established with the LRP. Because of the length of time needed for the receiver at the setup point, a reference point should be established on the line (or any other direction and then turning the angle between reference line and true line). Now the transmitter is moved to the other subdivisional corners along the meridional centerline. The C-N 1/16, C 1/4, and C-S 1/16 corners can each be occupied by the transmitter. One shot with the LRP should be all that is necessary to check the corner's position--on that line. The green "center" light should light up on each check, indicating that the checked corner is, in fact, "on line." If it is not on line, a few more shots with the LRP can be made to determine the actual direction to that corner, and the angular difference from the true line can be used to compute an approximate error, which should be further explored.

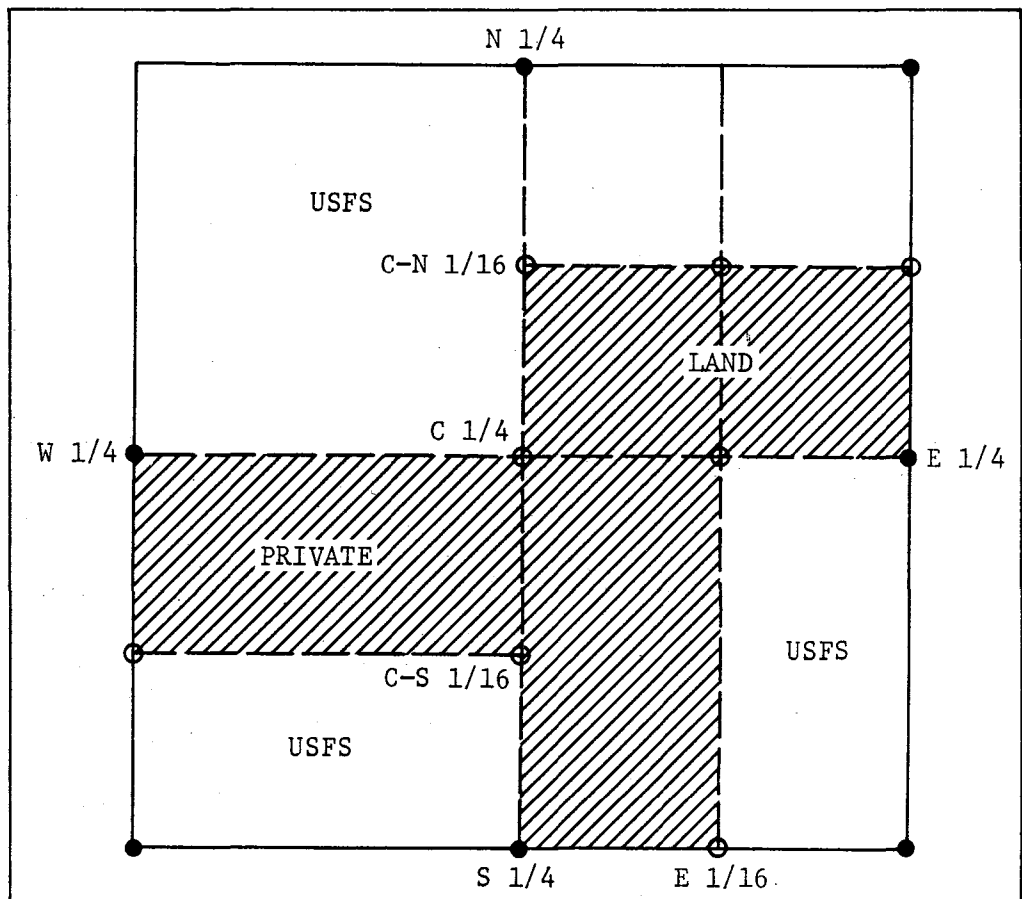


Figure 1.--
Section 10.

While the receiver is still at the S 1/4, the E 1/16 corner could be checked using the same method, after determining the true line by either turning the record angle at the S 1/4 (determined from the contractor's plat), or by first setting the transmitter on the southeast corner of section 10 and then checking the E 1/16. The most critical corner of all to be checked usually would be the C 1/4. If the center of the section is verified on both sectional centerlines (meridional and latitudinal), the following have essentially been checked.

1. The traverse closure or adjustments thereto are within the specifications.
2. The subdivisional breakdown was done correctly.
3. Any other corners checked on those lines verify corner moves or computations.

In other words, if any of those three items have been done incorrectly, the error will show up in this simple inspection method because the C 1/4 (unless set by direct intersection) will not be on one or both of the centerlines, thus reflecting the error.

ADDITIONAL CHECKS

Different applications of this method can be used to check any other corners or to detect any discrepancies. By carefully choosing the set-up location of the receiver, (perhaps at the C 1/4), we can effectively check the majority of corners. While the crew is backpacking the transmitter to new locations, they can also be verifying the posting of lines, proper clearing, and proper monumentation.

The laser triangulation method could be used with more than one LRP system. Azimuths from a few control stations could be computed to every controlling or subdivisional corner from the surveyor's plat, and random checks could be made. However, this is much more time consuming, but it may be necessary, especially if some errors have been found using the first method described.

ANOTHER APPLICATION

Often when a section has been subdivided by a private land surveyor for a landowner, we wonder if it was done correctly. Sometimes we wind up breaking the section down ourselves only to find his work was within our "limits." By using the LRP and checking the C 1/4 again, we can tell whether the entire sectional subdivision is correct. In some areas, this check can be done in half a day and can alert us to potential trespass situations before the landowner uses the survey.

CONCLUSION

There are many efficient uses of the LRP for inspecting survey data in the field. When using this method, it is important not to rely on a check of just one corner, thereby accepting the entire survey. Compensating errors--or just one incorrect corner move--on an unchecked corner can exist without detection, but a surveyor can make several random checks and easily spot most errors in closure, method, and computation. It is also important to ensure that the crews who use the LRP for this or any other use should be very experienced in LRP use, limitations, and safety. We at the Kaibab welcome any questions or comments you may have on this subject; write to Kaibab National Forest, 800 S. 6th Street, Williams, Arizona 86046, or call (602) 635-2681.

Portable Potable Water Tanks & Water Tank Fill Standard

*Edward N. Kuetemeyer, P.E.
West Zone Environmental Engineer
Region 1*

The PORTABLE WATER TANK

Historically, water from the closest source has been used to supply survey crews, spike camps, and other short-term field bases. A variety of development techniques have been used, ranging from plunging pipes into wet hillsides to building rock dams in small creeks. However, these installations usually do not provide protection from bacteriological contamination or water-borne diseases, such as Giardiasis. Also, the water source is often at a considerable distance from, or at a lower elevation than, the camp area.

One solution to these problems is the portable water tank (figures 1, 2, and 3). Criteria for the tank were developed by engineering personnel on the Idaho Panhandle National Forests. The tank is made of galvanized steel, is 36 inches in diameter and 6 feet long, and has a nominal size of 300 gallons. Interior baffles in the tank inhibit the weight from shifting while traveling with partial loads. The tank is filled through a convenient flip-up cap at the top, and water is withdrawn and drained through a double hose bibb outlet at the bottom rear of the tank. The tank's trailer is equipped with dual axles, automobile tires, fenders, lights, and electric brakes. The tank and trailer can be towed easily by a half-ton pickup truck. To use, the tank is filled at a safe water source, such as a ranger



Figure 1.--Portable water tanks, in place, front view.

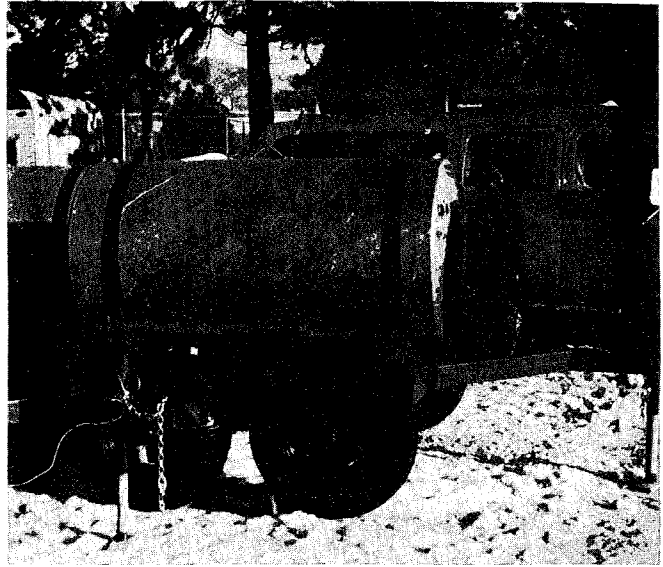


Figure 2.--Portable water tanks, in place, side view.

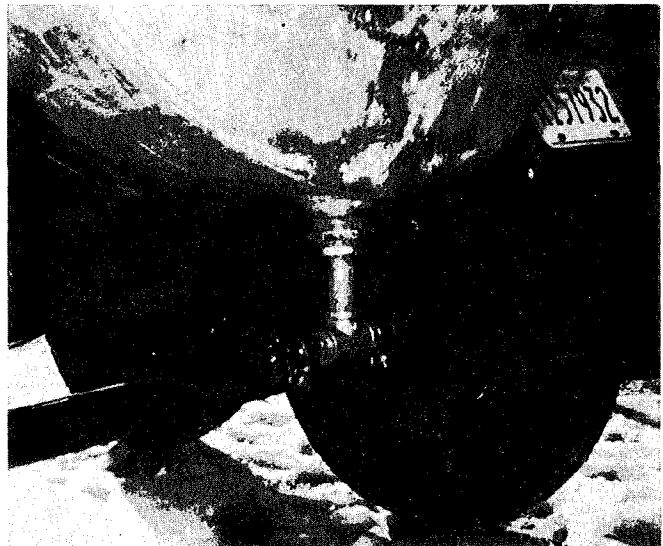


Figure 3.--Portable potable water tank outlet, detail.

station or campground, then towed to the field where it is set up. Depending on the terrain, the tank often can be set up above the camp area to produce some pressure at the delivery point. This is convenient for self-contained camp trailers.

Five tanks were purchased in 1978 at a delivered cost of \$1,600 each. Although their use is limited to areas having road access, use of portable water tanks in these situations has been entirely satisfactory.

WATER TANK FILL STANDARD

Until recently, the Northern Region had no standards for a fill station; consequently, a variety of installations were developed. These nonstandard installations had many drawbacks, the most significant

one being that they were unsanitary. They did not protect against back-siphonage into the potable water system; hoses and connections were dirty; and draining the system was difficult. Other problems included a lack of uniformity, absence of instructions, and inconvenience of use. Use of a fire hydrant provides an example of these difficulties (figure 4). The system required special fire wrenches and hindered the speedy use of the hydrant. In addition, the hose or pipe attachments used to fill the tanks usually looked messy and were difficult to keep clean.

In 1981, the Northern Region Environmental Engineering Staff developed a water tank fill standard drawing, shown in figure 5. The standard has a number of features worth noting: it is protected from traffic, is operable by one person, and can be drained. An antisiphon vacuum breaker prevents back-siphonage, and a warning sign indicates the intended use of the facility. It is simple to construct and should provide years of trouble-free service. The installation also can function as a filling point for water tankers used in such activities as dust abatement and fire suppression.

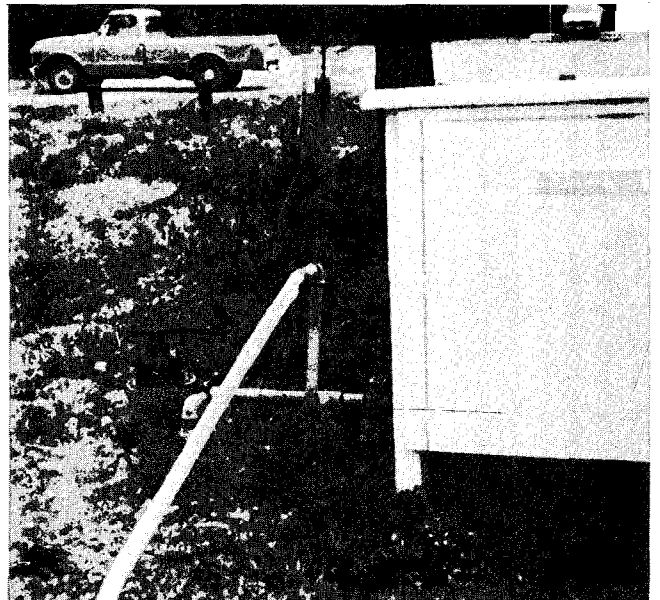


Figure 4.--Water tank fill station with hydrant.

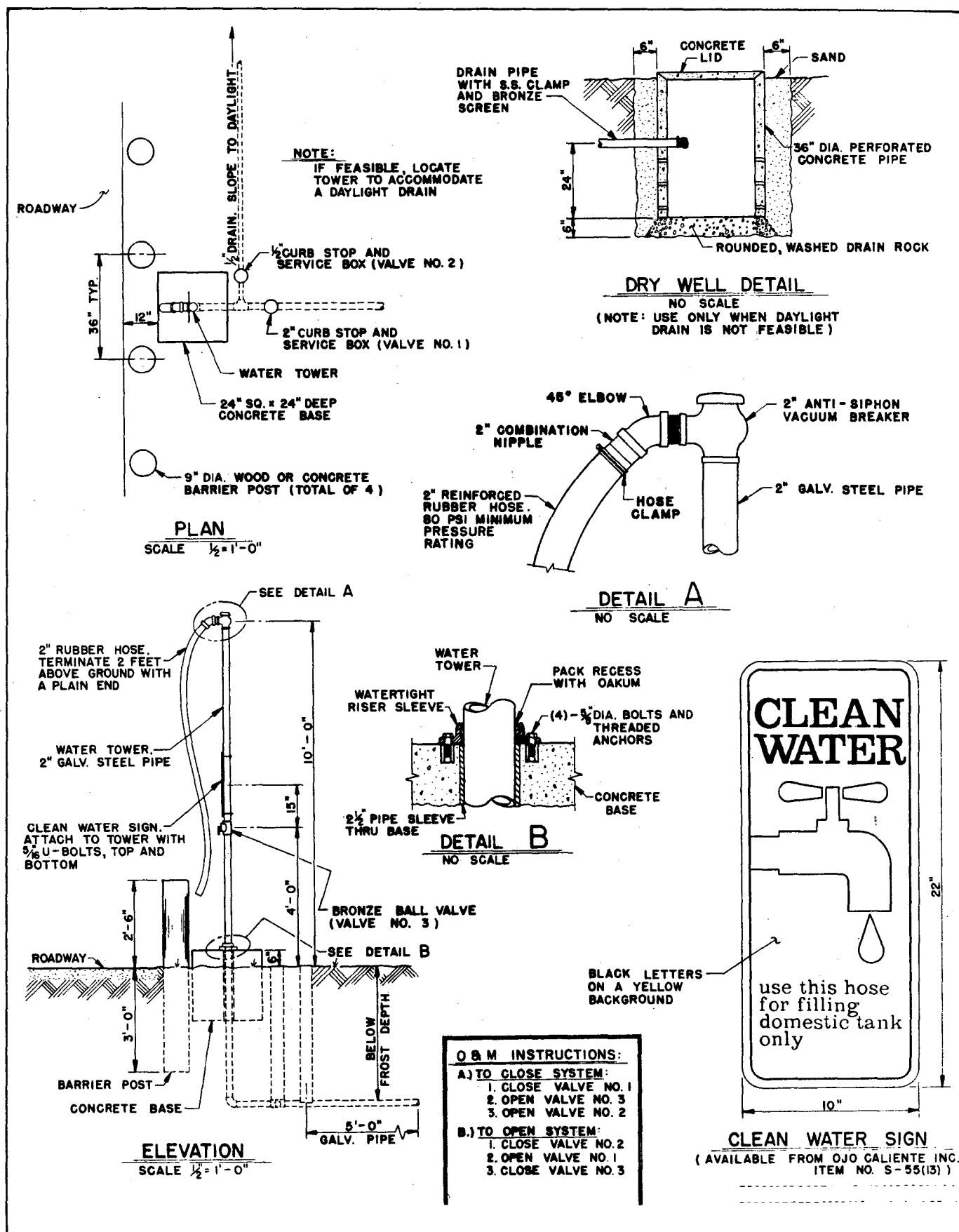


Figure 5.--Tanker fill water tower.

Using Central Tire Inflation Systems to Decrease Vehicular Damage to Forest Roads

*Leonard B. Della-Moretta
Industrial Engineer
San Dimas Equipment Development Center*

Note: This article is a synopsis of a Forest Service paper presented at the ASTM technical seminar on off-the-road uses of tires; Akron, Ohio, November 10, 1982.

DAMAGE to UNPAVED ROADS

Vehicular loads degrade unpaved road surfaces by dusting, rutting, and washboarding when tire loads and tractive shears are too high for the roads' bearing and shear strengths. The strength of a soil road surface depends on compaction. Compaction cannot occur when soil roads are flooded or too dry, but rolling for a wide intermediate range of moisture can alleviate the problem.

Pressure compacts soil while shear loosens it. Shears arise alongside the tire, where adjacent soil supports the compressed pressure bulb under the tire. When this gives way, the tire sinks deeper. When longitudinal travel and braking stresses are added, the longitudinal shears combine with support shear stresses, which are already on the failure boundary alongside the tire, causing the tire to sink still deeper. Deeper sinkage causes increased longitudinal travel stresses; thus, sinkage becomes self-escalating. The tire-to-ground contact pressure and the shears must be reduced before compactive healing can begin.

The types of vehicles and their tires, and the manner and times when they are used, can determine whether soil roads will improve or quickly deteriorate. Soil roads tend to suffer great abuse from highway vehicles in nations like ours, where drivers are used to paved highway systems. Vehicular soil road damage becomes commonplace, and continuous restorative maintenance can become a way of life.

HEALING SOIL ROADS

Washboards are caused by cyclic sinkage, which results first from shear slips and then from sudden climb-outs when the slips stop. Flattening out sudden releases of the slipping tire's energy and

reducing the climb-out angle eliminates washboarding by spreading out the cyclic energy release. Healing begins, and the washboards are ironed out by successive passes of long-contact, nonwashboarding tires.

When not cyclic, the excessive pressure and the slip of the tires causes ruts. Truck drivers follow each others' ruts when safety and mobility become marginal but will travel over an entire soil road surface when road width and edge strength make such travel safe.

USE of CENTRAL TIRE INFLATION SYSTEMS

Compacting roads by rolling is not mere theory--it has been standard road construction industry practice for many years. The new element involves the use of new tires and central tire inflation (CTI) systems, which can adjust tire pressure while the vehicle is moving, so that trained road-user traffic can maintain a soil road surface simply by driving on it. The potentially significant reductions in fuel consumption, surfacing losses and needs, and terrain damage make this a cost-effective approach worth investigating.

Nations without paved highway systems have used CTI systems for many years. American military leadership is now considering CTI systems because the steady development of tire and vehicle technology has increased vehicle mobility in CTI-equipped vehicles. Benefits from decreased vehicular road damage should awaken intense interest in off-highway forestry and other activities where current high hauling and maintenance costs are making the true cost of road damage more apparent. The use of CTI systems should result in forest roads improving with use instead of deteriorating over time.

DETAILED INFORMATION AVAILABLE

The preceding material was based on a 17-page ASTM paper that was presented in November 1982 at a technical seminar in Akron, Ohio, on off-the-road uses of tires. A copy of the paper, "Off-Highway Tire/Road Damage and Healing Mechanisms," by Leonard B. Della-Moretta (Forest Service) and Henry C. Hodges (President, Hodges Transportation, Inc.) can be requested from the San Dimas Equipment Development Center.

For a perspective on the CTI system's approach to reducing the need for periodic machine road maintenance, a review of past events is presented.

HISTORICAL BACKGROUND

The idea of lowering tire pressure to travel over soft ground is not new. In the early 1920s, the first transcontinental buses crossed the Mojave desert by doing so--it was the only way to get

through. The idea was ahead of its time, however, and tires were not ready for such operational use. Completion of US 66, the Lincoln Highway, in the 1920s brought a welcomed end to bus drivers' hand pumping and blowout-changing exertions. Nevertheless, the idea, though it was not without problems, worked. The biggest problem came from heat that concentrated at a buckling point where the deflated tire's long sidewall swelling intersected the shoulder.

The old ways of reinforcing tire sidewalls had yet to give way to new approaches in making them more limber. Early solid truck tires had been replaced by heavy-duty pneumatic tires that had multiple-ply layers with rubber layers between them. This design slowly gave way in the 1920s to a single layer of plies with a thinner sidewall. Whenever the tire sidewall was reduced, the tire ran cooler.

Air compressors for central airbrake systems appeared by the mid-1930s, so powered CTI became feasible, even though tires still were not ready for this operational use. Also in the 1930s, R. G. LeTourneau advocated that large earthmoving tires replace crawler tracks. This evolution brought heavier treads and, in proportion, still lighter sidewalls. Thus, sidewall swelling began to fade slightly at the ends. Tapered beads were developed to prevent rim slip when tires were deflated for use on loose sand. Again, these new tires ran cooler.

Good mechanical designs for CTI were developed during World War II and applied to amphibious "Duck" vehicles for mobility on saturated beach soils. These vehicles also were supplied to the Russians for river crossings. Since the USSR had large, roadless, soft-soil areas, the Russians adapted the CTI system to all their wheeled military vehicles. These vehicles became the backbone of the Russian commercial truck fleet in the post-war era and beyond. On the other hand, American CTI systems were phased out with the Duck and were never applied to land vehicles.

In the late 1950s, radial tires came on the scene. They swelled locally under the axle--swelling higher rather than down at the ground-contact line. The steel belt stretched the swelling out before it could reach the forward and rear shoulder areas. This moved the buckle further from the deflected zone, and, for slow and moderate speeds, tires could now be deflated to lower pressures with less heat buildup. We are just beginning to understand how this will affect future soil and off-highway road travel.

Nonplastic Surfacing Material Performance

Stuart C. Kohl
Civil Engineer
Green Mountain National Forest
Region 9

Washington Office comments:

The plasticity index (PI) requirement for surfacing should not be eliminated from Table 703-3 shown in Forest Service Standard Specifications for Construction of Roads and Bridges (EM-7720-100) without concurrently changing the percent passing the No. 200 sieve given in Table 703-4 of those specifications. The minimum percent passing the No. 200 sieve must be increased to obtain satisfactory performance of the surfacing if the PI requirement is eliminated. The percent of material passing the No. 200 sieve should be determined by lab testing. (See Assessment of Surface Aggregate Requirements and Specifications, EM-7170-1, William Vischer -- page 147.)

INTRODUCTION

In the Forest Service Standard Specifications for Construction of Roads and Bridges, 1979, Table 703.3 shows that aggregate surfacing material is required to have a plasticity index between 2 and 9. Experience has shown that surfacing material within these plasticity index limits performs satisfactorily.

It has been known since the early 1960s that the aggregate surfacing material used in the Green Mountain National Forest in Vermont is "nonplastic" when analyzed according to AASHTO T-90. Moreover, it has become evident that this surfacing material performs satisfactorily.

Because the use of an aggregate material with the specified plasticity index could mean hauling material long distances at a considerable cost, the Green Mountain National Forest decided to conduct a preliminary study to further evaluate the performance of locally available, nonplastic aggregate surfacing material. Should the study reveal the satisfactory performance of local materials, it could provide a basis for deleting the specified plasticity index requirement and result in more economical road construction costs.

INVESTIGATION and DISCUSSION

Aggregate surfacing samples were collected from existing roads surfaced from the same or similar sources, and placed under the same general specifications. Traffic volume, vehicle types, and

maintenance histories also were similar. Samples were taken from locations subjected to different conditions including:

1. Service life: three roads up to 2 years, two roads 7 to 12 years, and three roads over 15 years
2. Grade: less than 3 percent, 3 to 6 percent, and more than 6 percent
3. Alignment: tangent or curve
4. Canopy: generally shaded or basically unshaded

Samples were distributed to variables as shown in Table 1. All the samples were tested for plasticity index (AASHTO T-90) and sieve analysis (AASHTO T-27). The locations were visually observed for surfacing material performance.

The following comments reflect field observations and laboratory test data:

1. In 75 percent of the situations, the material, which was initially classified A-1-a (AASHTO classification), was reduced to the A-1-b group. Most of this change took place in the gravel size particles and occurred within 8 years. The cause may have been degradation or loss of coarse particles resulting from traffic, maintenance, or environmental factors.
2. Twenty-five percent of the situations that did not show any significant decrease in particle size were from areas where the grade was less than 3 percent.
3. Alignment and canopy did not have a significant effect on particle degradation.
4. All samples were nonplastic.
5. Performance of the aggregate surfacing material was essentially the same and satisfactory at all locations that were tested.

CONCLUSIONS

Based on this preliminary study, the following tentative conclusions are drawn:

1. The requirement that is in accord with Forest Service Specification 703 for aggregate surfacing material of a plasticity index from 2 to 9 does not appear to be essential for satisfactory performance in all situations.

2. The aggregate surfacing materials changed from AASHTO group A-1-a to AASHTO group A-1-b; however, the performance continued to be satisfactory.

3. In areas where aggregate surfacing material having the specified plasticity is not locally available and where nonplastic aggregates perform satisfactorily--as on the Green Mountain Forest--the cost of surfacing can be reduced by using such suitable nonplastic material.

RECOMMENDATIONS

1. Where performance of local nonplastic aggregate surfacing has been determined to be satisfactory, delete the requirement for plasticity from the specifications.

2. Undertake further studies to determine the effect of the following on aggregate surfacing performance:

- a. Mineralogical composition
- b. Aggregate gradation, particularly the percentage of fines passing the No. 200 sieve
- c. Climatological factors, such as water content and temperature

3. When further study has sufficiently quantified the different factors contributing to adequate aggregate surfacing performance (for example, the percent passing the No. 200 sieve, mineralogy, gradation, and plasticity), prepare specifications allowing for alternate acceptance criteria. The appropriate criteria then can be applied to the specific material being provided for a particular project.

Table 1.--
Variables used.

COVER	ALIGNMENT	GRADE	AGE
CANOPY	ON TANGENT	FLAT	NEW ROAD
			MED ROAD
			OLD ROAD
		MODERATE	NEW ROAD
			MED ROAD
			OLD ROAD
	ON CURVE	STEEP	NEW ROAD
			MED ROAD
			OLD ROAD
		FLAT	NEW ROAD
			MED ROAD
			OLD ROAD
OPEN	ON TANGENT	MODERATE	NEW ROAD
			MED ROAD
			OLD ROAD
		STEEP	NEW ROAD
			MED ROAD
			OLD ROAD
	ON CURVE	FLAT	NEW ROAD
			MED ROAD
			OLD ROAD
		MODERATE	NEW ROAD
			MED ROAD
			OLD ROAD
	ON CURVE	STEEP	NEW ROAD
			MED ROAD
			OLD ROAD

Cost of Wastewater Facilities

*Jim Sleeper
Environmental Engineer
Region 9*

The table that follows has been developed to provide guidance for comparing wastewater disposal systems.

In the last column of the table, uniform annual costs are listed for "typical" wastewater facilities. The listed cost is not applicable to any specific installation, but may be useful in the conceptual or planning stage for comparing wastewater disposal systems. The various units or components can be combined for a complete system.

Some of the facilities would not apply to the same system or use; for example, the mound costs more than the field, but a mound may be used in soil that is not suited for a field. The difference cited under "Initial Investment" for the items shows the increased cost that results from selecting a site unsuited to field disposal. Similarly, a lagoon-irrigation system applies to a larger system than the septic-tank field. The lagoon applies to a 5,000 or greater gallon-per-day system, serving about 50 to 500 users, depending upon whether they are residents or picnickers.

Use the cost figures with discretion and judgment. These costs should not be used for specific site analysis. The analysis of a site must be developed with information about the specific conditions and use of that site.

Table 1.--Cost of wastewater facilities.

Facility	Life	Initial Investment	Annual Expense		Net Present Cost During Facility Life	Net Present Cost (40-Year Period)	Uniform Annual Cost
			Maintenance	Operation			
Vault without Bldg. each 25 PAOT	15	\$500	--	\$100.00	\$1,611.80	\$3,624.18	\$144.07
Compost Toilet without Bldg. each 25 PAOT	20	4,000	--	25.00	4,339.76	6,320.37	319.33
Septic Tank each 100 gal.	25	150	\$3.40	--	203.12	273.57	13.82
Sewer Lines 4" - 100'	40	800	--	1.00	819.79	819.79	41.42
Sewer Lines 6" - 100'	40	950	--	1.00	969.79	969.79	48.99
Pressure Line 2" - 100'	40	800	--	10.00	997.63	997.63	50.42
Manhole, each	40	750	--	5.00	848.96	848.96	42.89
Lift Pump, each	10	1,500	--	30.00	1,743.33	4,254.20	214.94
Dosing Siphon, each	20	500	--	10.00	635.90	926.12	46.79
Field, each 100 gal/day capacity	40	800	--	10.00	997.93	997.93	50.42
Mound, each 100 gal/day capacity	40	1,200	--	10.00	1,397.92	1,397.92	70.63
Lagoon, each 100 gal/day capacity	40	330	24.00	14.50	1,092.02	1,092.02	55.17
Irrigation, each 100 gal/day capacity Pump System	10	50	--	0.04	50.32	122.79	6.20
	20	276	12.00	--	439.08	639.47	32.30

Distribution of Documents for Certification Program

The Washington Office has distributed all materials for the 1983 Engineering Construction Certification Program (ECCP).

If you need extra copies of any item (exams, reference documents, drawings books, pink paper and mylar examiner's masters, or answer sheets), please contact another Region that received a significant number of the documents you may need. The following table shows the distribution of ECCP materials by Region.

ITEM NUMBER	1	2	3	4	5	6	8	9	10
EM 7115-501-1	64	34	17	21	87	147	34	34	54
EM 7115-502/3-1	83	47	22	22	103	163	78	32	52
EM 7115-504-1	47	26	14	20	70	149	36	31	36
EM 7115-505-1	34	24	20	13	51	72	49	29	19
EM 7115-506-1	13	8	6	8	30	13	13	13	8
-3	16	11	9	11	33	16	16	16	11
EM 7115-507-1	17	6	13	11	40	60	17	22	7
EM 7115-508-1	17	15	13	20	34	39	20	26	26
EM 7115-509-1	43	16	7	11	27	33	26	22	17
EM 7115-511-1	5	5	3	10	25	20	10	10	10
-4	5	5	3	10	25	20	10	10	10
EM 7115-512-1	10	10	24	20	52	32	27	23	23
-3	8	8	11	18	75	30	25	21	21
-4	8	8	11	18	50	30	25	21	21
EM 7115-513-1	33	11	5	11	27	69	16	21	11
EM 7115-514-1	38	21	13	33	38	108	21	28	21
EM 7115-2 MYLAR	3	3	3	3	3	22	3	3	3
-2 PAPER	3	3	3	3	3	22	3	3	3
EM 7115 -X	386	205	128	182	566	1087	329	273	266

Changes to *Engineering Field Notes*

Make the changes shown below in your copy of Engineering Field Notes.

In Volume 14, April-June 1982, "A Guide for Determining Minimum Road Width on Curves for Single Lane Forest Roads":

1. On page 19, 7th line from the bottom, insert the word "log" between the words "for" and "trucks."
2. On page 21, in the equation change the last "+" to "-".
3. On pages 23 and 28, interchange the photographs labeled figures 2 and 5.
4. On page 26, table 2, second column, change the value "2.2" to "1.1".

In Volume 14, July-September 1982, "Bottomless Arch Selection for Fish Passage":

On page 3, line 0210, insert ".6115" between ".515" and ".708".



Engineering Technical Information System

The Series:

THE ENGINEERING FIELD NOTES SERIES is published periodically as a means of exchanging engineering-related ideas and information on activities, problems encountered and solutions developed, or other data that may be of value to Engineers Service-wide. Articles are usually less than six pages, and include material that is not appropriate for an Engineering Technical Report, or suitable for Engineering Management publications (FSM 1630 and 7113).

Distribution:

Each Field Notes edition is distributed to the Engineering Staff at Regional Offices, Forests, Stations, and Area Headquarters, as well as to Forest Service Engineering Retirees. If your office is not receiving the Field Notes, ask your Office Manager or Regional Information Coordinator to increase the number of copies for your location. Copies of back issues are available in limited quantities from the Washington Office.

Submittals:

Every reader is a potential author of a Field Notes article. If you have a news item or short description about your work that you wish to share with Forest Service Engineers, we invite you to submit the article for publication. Field Personnel should send material to their Regional Information Coordinator for review by the Regional Office to assure inclusion of information that is accurate, timely, and of interest Service-wide; short articles and news items are preferred. Type the manuscript double-spaced; include original drawings and black-and-white photographs (if only color photographs are available, send transparencies or negatives), and two machine copies of the manuscript.

Inquiries:

Regional Information Coordinators should send articles for publication and direct questions concerning format, editing, publishing schedules, etc., to:

FOREST SERVICE—USDA
Engineering Staff—Washington Office
Att: Publications Specialist (Room 1112 RP/E)
P.O. Box 2417—Washington, D.C. 20013

Telephone: Area Code 703—235-8198

Regional Coordinators:

R-1 Larry Bruesch
R-2 Mike Clinton
R-3 Jerry Martinez

R-4 Ted Wood
R-5 Phillip Russell
R-6 Kjell Bakke
R-8 Tom Poulin

R-9 Mujeebul Hasan
R-10 Mel Dittmer
WO Al Colley



Volume 15
January - March 1983

Engineering
Field Notes