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Field **Notes**

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

SELF-CLOSING TRAIL GATE --

FIELD COMMENT

Region 9 has commented on the safety factors involved in the self-closing trail gate described in *Engineering Field Notes* of July, 1978 (Vol. 10, No. 7).

The R-9 Director of Engineering expressed his concern in a letter to the Forest Supervisors in the Region:

We have not determined Region 9's needs for a gate of this kind, but have reservations about the safety of the optional bottom bar feature (listed in the article as advantage no. 4). This is an unyielding physical barrier that could be a collision hazard to snowmobilers, trail bikers, and even cross-country skiers -- especially under snow cover conditions. The hazard would be present if the gate remained open (did not self-close).

Also, the note on the need for "warning panels" may give the impression that hazard markers are not necessary unless the optional bar is installed. This would not be true.

We are bringing these concerns to the attention of the Washington Office. If this gate has application on any of your trails, please contact us for advice on the signing/markings to be used.

In the design, construction, and operation of any installation, safety factors are a major consideration. Region 9's letter emphasizes the requirement for careful evaluation of *all* features that are involved in *each* installation in relation to its *specific* location, as well as its *application* at that site.

The Washington Office has been developing information on Service-wide policy that will be applicable to all gate installations. Certainly, Region 9's comments on this trail gate will be reflected in the final FS Manual and Handbook material on gates and hazard markers.

WHAT HAPPENED TO THE "SIX RIVERS"

FIELD DESIGN METHOD?

John Bowman
Highway Engineer
R-1

EDITOR'S NOTE-- This method for surveying and designing Forest Service roads is only one of several cost-effective procedures that are used currently. The selection of the preconstruction method -- or combinations of methods -- that best fits the situation must always be based upon the Engineer's evaluation of all the pertinent issues in a particular situation.

To promote the exchange of information on this topic, we request readers to send us their comments on this article and their experiences -- both good and bad -- with the application of the Six Rivers Method and other preconstruction and design systems that they are using.

The *Six Rivers Field Design Method* is a low-cost, rapid, highly effective, accurate system for the field survey and design of forest roads, and the introduction of small, programmable calculators has increased its application. The field design system capitalizes on the strengths of the field engineering tables, the *PAL* system, the *P-line* and *L-line* methods, and the *RDS*; at the same time, it eliminates many of the shortcomings found in all those methods. The key to making the system effective is the making of significant decisions in the field; this process requires skills and capabilities of journeymen engineers.

Many new proposals die -- some slowly, some rapidly -- after being promoted as cure-alls for some current crises. The *Six Rivers Field Design Method* differs from many new proposals in several ways:

- (1) Most elements of the system are not new, but are used in a different combination than in the past;
- (2) The system was developed at the working level in the field by Forest Service Engineers;



Figure 1.--Field-designed road, one season old; shows free-flowing grade and alignment, self-balance, and fill-and-cut sections.

- (3) Efficiency of new elements had to be proven before they were recommended for general application in the system;
- (4) There is a substantial savings over traditional methods with no relevant loss of accuracy; and
- (5) Training has been more extensive, and has included actual practice on a project.

Most of the workshops on the *Six Rivers Method* that have been conducted since the spring of 1973 are shown in Table 1 (tables follow text); several Forest workshops in field design are not included in Table 1. In addition, several groups have worked with crews using the method and made several visits to the Six Rivers and other Forests so that they could apply those practices on their home Forests.

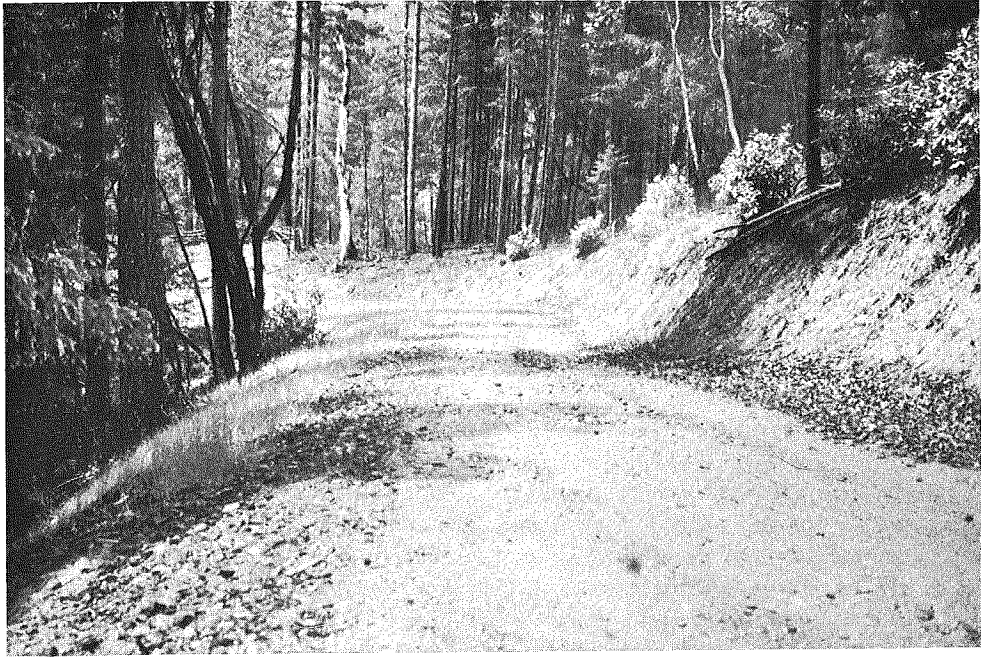


Figure 2.--Field-designed road, 5 years old; accumulation of forest litter and encroaching vegetation are main difference from new road.



Figure 3.--Field-designed road on 60-75 percent sideslopes.

At least 150 other engineers and technicians have had some experience with the system by these means, and there are an estimated 200 FS engineers and technicians who have not participated in the basic workshop, but who are using the system as their primary survey-design method (Table 2).

Most of the Forest Service people who are experienced in the use of this system are in R-1 (all but two of their small Forests have experts in system application); the distribution of some others is shown in Table 3. The distribution of experts on various calculator and computer programs used in the field design process is given in Table 4.

Of the roads constructed using the system, most are still on the Six Rivers Forest; in 2 years, Region 1 probably will have the largest number of road miles constructed by using the system. Approximately 1,900 miles (3,057.1 km) have been surveyed and designed using the system (Table 5).

The *Cholla Project* involved one unusual application of the system, a large powerline that crossed the Tonto NF. The Arizona Public Service and Salt River Project surveyed, designed, and built about 35 miles (56.3 km) of roads in a short time using the *Six Rivers Method*. All the work was done by the private companies, and they were very enthusiastic about the process and the results.

Many Forests have focused on the cost savings of the system over traditional methods. The Nezperce staff was able to do the survey-design-staking job at a significantly less cost with the field design method, and several other Forests have had similar savings (Table 6).

It is my opinion that field-designed roads fit the ground better and are less costly than the roads designed by traditional *P-line* or *L-line* methods. One project (the Bonners Ferry Ranger District in Idaho Panhandle National Forest) would have cost an estimated \$36,000 per mile to build using traditional methods, but it cost only \$29,500 per mile using the field design method.

The key to getting the system operational is to get a responsible engineer -- the person in charge of the work -- to decide to use the method. On units where the system is operational, its success usually can be traced to a commitment by a District, Zone Preconstruction, Forest, or Regional Engineer who has become familiar with the techniques. The most common and successful method of developing this familiarity is by visiting units that are using the method, and by studying its application in detail. The most effective visits to date have been those to the Six Rivers National Forest because of the many miles of roads that are available for viewing -- roads which were constructed using the *Six Rivers Field Design Method*.

A less common catalyst in some Forest Service units has been the study by a Preconstruction or other FS Engineer of the TRB's *Special Report 160*; usually, the Engineer followed up with a call to get additional data about the system.

After a commitment has been made to try the method, the next step is a Basic Field Design Workshop. The workshop is a 4- to 4½-day program that includes an actual field design on 2,000 to 2,500 feet (609.6 to 762 m) of road, and involves many of the more difficult problems encountered in the field. The attendees are grouped into five-man crews to do the exercise, and it is important to have one trained field designer available to work with each crew.

A Field Design Seminar was held in Missoula, April 11 through 14, at which an outline of a handbook for the system was developed. Because the term "Field Design" implies doing the entire design in the field, the seminar recommended changing the name to the *Rapid Survey Design System*. It was thought that the name change would help to overcome some of the initial bias against the method.

If the design and resulting constructed facility are to be effective, they must be properly geared to management goals and objectives. To overcome some of the problems in the development of timber sales and roads, a coordinated training program is being developed in Region 1. The program has six objectives:

- (1) Reduce noneffective time in preparation of timber sale EAR;
- (2) Eliminate unnecessary road proposals;
- (3) Prescribe most efficient, economic logging systems;
- (4) Achieve minimum environmental impacts;
- (5) Reduce individual road costs; and
- (6) Provide a systematic method of specialty input.

To meet the objectives, the training program will include eight topics:

- (1) A systematic method of timber sale and resource development planning;
- (2) How timber sale planning fits into other planning levels;
- (3) How to form and work with an interdisciplinary team;
- (4) Basic tools necessary;
- (5) Economics of resource development options;
- (6) Logging roads;
- (7) Logging systems; and
- (8) Preparing a sample resource development plan.

As with the *Six Rivers Method*, the proof of effectiveness will be its acceptance, use, and the demonstrated dollar savings.

Table 1.--Workshops conducted 1973-1978

Year of Workshop	1973	1974	1975	1976	1977	1978	Total
Number of Workshops	2	2	1	0	3	5	13
Number of Attendees	35	30	22	--	77	196	360

Table 2.--Experience-based users of system

Location of System Users	R-1	R-3	R-4	R-5	R-6	R-10	WO	GSC	BIA	BLM	Unknown	Private	Total
Years	Number of Users												
1973-1977	45	15	4	32	3	1	1	2	0	2	47	12	164
1978	114	0	43	6	15	0	0	0	16	0	--	2	196
Average per Year	26.5	2.5	15.6	6.3	3	.16	.16	.33	2.6	.33	8.30	2.3	142.78

Table 3.--Distribution of system applications experts, excluding Region 1

LOCATIONS		INDIVIDUALS
Region	Forest/Office	
R-3	Apache-Sitgreaves Tonto	Bringhurst, Dick Richardson, Mike
R-4	RO Challis Sawtooth NRA	Benson, Lynn; Ewing, Max Lenz, Larry Johnson, Quinn
R-5	RO Eldorado Sequoia Shasta-Trinity Sierra Six Rivers Gasquet RD Stanislaus	Allen, Levi Jesse, Paul Grenz, John Bentson, Gary; Bryant, Jeff Gregory, Fred McKinon, Dennis Peck, Greg Brink, Steve
R-6	Siskiyou Siuslaw-Hebo RD Willamette	Deadmond, Bob Dixon, Dan McCrea, Bob
R-10	RO	Van Lear, Jack

Table 4.--Distribution of Field Design Program experts

Location	Program	Individuals
Flathead	TI-SR 60 HP 9815A	Tabor, Clarence Valleries, Gary
Gallatin	TI-59	Fallang, Bob
Idaho Panhandle	HP 97	Wheeler, Ken
Kootenai	SR 52, TI-59, FCCC SR 52, TI-59, FCCC FCCC	Crider, Brian Leo, George Ness, Dennis (short-cut RDS)
Nezperce	TI-59	Miller, Richard
Willamette	FCCC	Knudson, Joe (his own program)

Table 5.--System experience 1966-1978

Year	1966	1967	1968	1971	1972	1973	1974	1975	1976	1977	1978
Miles	5	25	10	5	60	110	110	120	160	450	870
Total - 11 Years: 1,900 ($\pm$ 200 Miles)											

Table 6.--Comparison of cost per mile of road on Nezperce NF Projects

Method	Survey	Design, Plans, & Estimates	Construction Staking	Total
Field Design System	\$1,000	\$ 700	\$ 600	\$2,300
Staff Compass and Chain	2,400	1,000	2,800	6,200

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CONCRETE REPAIR OF THE VESUVIUS DAM

Gerald Coghlan
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Wayne-Hoosier National Forest
R-9

The Vesuvius Dam and Reservoir provide a main attraction to the Vesuvius Recreation Area on the Wayne National Forest, located 7 miles (11.3 km) north of Ironton, Ohio. The earthfill dam and concrete spillway structure hold 143 surface acres (578,721 m²) of water, with a maximum depth of 30 feet (9.1 m). Relatively minor concrete repairs were made to the spillway walls and floor in 1954 and 1963.

Annual dam inspection reports identified progressive concrete deterioration. In 1977 it was determined that repairs should be made before the structural integrity became seriously affected, and a thorough investigation of the entire concrete structure followed. The layout of the spillway structure (fig. 1) consists of a 126-foot (38.4 m) overflow section and a 236-foot (71.9 m) chute channel with walls between 15 and 30 feet (4.6 to 9.1 m). It also includes a stilling basin and a 175-foot (53.3 m) lower channel. The pond-drain channel, which was used to divert water during repair, parallels the spillway.

The extent of deteriorated areas were identified primarily by using a ball peen hammer, judging quality by the *thunk* or *ring* caused by the hammer blows. This procedure compared well with the results obtained with a Schmidt Rebound Hammer, and was much faster. *Areas to be repaired were marked on the concrete.*

A contract was advertised for the concrete repairs; rather than arbitrarily restrict the concrete repair method, it was decided to prepare a contract with an end product specification and to require that the contractor demonstrate his experience with the materials and methods that he proposed to use. The specification identified six alternative repair methods:

- (1) Dry mixed, pneumatically applied mortar (also called *shotcrete* or *gunite*);
- (2) Portland cement concrete replacement;
- (3) Dry packed grout;
- (4) Prepacked aggregate with intruded grout;
- (5) Polymer concrete; or
- (6) Epoxy-resin concrete.

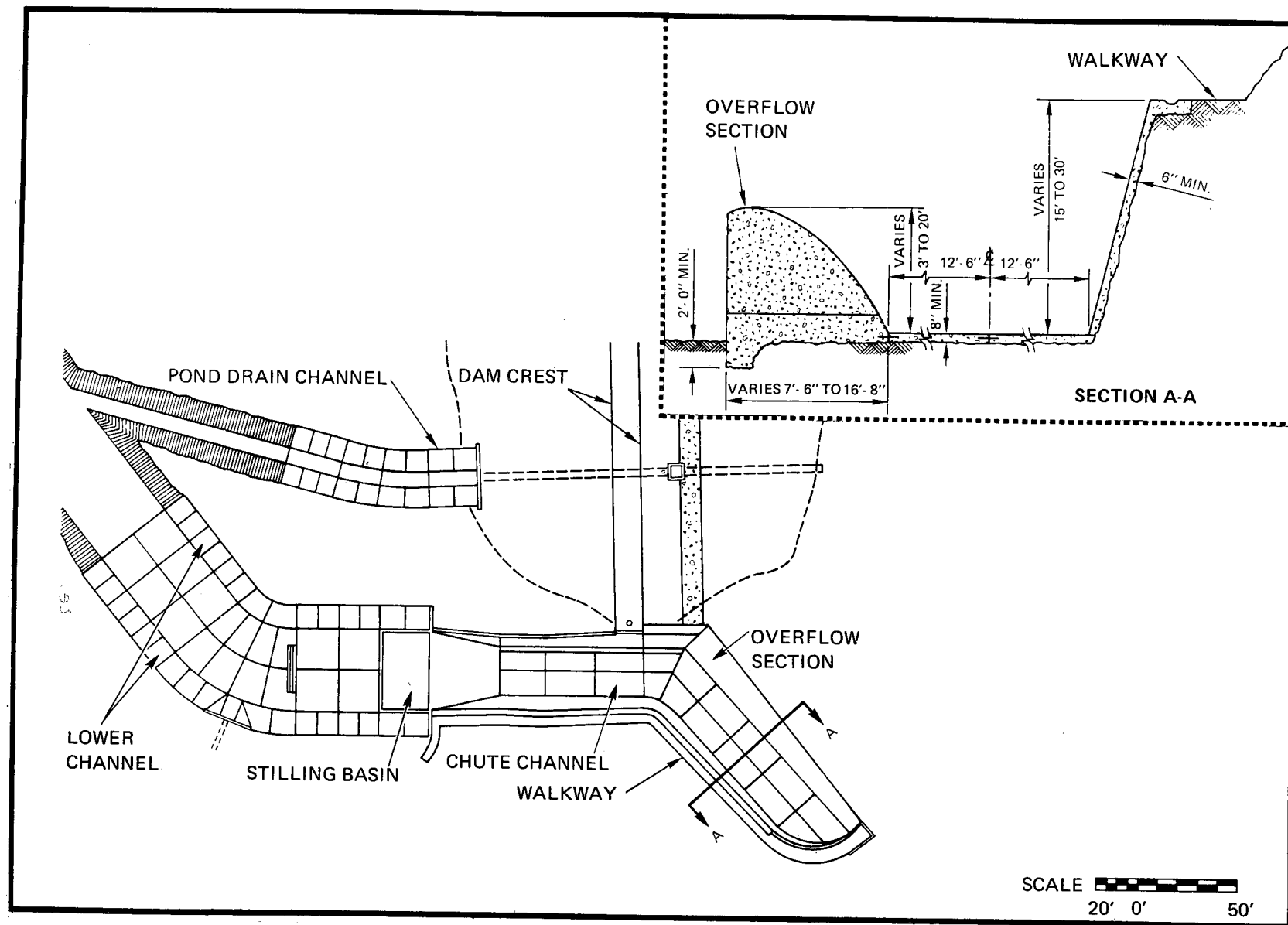


Figure 1.--General site plan, Vesuvius Dam and spillway structure.

The drawings included a summary of as-built details, identification of areas to be repaired, and repair details. Pay items included:

- (1) Wall cavity repairs - shallow.....900 sq. ft. (83.6 m²).
- (2) Wall cavity repairs - deep.....945 sq. ft. (87.2 m²).
- (3) Wall edge and joint repair.....1,313 ln. ft. (400.2 m).
- (4) Floor repair.....1,234 sq. ft. (114.6 m²).
- (5) Surface cleaning and treatment..2,200 sq. ft. (204.4 m²).

The contract was awarded to Gunitite Contracting Company, Inc., of Florence, Alabama. There was a difference of over 100 percent between the low bid by the Gunitite firm and the bid by a contractor who proposed to use conventional repairs with forms and ready-mix concrete.

The contractor began operations by chipping deteriorated concrete from the walls with hand-held 12-pound (4.48 kg) jack hammers (fig. 2). The Corps of Engineers had warned us that in several of their similar projects the quantities overran by as much as 100 percent because the contractor removed excessive concrete.

A relatively close watch was kept on this item, with a requirement for FS authorization to permit the contractor to chip beyond the painted repair limits. The contractor was extremely cooperative in this regard, both by pointing out additional areas he felt needed repair, and by leaving good concrete intact within the designated repair areas. With the 12-pound jack hammers, it was relatively easy to differentiate between good and deteriorated concrete. The good concrete was extremely hard to break out and came out in fist-sized pieces in contrast to the fine segregated aggregate that came from the poor concrete.

The concrete repairs were made through the gunitite placement technique (figs. 3 and 4). A dry mixture of sand and cement was pumped through 1½-inch (3.81 cm) diameter hose, pressurized up to 100 psi (689.5 kPa), with water being added at the nozzle through a separate hose. Before placement of the gunitite, a 2" x 2" (5.08 cm x 5.08 cm) wire mesh was installed and the areas were washed and sandblasted. The mixture was sprayed onto the surface to a slight overdepth, the excess was removed with a trowel to a relatively smooth surface, and then the surface was brush finished. Test specimens of the gunitite at 14 days ranged from 5,284 psi (36,431.6 kPa) to 5,425 psi (37,403.7 kPa) compressive strength.

The finish on smaller repairs of 3 sq. ft. (0.28 m²) or less were nearly indistinguishable from the old concrete. However, the larger surfaces were noticeably rougher than the original, and more difficult to finish. Staging the removal and limiting repair to 3-foot (0.9 m) sections at a time would improve the finish on large areas where aesthetics are particularly important.

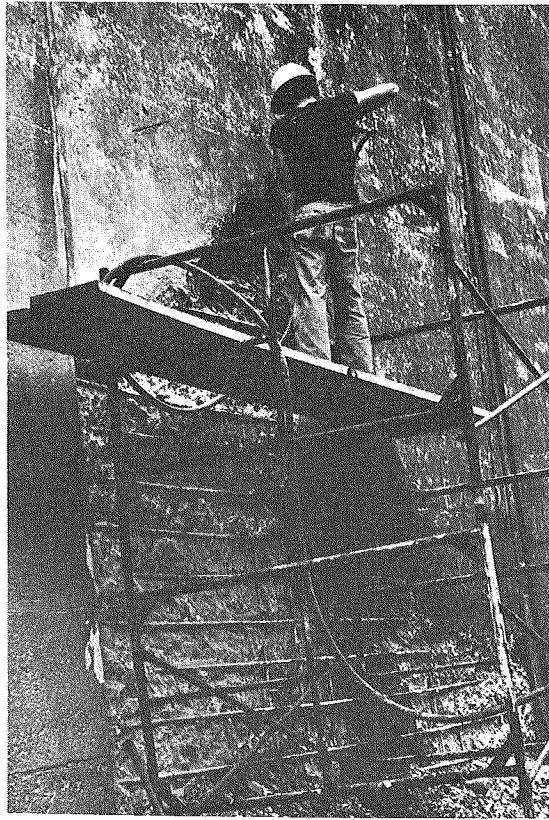


Figure 2.--Removing deteriorated concrete.

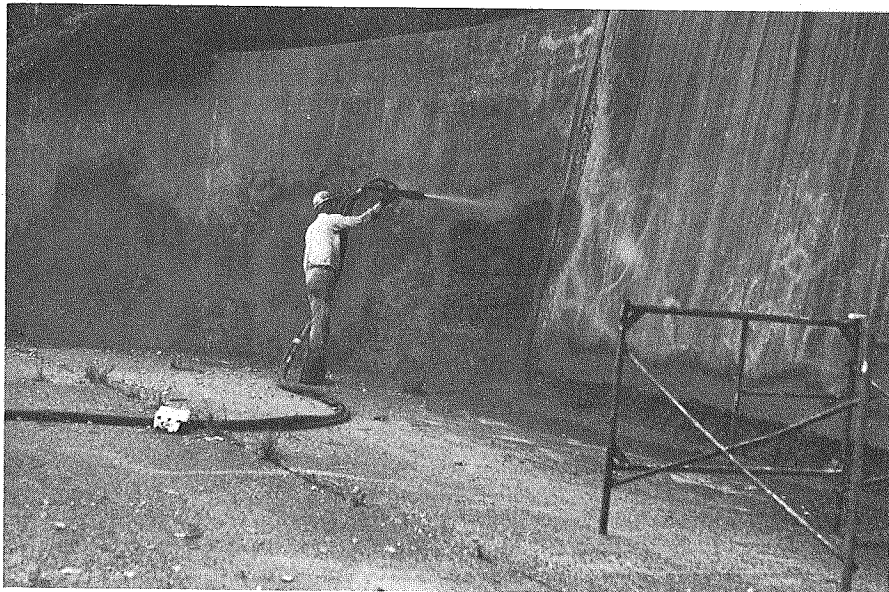


Figure 3.--Shooting gunite into repair areas.

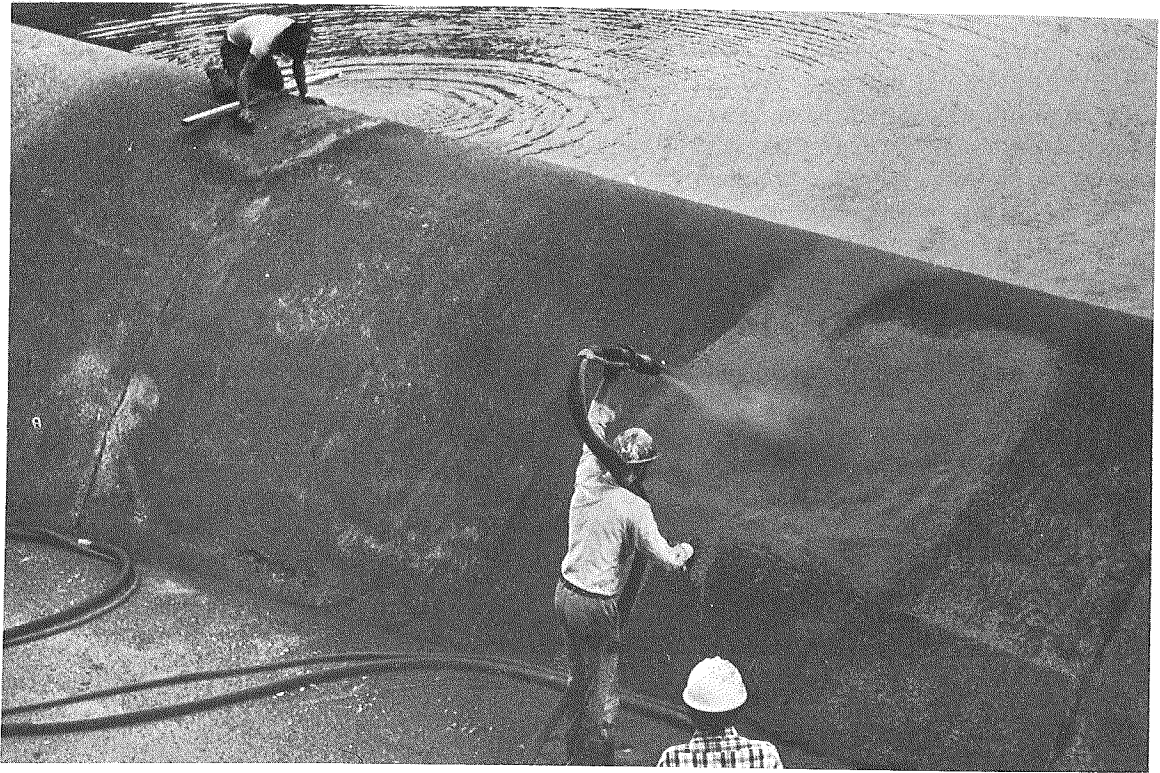


Figure 4.--Shooting gunite and finishing repair areas.

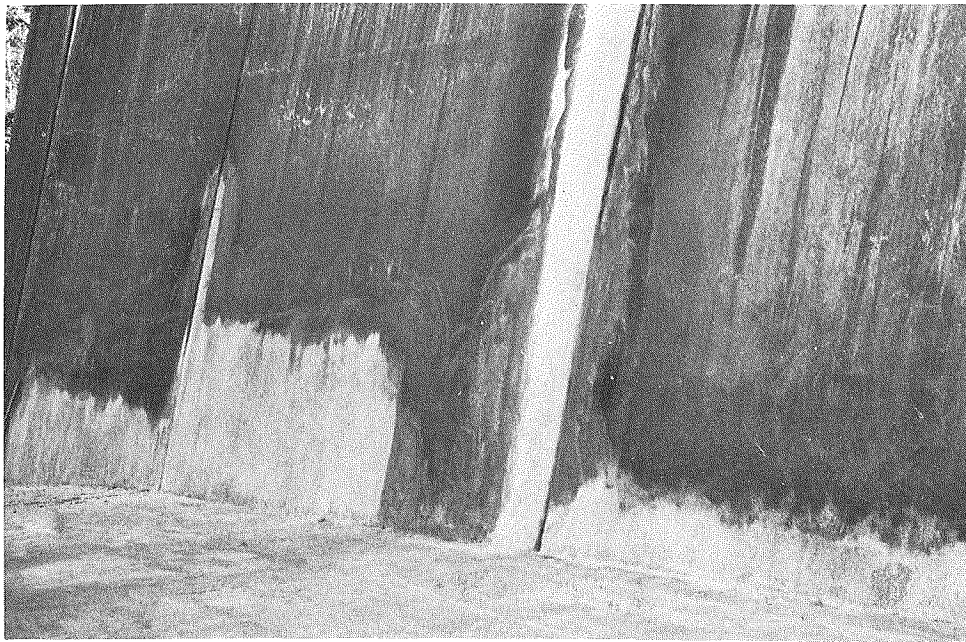


Figure 5.--Finished wall section showing repaired areas.

The surface treatment item consisted of a final overall sandblasting and treating with a linseed oil solution. The linseed oil was to improve the weather resistance of the existing concrete, and we hoped the appearance of the old concrete would blend with the repairs. However, after application of the linseed oil solution, the repaired areas were more noticeable than before. This has improved some with curing, and heavier applications of linseed oil (particularly on the light colored repairs) might have resulted in a more uniform appearance. Figure 5 (see preceding page) shows some completed repairs.

The gunite method proved to be a very effective means for doing this type of repair, and there were several advantages over a conventional repair technique:

- (1) It was cheaper;
- (2) Work was completed much faster than could otherwise be expected;
and
- (3) The strengths obtained were much higher than those obtained by normal concrete repairs.

Final construction cost was \$80,000.

INVITATION TO READERS OF *FIELD NOTES*

Every reader is a potential author of an article for *Field Notes*. If you have a news item or short article you would like to share with Service engineers, we invite you to send it for publication in *Field Notes*.

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