Editors

United States
Department of
Agriculture

Forest
Service

Engineering Staff

Washington, D.C.

Engineering Field Notes

Engineering Technical Information System

Volume 15
April-June
1983

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: G.L. Rome, Editor (Room 1112 RP/E)
P.O. Box 2417—Washington, D.C. 20013

Telephone: Area Code 703—235-8198

Awards for 1982 *Field Notes* Articles

The rating for the 1982 Field Notes articles is complete, and we have identified the following winners:

Author	Title
James Bassel Civil Engineer, SDEDC	"Use of Mobile Hammermill for Inplace Processing of Oversize Rock"
Carl Cain Civil Engineer, R-1 and James Langdon Civil Engineer, R-1	"A Guide for Determining Minimum Road Width on Curves for Single-Lane Forest Roads"
George Lippert Civil Engineer, WO-E	"Some Considerations in Using Wood for Energy"

To determine the award-winning authors, a point value was assigned which reflected your rating for each article:

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

Congratulations to the winners! The papers have been processed, and the checks were mailed to the respective offices.

In spite of their heavy workloads and slim staffing, all authors made the time to write good articles; Field Notes readers extend their thanks. All the readers who submitted rating sheets showed that the authors' efforts are appreciated in the field.

We are now well into 1983; submit YOUR article for the next Field Notes Articles Awards. Explain to others how YOU found a better way to perform a difficult task, or why YOU found a particular experience challenging and valuable. (Or, explain at home why you didn't have a chance for an extra $100 this year!)

Little Joe Road Surfacing Study

Steve Monlux
Materials Engineer
Region 1

When designing the thickness of aggregate road surfaces, it is important to estimate aggregate surface loss and the degree of subgrade contamination. The latest draft version of Chapter 50 (FSH 7709.11) suggests using local information about aggregate surface loss whenever possible. Although this study was originally undertaken to obtain data about materials for a bituminous pavement thickness design, the materials data should be valuable for making estimates of aggregate loss for projects that have similar characteristics.

PROJECT VARIABLES

The Little Joe Road is located on the Lolo National Forest in western Montana. The 15-mile, two-lane road begins near St. Regis at an elevation of 2,700 feet and ends on the Idaho border at 5,800 feet. The road was constructed in 1973 and 1974, and 9 inches of dense graded aggregate surfacing was placed on it in the fall of 1976. Road grades average 4 percent, with some half-mile segments approaching 7 percent. Superelevations vary considerably along the road and have been reconstructed out of aggregate surfacing in some locations.

Normally, the traffic distribution on the road is 80 percent light vehicles and 20 percent logging trucks. These trucks haul approximately 22 million board feet (mmbf) of timber over the road each year. Although the road was designed for a speed of 45 miles per hour, loaded logging trucks drive portions of the road at speeds exceeding 55 miles per hour. Annual precipitation in the area ranges from 35 to 80 inches; about 60 percent of this amount usually is in the form of snowfall. Snow is generally plowed through November, and load restrictions have been imposed during spring breakup.

The aggregate surface is usually bladed 3 times per year, and dust abatement material has been applied on an average of 1-1/2 times per year. From 1976 through 1981, annual dust abatement was done with either clarified dust oil (DO4) or lignin sulfonate. Because of sharp decreases in timber haul, no dust abatement was done in 1982.

Subgrade materials are GM (silty gravel) with 15 to 40 percent minus #200. Seven subgrade samples were taken in 1982, and lab CBR values ranged from 9.5 to 24.0 (AASHTO T193--95 percent of T99). Aggregate thickness designs according to the Pavement Design and Management System indicate that there is considerable life remaining in the existing surfacing thickness. This is confirmed by visual observation.

FIELD MEASUREMENTS

The existing aggregate surface was profiled before digging a trench across the road. Another profile was taken of the subgrade surface after the trench had been dug. Surfacing thicknesses, super-elevations, and rutting of the subgrade and aggregate were determined from survey data. The results are shown in table 1.

AGGREGATE TESTING DATA

Aggregate samples were split down in the field and then tested in the laboratory. Test results for the 1 inch minus aggregate are shown in table 2 for the original crushed material and also for samples taken from the roadway during the 1982 field investigation.

CONCLUSIONS

Aggregate Surfacing Loss. The weighted average loss figures shown in table 1 are considerably different for the three separate segments. Segment I had the greatest surfacing loss because vehicle speeds are greatest and dust abatement is the least successful.

$$\begin{aligned}\text{Surfacing Loss} &= (9\text{ in}-5.8\text{ in}) \div 113.7\text{ mmbf}\\ &= 0.028\text{ in/mmbf}\\ &= 0.28\text{ in/10 mmbf}\\ &= 1\text{ in/35.5 mmbf}\end{aligned}$$

Segment II has the least surfacing loss as a result of slow vehicle speeds and moderate grades. Loss of fines by dusting is probably not significant.

$$\begin{aligned}\text{Surfacing Loss} &= (9\text{ in}-7.33\text{ in}) \div 113.7\text{ mmbf}\\ &= 0.015\text{ in/mmbf}\\ &= 0.147\text{ in/10 mmbf}\\ &= 1\text{ in/68 mmbf}\end{aligned}$$

Segment III had a significant loss mostly because of snowplowing, surface erosion caused by snowmelt, and

Table 1.--Field measurements.

Segment and Station	Aggregate Thickness (Inches)				Rutting (Inches)		Template		
	Minimum	Maximum	Average[a]	Weighted Average[b]	Subgrade	Aggregate	Crown (Inches)	Super (Percent)	Shoulders (Feet)
I									
14+00	8.25	12.00	8.50	5.80	1	0	2.5	3.5	4&4
38+75	0.00	7.00	4.25		1	0	2.0	4.5	1&2
55+50	5.50	9.75	6.50		1	1	5.0	0.5	1&2
78+00	1.00	8.25	5.00		2	0	3.0	0.5	4&5
102+00	3.00	9.00	5.50		1	0	0.0	4.5	3&2
134+50	4.75	8.00	5.00		1	0	5.0	6.5	2&2
II									
565+00	7.25	9.25	8.00	7.33	1	0	3.5	1.5	3&6
571+50	4.75	9.00	6.00		2	0	9.5	6.0	5&2
583+25	7.00	9.00	8.00		1	0	0.0	0.0	2&3
III									
807+50	0.00	7.00	4.25	6.07	1	0	0.0	6.0	2&2
814+00	7.00	9.75	8.50		0	0	1.5	1.0	--
822+00	5.75	8.50	6.00		2	1	3.0	4.5	--
826+00	0.00	9.75	4.75		1	0	0.0	6.5	2&12

[a]The "average" is based on the existing cross-sectional area of aggregate occupying the original specified surfacing width.
[b]The "weighted average" considers the amount of road length each thickness represents.

Table 2.--Aggregate test data.

Test Results	Sieve Analysis % Pass #4	Sieve Analysis % Pass #200	Aggregate Quality T176 SE	T96 LAA	T210 Dc	T210 Df	% Fracture
1976 Average ..	40	9.5	--	21	73	69	68
1982 Average	51.2	14.8	30	18	75	65	77
By Station							
14+00	51	14.3					
38+75	48	16.3					
55+50	53	14.8					
78+00	52	13.5					
102+00	48	13.3	29	17.5	74	59	80
134+50	52	13.4					
565+00	52	14.7					
571+50	51	14.3	31	18.2	76	68	80
583+25	49	13.9					
807+50	53	14.9					
814+00	51	16.2	31	18.1	74	69	70
822+00	52	15.2					
826+00	54	17.7					

more surface raveling resulting from sharp curves. Dust abatement is very effective because of a short season and low vehicle speeds on steep grades.

$$\begin{aligned}\text{Surfacing Loss} &= (9\text{ in}-6.07\text{ in}) \div 113.7\text{ mmbf}\\ &= 0.026\text{ in/mmbf}\\ &= 0.258\text{ in/10 mmbf}\\ &= 1\text{ in/38.8 mmbf}\end{aligned}$$

The accuracy of these surfacing loss figures is directly dependent on the accuracy of the original thickness, which is probably within ± 1/2 inch of the 9 inches specified in the original contract.

Degree of Subgrade Contamination. Aggregate test results show that about 10 percent minus #4 and 5 percent minus #200 were added to the surfacing material. This additional material is believed to have come from road shoulders and ditch lines during blading operations. This theory is reinforced by the fact that, just after laying the aggregate, Forest personnel commented that the aggregate did not have enough binder (minus #4 sieve material) to prevent raveling.

RECOMMENDATIONS

Selecting the appropriate aggregate surfacing loss figure requires considerable judgment in evaluating project variables. Under ideal project circumstances, loss may be as low as 0.15 inches per 10 mmbf. Normally, a loss of 0.30 inches per 10 mmbf would be appropriate for projects that require dust abatement, utilize good quality dense graded crushed aggregate, and are driven at speeds below 25 miles per hour.

Subgrade contamination of aggregate surfacing does not appear to be a problem for the materials studied. Subgrade contamination could be a problem where subgrade soils have low strengths, high fines contents, high moisture contents, or inadequate aggregate thicknesses. Geotextiles may be used as an effective separating layer between weak subgrade materials and aggregate. Also, some subgrade soils may be chemically stabilized, which will prevent subgrade materials from weakening the aggregate layer. Increasing the "binder" in aggregate surfacing during maintenance operations is a high-risk operation because it is difficult to control the nature and extent of material added. The strength of any aggregate surfacing is significantly reduced if the minus #200 exceeds 20 percent by weight. There is no substitute for specifying the most desirable gradation in the crushing contract.

The data presented in this report may help in estimating aggregate surface loss, provided personnel thoroughly evaluate project variables. However, as the draft Chapter 50 points out, there is no substitute for using local information on aggregate surface loss that has occurred on existing projects.

Survey Economics

Tom Grabinski
Civil Engineer
Gallatin National Forest
Region 1

A program has been written to help give engineering crew supervisors estimates of the lodging, driving, and labor costs for alternative approaches to a particular survey project. The program is based on one written by Earl R. Williams of the Deerlodge National Forest in 1971 for a Monroe 1765 programable calculator. With the programing assistance of Bob Fallang, Gallatin National Forest, we rewrote the program for the Hewlett Packard system.

This program calculates some basic answers to a problem where answers to similar questions in the past were best guesses based on the experience of supervisors. Some survey projects are located such that the answers to "stay-out/driving" questions are obvious. However, there are many projects where there may be multiple ways of completing the project and where it is not immediately evident whether the crew should drive daily or stay out or where they should stay. Comparing these various alternatives is not easy when done by hand or when estimated from experience. The program is only a tool to help crew supervisors make sound economic decisions. There are other factors in the project assignment, such as weather and crew morale, that need to be taken into account before the assignment is completed.

The input factors for a job are easily obtained. When input into this program, they are combined to give four answers: (1) weeks to complete; (2) cost per week; (3) total cost; and (4) total miles driven.

The program was written for use with an HP 41CV with the HP 82143A thermal printer. The program has been put on magnetic cards, and the program will operate as written without the thermal printer plugged into the calculator. In this case, the answers will be stored in registers--38 (weeks to complete), 43 (weekly job cost), 44 (total job cost), and 45 (total miles driven)--instead of being printed out.

When the program is finished, the calculator will display "NON-EXISTENT"; however, all calculations are done and stored correctly. The loop options to input a different work week or lodging location also are not available to the user without the printer.

The PROGRAM

The objective of the program is to find a least cost/work year equivalent solution for each engineering survey.

There are 17 input factors that are known or can be easily obtained.

(1) Survey project length in miles.

(2)** Distance from official station to motel or camp in miles (one way).

(3)** Distance from motel or camp to job in miles (one way).

(4) Distance from end of road to midpoint of project in walking miles.

(5) Daily work hours (greater than 8 hours).

(6)* Work days per week.

(7)* Daily work hours paid at standard hourly rates.

(8) Production rate in feet per hour (actual production when working).

(9) Labor cost for entire crew in dollars per hour.

(10) Number of crewmembers.

(11)** Travel speed from official station to camp in miles per hour.

(12)** Travel speed from camp to job in miles per hour.

(13)** Lodging cost per day for each crewmember in dollars.

(14)** Per diem or subsistence cost per day for each crewmember in dollars.

(15)** Fixed cost in dollars (trailer move, campground fee, etc.).

(16) Vehicle F.O.R. cost per month in dollars.

(17) Vehicle mileage cost per mile in dollars per mile.

LOOP OPERATIONS

This program is designed to allow two different sets of variables to be changed by way of loop options in order to help select the best combination of crew time and cost. One set of variables that can be changed is (5) work hours per day, (6) days per week, and (7) standard rate work hours, which are marked with an asterisk (*) above. These variables can be changed by responding "Yes" (Y) when the calculator asks "NEW WEEK?" The second set of variables corresponds to lodging costs and is entered when the calculator asks "NEW LODGE?" Because a change in lodging locations almost always changes the distance traveled, the distance and travel speed inputs also can be changed to accommodate this. The second set of variables that may be modified is identified by a double asterisk (**). This second set can be changed only after changing or reentering the "NEW WEEK?" variables. As shown in instructions in figure 1, the program will prompt the user to enter the proper data.

For the program to calculate the correct costs and mileage for a situation of driving daily from the official station to the job, the second distance (3) (CP-Job) must be entered as 0.00 miles. If you have a trailer at the beginning of your job, you must insert some number greater than 0.00 miles (minimum of 0.01 miles) for the distance from camp to job (3) (CP-Job).

This program does not include the survey supplies used and equipment amortization in the cost, although it can be included in the fixed cost input (15). Because this program is intended only for relative analyses of alternatives for a specific project, it can be assumed that such fixed costs would remain constant regardless of how the project is completed; therefore, it is not necessary to include these or other fixed costs.

The daily hours paid at the standard hourly rate are included as a reference item in output. No calculation is performed based on this item.

Another assumption made is that the project (job beginning) is beyond the camp/motel. If the project is between the official station and the camp/motel, the total miles driven may be incorrect because on

1. KEY XEQ ALPHA SIZE ALPHA, PROGRAM WILL PROMPT SIZE _ _ _ KEY 050. THIS STEP IS NECESSARY ONLY IF THE CALCULATOR IS SIZED FOR A SMALLER PROGRAM.

2. TURN PRINTER ON. SET PRINTER MODE TO MAN. KEY XEQ ALPHA CREW ALPHA EXECUTES PROGRAM.

3. AFTER THE TONE AND DISPLAY THE PROGRAM WILL PROMPT FOR THE INPUT VARIABLES. FOLLOW EACH INPUT WITH THE R/S KEY TO PROCEED TO THE NEXT.

    1. PROJLN = PROJECT LENGTH IN MILES
    2. OS-CP = DISTANCE IN MILES FROM OFFICIAL STATION TO CAMP OR MOTEL
    3. CP-JOB = DISTANCE IN MILES FROM CAMP OR MOTEL TO THE JOB
    4. EOR-MP = DISTANCE IN MILES FROM THE END OF ROAD TO THE JOB MIDPOINT
    5. HR/DAY = DAILY WORK HOURS
    6. DAY/WK = DAYS WORKED PER WEEK (4 OR 5 DAYS)
    7. WRKDAY = WORK HOURS PER DAY AT STANDARD PAY RATE (REFERENCE ONLY; 8, 9, OR 10 HRS.)
    8. PRD/HR = ACTUAL PRODUCTION PER HOUR ON THE JOB IN FEET PER HOUR
    9. CR$/HR = LABOR COST PER CREW PER HOUR AT STANDARD RATE (HOURLY COST TO GOVERNMENT)
    10. CRNO? = NUMBER OF PEOPLE ON THE CREW
    11. SPD-CP = SPEED IN MPH FROM OFFICIAL STATION TO CAMP OR MOTEL
    12. SPD-JB = SPEED IN MPH FROM CAMP OR MOTEL TO THE JOB
    13. LODGE$ = LODGING COST/DAY/EACH CREWMEMBER
    14. PRDSB$ = PER DIEM OR SUBSISTENCE COST/DAY/CREWMEMBER
    15. FIXED$ = ANY FIXED JOB COST (TRAILER MOVE, ETC.)
    16. VEHFOR = VEHICLE F.O.R. COST PER MONTH IN $/MONTH
    17. VEHMI$ = VEHICLE MILEAGE CHARGE PER MILE IN $/MILE

4. THE PRINTER WILL PRINT THE INPUT NAME FOLLOWED BY THE INPUT VALUE AT THE END.

    WKS/JOB = XXXX.XX (WEEKS TO COMPLETE THE JOB)
    WKLY$ = XXXXX.XX (WEEKLY COST OF THE JOB)
    JOB$ = XXXXXX.XX (TOTAL JOB COST FOR CREW)
    TOTMILES = XXXXX (TOTAL MILES DRIVEN)

5. THE CALCULATOR WILL DISPLAY NEW WEEK? (YOU MUST ANSWER THIS QUESTION). ANSWER Y FOR YES, OR N FOR NO, KEY R/S. IF THE ANSWER TO STEP 7 WILL BE Y YOU MUST ANSWER Y FOR STEP 5.

6. IF YOU ANSWER N TO STEP 5, NEW JOB WILL BE DISPLAYED. ANSWER Y FOR YES, KEY R/S AND PROGRAM WILL START AGAIN AT STEP 3. ANSWER N FOR NO, KEY R/S AND PROGRAM WILL BE OVER.

7. THE CALCULATOR WILL DISPLAY NEW LODGE? - ANSWER Y FOR YES OR N FOR NO--KEY R/S.

    THE CALCULATOR WILL THEN PROMPT FOR THE NEW INPUTS REQUIRED IN THE SAME MANNER AS STEP 3.

    THE PRINTOUT FOR NEW WEEK AND NEW LODGE WILL BE SIMILAR TO STEP 4 EXCEPT ONLY THE NEW INPUTS WILL BE SHOWN.

PROGRAM LIMITATIONS

A. IF THE CREW IS DRIVING TO THE JOB FROM THE OFFICIAL STATION, CP-JOB AND SPD-JB MUST BE ENTERED AS ZERO (0.0).

B. IF YOU HAVE A CAMP, YOU MUST INPUT A VALUE OTHER THAN ZERO FOR CP-JOB AND SPD-JOB (SUGGESTION: USE 0.01 AND 2.5 MPH IF THE CAMP IS AT THE EOR).

C. DO NOT TOUCH THE PRGM SWITCH.

Figure 1.--Program instructions for survey economics using HP 41CV.

the last day of work the crew may not normally go back to the camp/motel and then to the official station. This will also affect the cost to do the project.

CONCLUSIONS

The input data for three alternatives for a survey are presented in figure 2. The alternatives are working from a motel near the job, moving a trailer to a camp near the job, and driving daily from the official site to the job. These were evaluated using the program. The answers are presented in the first three columns of figure 3. The following conclusions are easily drawn from the printouts:

Least Weeks/Job - Trailer Option
Least Weekly Cost - Drive Daily Option
Least Job Cost - Trailer Option
Least Total Miles - Trailer Option

Therefore, the most economic option is to move the trailer to the job site. This option was further evaluated for differing work schedules:

Basic Option	10 hrs/day, 4 days per week
Choice 1.	11 hrs/day, 4 days per week (4 OT hrs/week)
2.	12 hrs/day, 4 days per week (8 OT hrs/week)
3.	8 hrs/day, 5 days per week (normal)
4.	10 hrs/day, 5 days per week (10 OT hrs/week)

From these we can see that the following is the most economic survey: move trailer to site; work 10 hours per day, 4 days per week (if overtime money is authorized).

The reduction when comparing the trailer option to the motel option is as follows:

Crew weeks	0.75
Job cost	2,072.79
Total Miles	495

Man-Year Equivalence Savings 8.9 days

The definition of the input registers are shown in figure 4, the equation in figure 5, and the detail of the program steps in figure 6.

SURVEY ECONOMICS DATA INPUT

MADE BY________________
CHECKED BY______________

PROJECT:______________________________

INPUT	MOTEL•	TRAILER/CAMP	DRIVE DAILY	REMARKS/CONCLUSIONS
PROJLN (1)	6.5	6.5	6.5	
OS-CP (2)	50.00	60.00	60.00	
CP-JOB (3)	10	0.01	0.00	
EOR-MP (4)	4.5	4.5	4.5	
HR/DAY (5)	10	10	10	
DAY/WK (6)	4	4	4	
WRK/DAY (7)	10	10	10	
PRD/HR (8)	250	250	250	
CR$/HR (9)	17.91	17.91	17.91	1-GS5 AND 2-GS4
CR NO? (10)	3	3	3	
SPD-CP (11)	55	50	50	
SPD-JB (12)	25	2.5	0.00	
LODGE $(13)	21	0	0	
PRDSB$ (14)	12	12	0	
FIXED $(15)	0.00	175.00	0.00	COST TO MOVE TRAILER TO SITE
VEH FOR(16)	138.00	138.00	138.00	GSA LEASE FOR 4X4 CARRYALL
VEHM1 $(17)	.22	.22	.22	GSA MILEAGE

Figure 2.--Input data sheet.

```
DRIVE DAILY
  NO OVERTIME
R01= "PROJLN"
R02=  6.50
R03= "OS-CP"
R04=  60.00
R05= "CP-JOB"
R06=  0.00
R07= "EOR-MP"
R08=  4.50

R15= "PRD/HR"
R16=  250.00
R17= "CR$/HR"
R18=  17.91
R19= "CRNO?"
R20=  3.00
R21= "SPD-CP"
R22=  50.00
R23= "SPD-JB"
R24=  0.00
R25= "LODGE$"
R26=  0.00
R27= "PRDSB$"
R28=  0.00
R29= "FIXED$"
R30=  0.00
R31= "VEHFOR"
R32=  130.00
R33= "VEHMI$"
R34=  0.22


R09= "HR/DAY"
R10=  10.00
R11= "DAY/WK"
R12=  4.00
R13= "WRKDAY"
R14=  10.00
WKS/JOB=8.75
WKLY$=847.09
JOB$=7,412.05
TOTMILES=4,200.
```

```
DRIVE DAILY
  1 HR O-T/DAY
R09= "HR/DAY"
R10=  11.00
R11= "DAY/WK"
R12=  4.00
R13= "WRKDAY"
R14=  10.00
WKS/JOB=7.00
WKLY$=954.55
JOB$=6,681.86
TOTMILES=3,360.

STAY AT MOTEL
  NO OVERTIME
R03= "OS-CP"
R04=  50.00
R05= "CP-JOB"
R06=  10.00

R21= "SPD-CP"
R22=  55.00
R23= "SPD-JB"
R24=  25.00
R25= "LODGE$"
R26=  21.00
R27= "PRDSB$"
R28=  12.00
R29= "FIXED$"
R30=  0.00

R09= "HR/DAY"
R10=  10.00
R11= "DAY/WK"
R12=  4.00
R13= "WRKDAY"
R14=  10.00
WKS/JOB=6.75
WKLY$=1,127.59
JOB$=7,611.24
TOTMILES=1,215.
```

```
STAY AT MOTEL
  1 HR O-T/DAY
R09= "HR/DAY"
R10=  11.00
R11= "DAY/WK"
R12=  4.00
R13= "WRKDAY"
R14=  10.00
WKS/JOB=5.75
WKLY$=1,235.05
JOB$=7,101.54
TOTMILES=1,035.

TRAILER AT SITE
  NO OVERTIME
R03= "OS-CP"
R04=  60.00
R05= "CP-JOB"
R06=  0.01

R21= "SPD-CP"
R22=  50.00
R23= "SPD-JB"
R24=  2.50
R25= "LODGE$"
R26=  0.00
R27= "PRDSB$"
R28=  12.00
R29= "FIXED$"
R30=  175.00

R09= "HR/DAY"
R10=  10.00
R11= "DAY/WK"
R12=  4.00
R13= "WRKDAY"
R14=  10.00
WKS/JOB=6.00
WKLY$=893.91
JOB$=5,536.45
TOTMILES=720.
```

```
TRAILER AT SITE
  1 HR O-T/DAY
R09= "HR/DAY"
R10=  11.00
R11= "DAY/WK"
R12=  4.00
R13= "WRKDAY"
R14=  10.00
WKS/JOB=5.25
WKLY$=1,001.37
JOB$=5,432.18
TOTMILES=630.

TRAILER AT SITE
  2 HRS O-T/DAY
R09= "HR/DAY"
R10=  12.00
R11= "DAY/WK"
R12=  4.00
R13= "WRKDAY"
R14=  10.00
WKS/JOB=4.50
WKLY$=1,106.83
JOB$=5,164.73
TOTMILES=540.

TRAILER AT SITE
  STANDARD WEEK
R09= "HR/DAY"
R10=  8.00
R11= "DAY/WK"
R12=  5.00
R13= "WRKDAY"
R14=  8.00
WKS/JOB=7.20
WKLY$=936.19
JOB$=6,915.54
TOTMILES=865.

TRAILER AT SITE
  2 HR O-T/DAY
R09= "HR/DAY"
R10=  10.00
R11= "DAY/WK"
R12=  5.00
R13= "WRKDAY"
R14=  8.00
WKS/JOB=4.80
WKLY$=1,204.84
JOB$=5,958.21
TOTMILES=576.
```

Figure 3.--Survey economics example.

SURVEY ECONOMICS

REGISTER	INPUT VARIABLES	
2	L	= PROJECT LENGTH
4	L_1	= DISTANCE OFFICIAL STATION TO CAMP OR MOTEL
6	L_2	= DISTANCE CAMP OR MOTEL TO JOB
8	L_3	= DISTANCE END OF ROAD TO JOB MIDPOINT (WALKING MILES)
10	D_1	= DAILY WORK HOURS
12	D_2	= DAYS PER WEEK
14	D_3	= HOURS PER DAY PAID AT STANDARD RATE
16	P	= PRODUCTION RATE - FEET PER HOUR
18	R	= LABOR COST - DOLLARS PER HOUR FOR ENTIRE CREW
20	C	= NUMBER OF CREWMEMBERS
22	T_1	= TRAVEL SPEED OFFICIAL STATION TO CAMP - MPH
24	T_2	= TRAVEL SPEED CAMP OR MOTEL TO JOB - MPH
26	S_1	= LODGING COST PER DAY FOR EACH CREWMEMBER
28	S_2	= PER DIEM OR SUBSISTANCE COST PER DAY EACH
30	S_3	= FIXED COST - TRAILER MOVE, ETC.
32	M_1	= VEHICLE F.O.R. PER MONTH
34	M_2	= VEHICLE MILEAGE COST PER MILE

Figure 4.--Survey economics input variables.

REGISTERS	
35	H_T = TRAVEL HOURS PER WEEK
	$H_T = 2x\left(\frac{L_1}{T_1} + \frac{D_2L_2}{T_2} + \frac{D_2L_3}{2.5}\right)$
	IF DRIVING TO JOB FROM O.S. ($L_2 = 0$)
	$H_T = 2x\left(\frac{L_1D_2}{T_1} + \frac{D_2L_3}{2.5}\right)$
36	H_P = PRODUCTION HOURS PER WEEK
	$H_P = D_2D_1 - H_T$
37	H_{PF} = PRODUCTION FEET PER WEEK
	$H_P = H_PP$
38	W = WEEKS TO COMPLETE JOB
	$W = \left(\frac{L \times 5280 \times D_2}{H_{PF}} + .5\right) \div D_2$
39	W_C = WEEKLY SALARY COST
	$W_C = 40xR + 1.5xR(D_1D_2 - 40)$
40	M_W = WEEKLY MILES
	$M_W = 2x(L_1 + D_2L_2)$
	IF $L_2 = 0$
	$M_W = 2x(D_2L_1)$
	IF W IS LESS THAN 1.0 WEEKS
	$M_W = 2x(L_1 + D_2L_2W) \div W$
41	$M_\$$ = WEEKLY COST
	$M_\$ = \left(\frac{D_2M_1}{22} + M_WM_2\right) \times W$
42	P_D = WEEKLY LODGING COST AND PER DIEM
	$P_D = Cx(S_1 + S_2)(D_2 - 0.5)$
43	$T_{\$W}$ = TOTAL WEEKLY COST
	$T_{\$W} = W_C + M_\$ + P_D$
44	$T_{\$J}$ = TOTAL JOB COST
	$T_{\$J} = T_{\$W}W + S_3$
45	M_T = TOTAL MILES PER JOB
	$M_T = M_WW$

Figure 5.--Engineering economics equations.

```
 01♦LBL "CRE
W"
 02 TONE 9
 03 SF 12
 04 "  SURVE
Y"
 05 AVIEW
 06 "ECONOMI
CS"
 07 AVIEW
 08 ADV
 09 CF 12
 10 "   GALL
ATIN N.F"
 11 "⊢."
 12 AVIEW
 13 ADV
 14 ADV
 15 "PROJECT
---------"
 16 "⊢------
--"
 17 AVIEW
 18 ADV
 19 "DATE---
---------"
 20 "⊢------
--"
 21 AVIEW
 22 ADV
 23 "ESTIMAT
OR------"
 24 "⊢------
--"
 25 AVIEW
 26 ADV
 27 ADV
 28 CLRG
 29 "PROJLN"
 30 ASTO 01
 31 "OS-CP"
 32 ASTO 03
 33 "CP-JOB"
 34 ASTO 05
 35 "EOR-MP"
 36 ASTO 07
 37 "HR/DAY"
 38 ASTO 09
 39 "DAY/WK"
 40 ASTO 11
 41 "WRKDAY"
 42 ASTO 13
 43 "PRD/HR"
 44 ASTO 15
 45 "CR$/HR"
```

```
 46 ASTO 17
 47 "CRNO?"
 48 ASTO 19
 49 "SPD-CP"
 50 ASTO 21
 51 "SPD-JB"
 52 ASTO 23
 53 "LODGE$"
 54 ASTO 25
 55 "PRDSB$"
 56 ASTO 27
 57 "FIXED$"
 58 ASTO 29
 59 "VEHFOR"
 60 ASTO 31
 61 "VEHMI$"
 62 ASTO 33
 63♦LBL 01
 64 FIX 2
 65 CF 00
 66 CF 01
 67 0
 68 STO 49
 69 CLA
 70 ARCL 01
 71 PROMPT
 72 STO 02
 73♦LBL "LLL
"
 74 CLA
 75 ARCL 03
 76 PROMPT
 77 STO 04
 78 CLA
 79 ARCL 05
 80 PROMPT
 81 STO 06
 82 FS? 01
 83 GTO "4L"
 84 CLA
 85 ARCL 07
 86 PROMPT
 87 STO 08
 88♦LBL 02
 89 CLA
 90 ARCL 09
 91 PROMPT
 92 STO 10
 93 CLA
 94 ARCL 11
 95 PROMPT
 96 STO 12
 97 CLA
 98 ARCL 13
 99 PROMPT
```

```
100 STO 14
101 FS? 00
102 GTO 03
103 CLA
104 ARCL 15
105 PROMPT
106 STO 16
107 CLA
108 ARCL 17
109 PROMPT
110 STO 18
111 CLA
112 ARCL 19
113 PROMPT
114 STO 20
115♦LBL "5L"
116 CLA
117 ARCL 21
118 PROMPT
119 STO 22
120 CLA
121 ARCL 23
122 PROMPT
123 STO 24
124 CLA
125 ARCL 25
126 PROMPT
127 STO 26
128 CLA
129 ARCL 27
130 PROMPT
131 STO 28
132 CLA
133 ARCL 29
134 PROMPT
135 STO 30
136 FS? 01
137 GTO "6L"
138 CLA
139 ARCL 31
140 PROMPT
141 STO 32
142 CLA
143 ARCL 33
144 PROMPT
145 STO 34
146 CLA
147♦LBL 03
148 RCL 06
149 X=0?
150 XEQ 08
151 RCL 04
152 RCL 22
153 /
154 RCL 12
```

```
155 RCL 06
156 *
157 RCL 24
158 /
159 +
160 RCL 12
161 RCL 08
162 *
163 2.5
164 /
165 +
166 2
167 *
168 STO 35
169♦LBL 09
170 RCL 12
171 RCL 10
172 *
173 RCL 35
174 -
175 STO 36
176 RCL 16
177 *
178 STO 37
179 RCL 02
180 /
181 5280
182 /
183 1/X
184 RCL 12
185 *
186 .50
187 +
188 FIX 0
189 RND
190 RCL 12
191 /
192 FIX 2
193 STO 38
194 40
195 RCL 18
196 *
197 RCL 12
198 RCL 10
199 *
200 40
201 -
202 RCL 18
203 *
204 1.5
205 *
206 +
207 STO 39
208 RCL 06
209 X=0?
```

Figure 6.--Program steps (part 1).

```
210 XEQ A
211 .99
212 RCL 38
213 X>Y?
214 XEQ "CC"
215 RCL 04
216 RCL 12
217 RCL 06
218 *
219 RCL 38
220 *
221 +
222 2
223 *
224 RCL 38
225 /
226 STO 40
227◆LBL B
228 RCL 34
229 *
230 RCL 32
231 22
232 /
233 RCL 12
234 *
235 +
236 STO 41
237 RCL 12
238 .5
239 -
240 RCL 28
241 RCL 26
242 +
243 *
244 RCL 20
245 *
246 STO 42
247 RCL 39
248 RCL 41
249 +
250 RCL 42
251 +
252 STO 43
253 RCL 38
254 *
255 RCL 30
256 +
257 STO 44
258 RCL 38
259 RCL 40
260 *
261 STO 45
262 FS? 01
263 GTO 10
264 FS? 00
```

```
265 GTO 07
266 1.008
267 PRREGX
268 15.034
269 PRREGX
270 ADV
271 GTO 07
272◆LBL 10
273 3.006
274 PRREGX
275 21.030
276 PRREGX
277◆LBL 07
278 9.014
279 PRREGX
280 "WKS/JOB
="
281 ARCL 38
282 AVIEW
283 "WKLY$="
284 ARCL 43
285 AVIEW
286 "JOB$="
287 ARCL 44
288 AVIEW
289 FIX 0
290 "TOTMILE
S="
291 ARCL 45
292 AVIEW
293 FIX 2
294 ADV
295 ADV
296 "Y"
297 ASTO Y
298 AON
299 "NEW WEE
K?"
300 PROMPT
301 ASTO X
302 AOFF
303 X=Y?
304 GTO 04
305 "Y"
306 ASTO Y
307 AON
308 "NEW JOB
?"
309 PROMPT
310 ASTO X
311 AOFF
312 X=Y?
313 GTO "CRE
W"
314◆LBL 05
```

```
315 STOP
316◆LBL 04
317 SF 00
318 50
319 RCL 49
320 X=Y?
321 CF 01
322 XEQ "L
323 GTO 02
324◆LBL 08
325 RCL 04
326 RCL 12
327 *
328 RCL 22
329 /
330 RCL 12
331 RCL 08
332 *
333 2.5
334 /
335 +
336 2
337 *
338 STO 35
339 GTO 09
340◆LBL A
341 RCL 12
342 RCL 04
343 *
344 2
345 *
346 STO 40
347 GTO B
348◆LBL "CC"
349 RCL 04
350 RCL 12
351 RCL 06
352 *
353 +
354 2
355 *
356 STO 40
357 GTO B
358◆LBL "L"
359 "Y"
360 ASTO Y
361 AON
362 "NEW LOD
GE?"
363 PROMPT
364 ASTO X
365 AOFF
366 X=Y?
367 GTO "LL"
368 RTN
```

```
369◆LBL "LL"
370 SF 01
371 50
372 STO 49
373 GTO "LLL
"
374◆LBL "4L"
375 GTO "5L"
376◆LBL "6L"
377 RTN
378 .END.
```

Figure 6.--Program steps (part 2).

"Two-Rule" Method of Aligning Bridge Abutments & Piers

Allan A. Johnson
Supervisory Civil Engineer
Nicolet National Forest
Region 9

The Forest Service often is required to check or to provide the correct alignment and location of poured concrete bridge abutments and piers. The following description, in conjunction with figure 1, illustrates a fast and accurate method to accomplish this task.

<u>Step 1</u>. While shooting line for abutment A footing (or anytime before form work for the abutment A wall precludes seeing through on reference line A), mark accurately with a crow's foot the location of reference line A on the footing or on some other convenient place.

<u>Step 2</u>. When alignment is needed for forming or checking the abutment A wall, set up a transit at location B. Location B is established by "eyeballing" along the formwork so that you clear the formwork and whalers on your offset line. With a little practice, this becomes quite easy. Lay two engineer's rulers perpendicular to reference line A with the zero end at the crow's foot marks.

<u>Step 3</u>. After the transit is leveled, adjust the horizontal azimuth by trial and error until the reading is identical on both engineer's rulers. In the figure 1 example, this reading is 1.50 feet. You have now established a line parallel to reference line A.

<u>Step 4</u>. You can now check or establish true alignment anywhere on abutment A. For example, to check the alignment of the wall's outside edge, we calculate that it is 0.69 feet from the offset line to the outside of the 3/4-inch form plywood. Hold an engineer's rule against the outside of the form plywood. If the transit man reads 0.69 feet, the wall is exactly on line. If it does not read 0.69 feet, the form bracing can be loosened and adjusted

by the contractor to bring the forms to correct alignment. To make sure your readings are correct, the rodman should "rock" the ruler in a horizontal direction, and then take the lowest reading. Use the horizontal crosshair to ensure that the ruler is level in the other direction.

The method described above has been developed and used on actual bridge construction projects, and it has worked very well. As the height of abutments and piers increases, this method is increasingly helpful. With high walls and piers, you can seldom see through on the reference lines when forms are in place, thus increasing the chance for an error by a contractor plumbing up from footings.

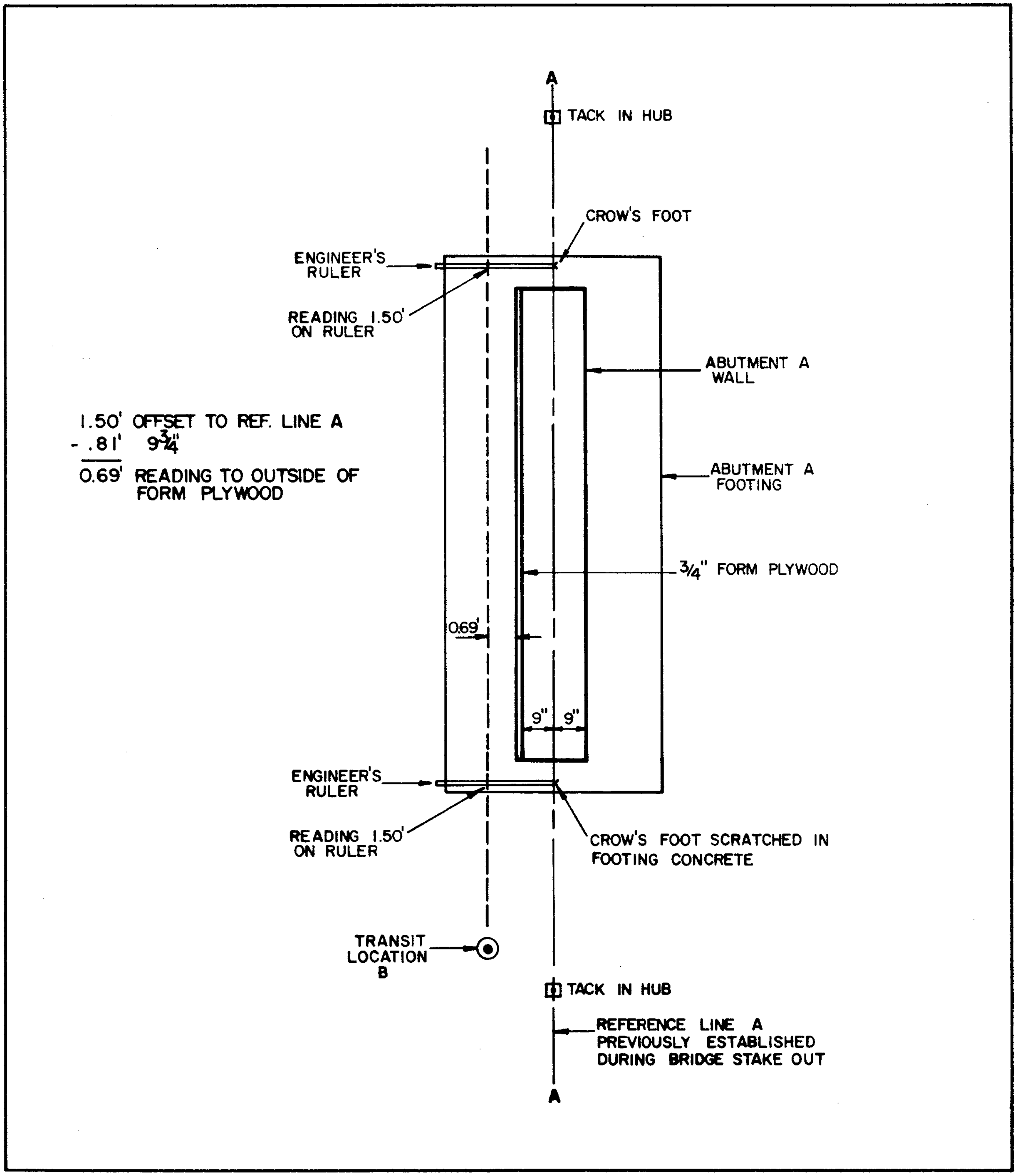


Figure 1.--"Two-rule" alignment method.

Embankment Dam Overtopping Project

Sam Fischer
Water Resources Engineer
Washington Office

The Forest Service has signed an agreement with the Federal Highway Administration (FHWA) to participate in a study to determine rates of failure of earth embankments resulting from flood overtopping.

BACKGROUND

In response to the Dam Safety Act of 1972, the Army Corps of Engineers, the Forest Service, other Federal agencies, and States evaluated the safety of approximately 9,000 dams in the United States between 1977 and 1981. Of the more than 2,900 dams found to be "unsafe," a large percentage were so designated because of inadequate spillways or outlet capacities.

During preparation of the Corps of Engineers' "Recommended Guidelines for Safety Inspections of Dams," it was recognized that the hydrologic criteria and assumptions were conservative with regard to the resistance of earth embankment dams to erosion when overtopped. However, there were little data available to refine these criteria and assumptions.

Because of the large number of embankment dams on National Forest System lands, the Forest Service was particularly interested in finding ways to make dams "safe"--that is, so they would not fail catastrophically--without facing the high costs of major spillways or dam reconstruction. There is some evidence that an embankment dam can withstand overtopping for some time before failing. The Soil Conservation Service, for example, has reports on 11 dams that have been overtopped without failing. One, a 45-foot high structure, was overtopped with 2.5 feet of water for approximately 1.5 hours and suffered only minor damage. If a reasonable method could be found to determine and extend this apparently inherent capability of an embankment dam to withstand some overtopping, it seemed that a significant amount of money could be saved.

The Forest Service's fiscal year 1983 budget included $85,000 in funding for a cooperative project to be undertaken with another agency. Initially there was a problem when other "dam" agencies that previously had expressed interest in a cooperative venture were unable to participate because of funding cutbacks. Through a series of coincidences, however, the Forest Service learned that the FHWA had just started a $375,000, 3-year project entitled "A Methodology for Estimating Embankment Damage Due to Flood Overtopping." Subsequently it was learned that this project was similar to the one planned by the Forest Service, that the overtopping tests the Forest Service wanted would add to the data the FHWA wanted and vice versa, and that the FHWA was willing to add the dam overtopping tests to their project.

PROJECT GOALS & OBJECTIVES

The study has two main objectives:

(1) To develop a method for predicting embankment damage and rates of failure resulting from flood overtopping.

(2) To determine if cost-effective protective techniques are available for extending the life of an embankment during flood overtopping.

The Forest Service goal is to provide data and methods, which would be used in risk-based analyses of dams currently classified as unsafe because of inadequate spillway capacity, as possible alternatives to reconstruction of the spillways or dams.

The PROJECT

Simons, Li and Associates, Incorporated, of Fort Collins, Colorado, is undertaking the project. The full-scale embankment overtopping tests will be conducted at the Engineering Research Center outdoor testing facilities at Colorado State University. The following is a summary of the work to be performed for the FHWA and the Forest Service:

(1) Analyze literature to derive coefficients for a soil detachment rate equation and develop a tentative procedure to apply the equation to the embankment damage problem.

(2) Analyze literature to identify and evaluate low-cost protective techniques or devices for prolonging the life of an embankment during overtopping.

(3) Construct a 6-foot high embankment and an open-bottom portable flume to conduct the overtopping tests. Three soil types will be used.

(4) Conduct 66 hydraulic test runs (50 FHWA, 16 Forest Service) with varying side slope, slope vegetation or protection, overtopping depth, overtopping duration, and tailwater for each soil type.

(5) Develop a procedure for estimating embankment damage and rate of failure resulting from flood overtopping that can be incorporated into risk-based analysis for stream crossings and embankment dams.

The project is scheduled to be completed and the results to be available in the fall of 1985.

Use of Precast Concrete Ramp Planks for Low-Water Crossings

Ron McNemar
Civil Engineer
Daniel Boone National Forest
Region 8

For the past several years, the Daniel Boone National Forest has used standard bolted connection concrete boat ramp planks with a precast cutoff wall for low-water crossings. Their performance has been excellent, including installations across silty, boggy bottoms (see figure 1).

Each concrete plank is 14 feet long, 16 inches wide, and 5-1/2 inches deep and weighs about 1,300 pounds. The planks are bolted together by means of two steel straps, predrilled for 3/4-inch bolts. The straps are cast in the concrete during fabrication. A downstream cutoff wall normally is necessary, and precast concrete blocks with lifting eyes can be used for this purpose.

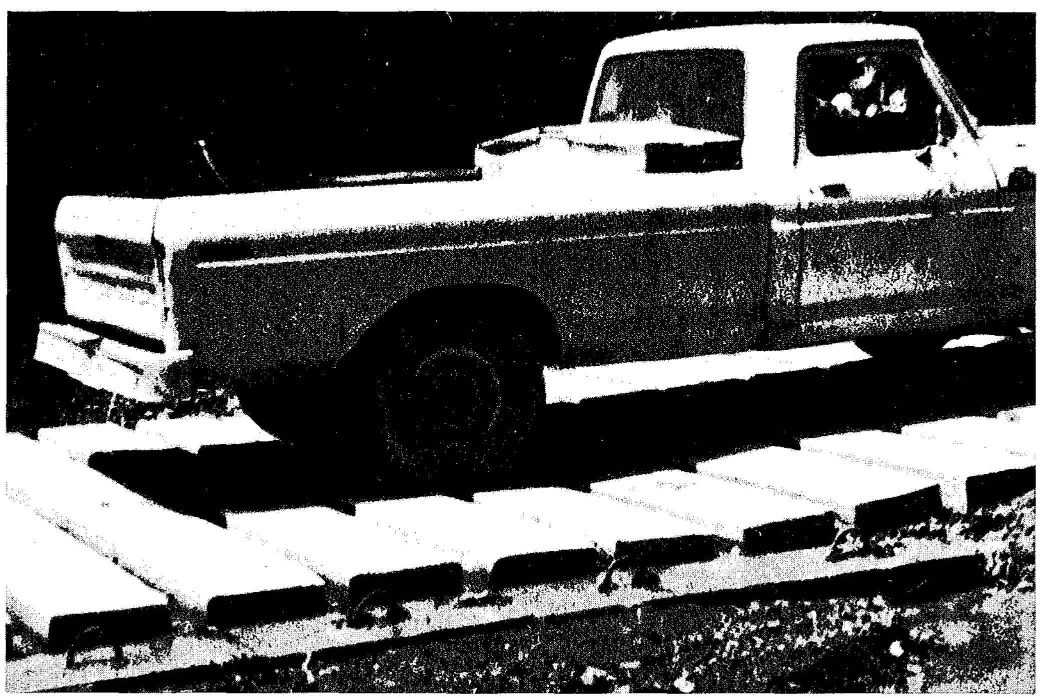


Figure 1.--Precast concrete ramp planks, installed.

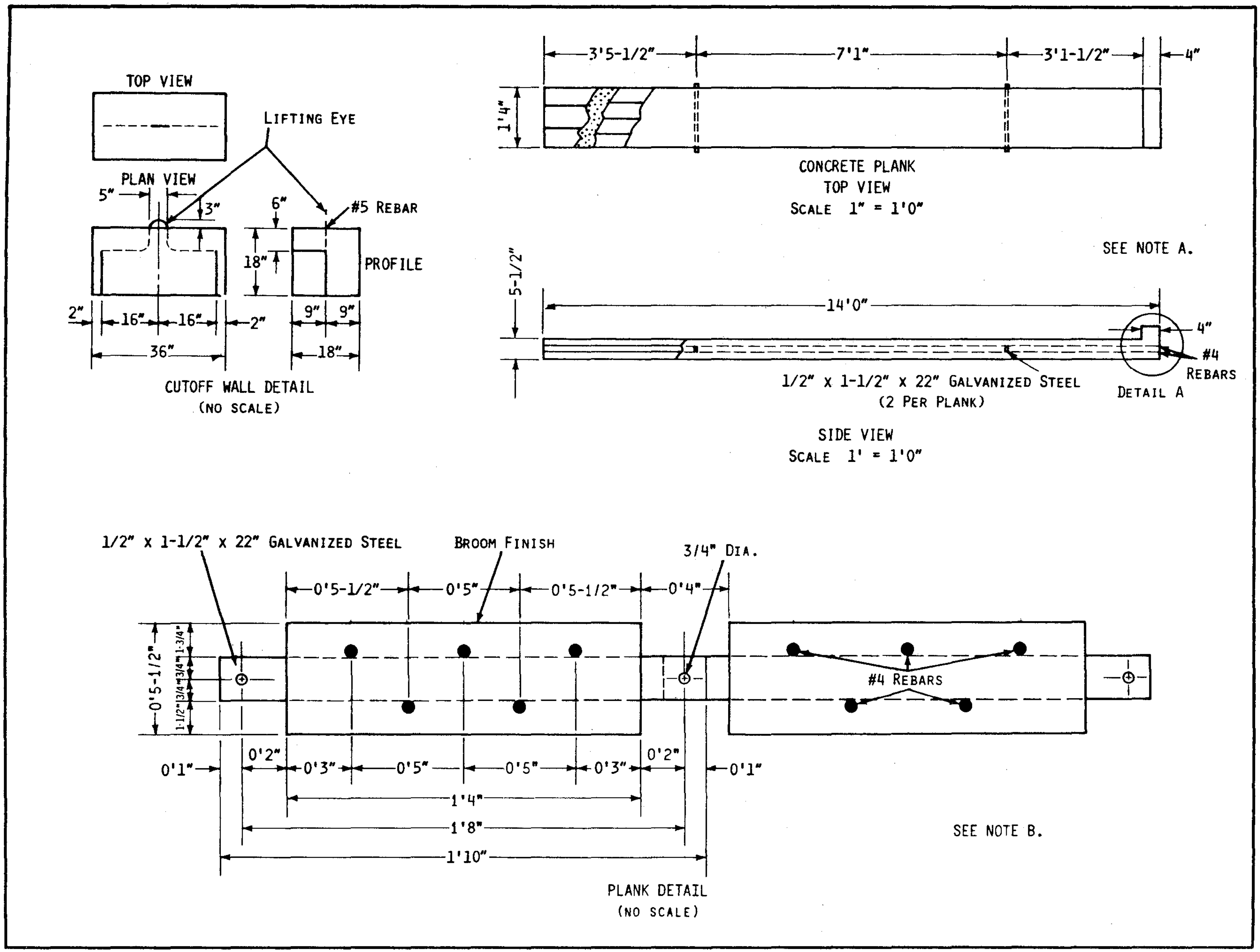
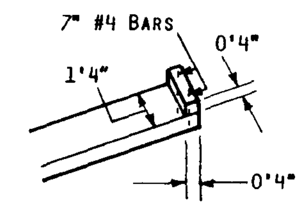


Figure 2.--Construction detail of precast concrete ramp planks (part 1).



DETAIL A
DOWNSTREAM SAFETY WHEEL STOP
(NO SCALE)

NOTE A:

(1) WHEEL STOP IS TO BE CAST INTO ALL PLANKS FOR FUTURE POURS. (DO NOT MODIFY ANY EXISTING PLANKS.)

(2) WHEEL STOP TO BE INSTALLED ON ONE END OF TOP OF EACH PLANK.

(3) INSTALL 2 EA. 7" LONG NO. 4 BARS VERTICALLY FOR EACH WHEEL STOP. EXTEND THE BARS 4" INTO THE PLANK AND 3" INTO THE STOP. LOCATE THE BARS ON THE LONGITUDINAL CENTERLINE OF THE STOP IN 2" FROM EACH END OF THE STOP.

(4) THE STOP CAN BE CAST DURING THE SAME POUR WITH THE PLANK OR IT CAN BE CAST LATER, HOWEVER THE TWO 7" BARS MUST BE INSTALLED DURING THE PLANK POUR.

NOTE B:

(1) USE OF AN APPROVED MINIMUM 3,000 PSI CONCRETE WITH 5% AIR ENTRAINMENT.

(2) VIBRATORS SHALL BE USED IN PLANKS AND BLOCKS TO ENSURE UNIFORMITY.

(3) ALL CONCRETE SURFACES SHALL BE KEPT WET FOR AT LEAST 5 DAYS AFTER PLACING. IF NOT PROTECTED BY FORMS, THE SURFACES SHALL BE COVERED WITH PLASTIC OR SPRAYED WITH MEMBRANE CURING COMPOUND.

Figure 2.--Construction detail of precast concrete ramp planks (part 2).

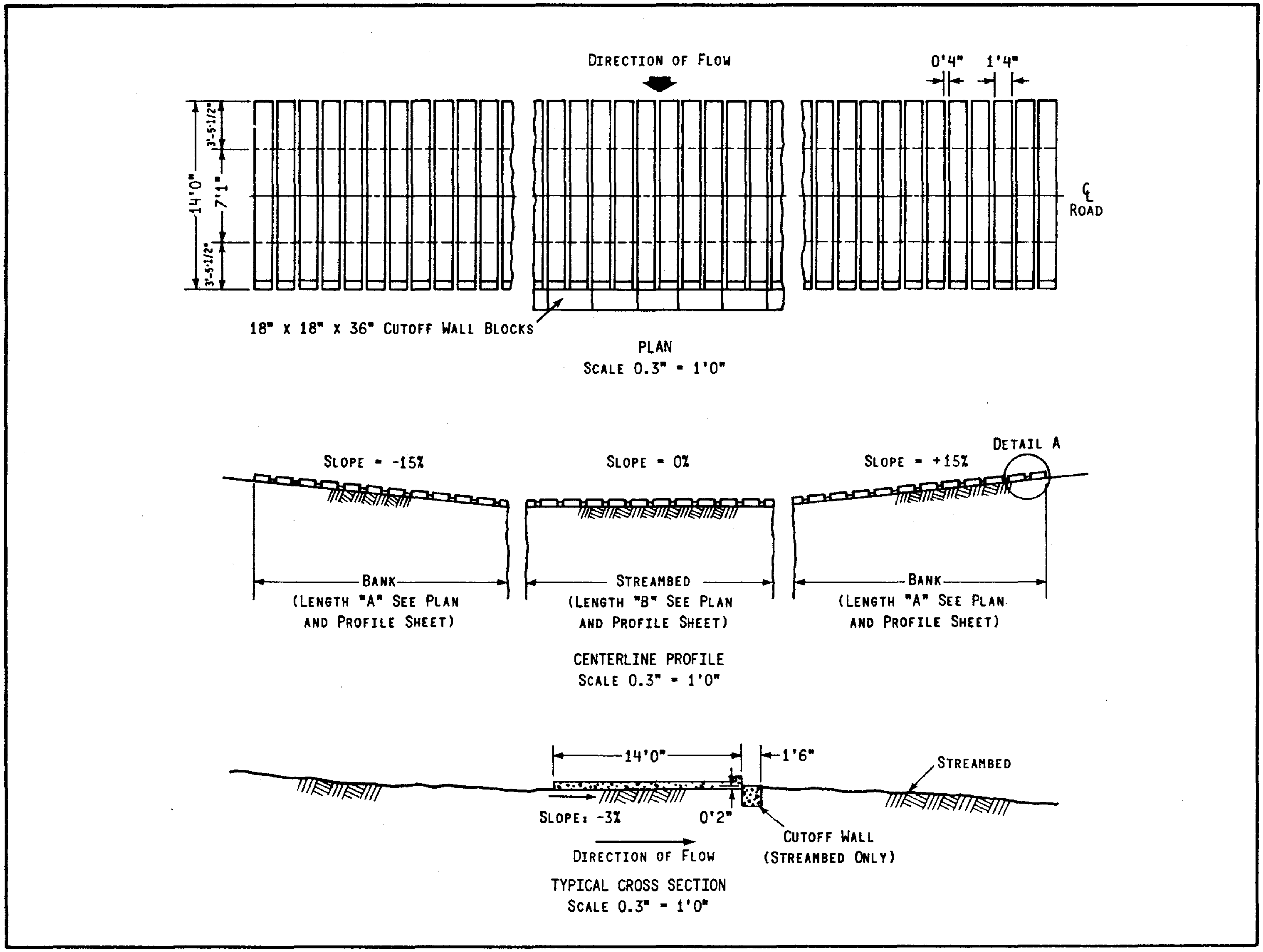
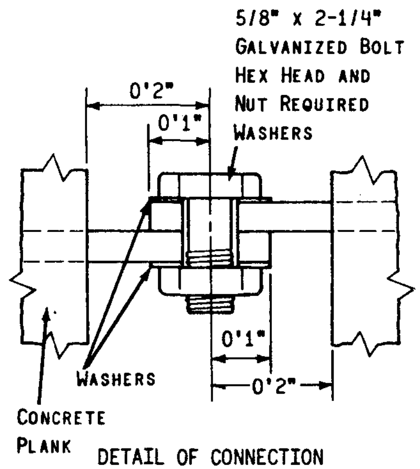
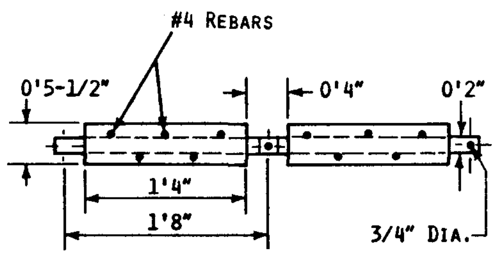


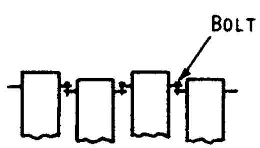
Figure 3.--Assembly detail of precast concrete ramp planks (part 1).



DETAIL OF CONNECTION
SCALE 1" = 1'0"



PROFILE DETAIL A



CONNECTIONS SHOULD BE
STAGGERED AS ILLUSTRATED
TO MAINTAIN CONTINUITY

NOTE A:

(1) THE CONCRETE PLANKS AND CUTOFF WALL SHALL BE PRECAST CONCRETE, 3,000 PSI, AND SHALL BE FURNISHED BY THE FOREST SERVICE.

(2) THE 5/8" X 2-1/4" GALV. HEX HEAD BOLTS, NUTS, AND WASHERS SHALL BE FURNISHED BY THE TIMBER PURCHASER.

(3) THE CONCRETE PLANKS AND CUTOFF WALL BLOCKS SHALL BE PICKED UP AT THE MOREHEAD RANGER STATION BY THE TIMBER PURCHASER.

(4) THE APPROXIMATE WEIGHT OF THE CONCRETE PLANKS AND CUTOFF WALL BLOCKS ARE 1,300 LBS AND 1,000 LBS, RESPECTIVELY.

Figure 3.--Assembly detail of precast concrete ramp planks (part 2).

The planks and cutoff walls are precast by both the Frenchburg and Pine Knot Job Corps Centers for later use on Forest road projects. The plank crossings have been incorporated into force account, timber purchase, and public works projects.

One of the primary reasons the Daniel Boone National Forest is pleased with these structures is that they provide dry crossings during a large part of the year; much of the normal flow goes between the planks and provides a dry running surface. Another reason is that, by articulating the structure, the bolted connections allow some differential settlement to occur without causing structural damage. This type of installation can also be used as a temporary crossing. When it is no longer needed, it can be disassembled and moved to a new site.

The drawings for precast concrete ramp planks are shown in figures 2 and 3. Anyone interested in these installations can contact the Daniel Boone Engineering Staff for plans or further information.

Automated Special Project Specifications

Lester M. Pence, Jr.
Civil Engineer
Region 8

In the past, regionally approved Special Project Specifications (SPS) were sent to each Forest printed on 8-1/2- by 11-inch sheets. In turn, each Forest either retyped the SPS or reprinted the applicable SPS and used the cut-and-paste system for each contract package. Both processes were costly, were time consuming, and promoted errors.

With the assistance of Region 8's computer specialist, Leon Furnish, the Automated Special Project Specifications (ASPS) were designed. The specifications are stored on a TI 990 diskette and are sent to each Forest annually. Forests will also store on the diskette any Special Project Specifications (such as the rate of application of seed, lime, fertilizer, and mulch) that are required by the Standard Specifications. Forest personnel are not authorized to make changes to the SPS without Regional Office approval. In approximately 20 minutes using a TI 990, a designer can prepare the Specification and Special Project Specification List (figure 1), Abbreviation List (figure 2), Errata Sheet (figure 3), and Special Project Specifications for a contract package (figure 4).

SPECIFICATION AND SPECIAL PROJECT SPECIFICATION LIST

ROAD NAME		KIM's SPUR	KIM'S CREEK		
ROAD NUMBER		637A	637		
TERMINI		0.0-3.6	0+00-73+00		
CONSTRUCTION			X		
RECONSTRUCTION		X			
STANDARD: SPEC. OR: SPS NO.	LATEST REVISION: DATE	NOTE: Specifications that are referenced by other specifications are not listed below.			
STANDARD: SPEC.	1979				
101		X	X		
102		X	X		
103		X	X		
104		X	X		
105		X	X		
106		X	X		
201		X	X		
202		X			
203			X		
304		X	X		
ABBREV	6/82	X	X		
ERRATA	6/82	X	X		
START	6/82	X	X		
REGIONAL: SPS	AS SHOWN: BELOW				
104-1	6/82	X			
105-2	6/82	X	X		
106-1	6/82	X	X		
106-2	6/82	X	X		
201-1	6/82		X		
201-3	6/82	X			
201-4	6/82	X	X		
201-5	6/82	X	X		
201-14	6/82	X	X		
201-16	6/82		X		
201-19	6/82	X			
FOREST SPS	AS SHOWN: BELOW				
GW201-1	10/82	X	X		
GW201-a	7/82	X			
GW625-1	10/82	X	X		
GW625-2	10/82	X	X		
GW625-c	7/82		X		

Figure 1.--Specification and Special Project Specification List.

FORREST SERVICE STANDARD SPECIFICATIONS

SECTION 101 - ABBREVIATIONS   Add the following:

Words abbreviated	Abbreviations
Cubic Yard	C.Y.
Cubic Yard Mile	CU. YD. MI.
Each	EA.
Gallon	GAL.
Hour	HR.
Linear Foot	L.F.
Lump Sum	L.S.
One Thousand Gallons	M. GALS.
Pounds	LBS.
Square Yard	S.Y.
Station	STA.
Station Yard	STA. YD.
Square Foot	S.F.
Asphalt	ASP.
Barbed Wire	B.W.
Bituminous Coated Corrugated Steel Pipe	B.C.C.S.P. OR B.C.C.S. PIPE
Cement	CEMT.
Cement-treated	CEMT.-T.
Compaction	CMPCT.
Concrete	CONC.
Corrugated Steel Pipe	C.S.P.
Corrugated Steel Pipe Arch	C.S.P. ARCH
Erosion and Pollution Control	E&P CONTROL
Fabricated	FABR.
Foundation	FOUND.
Furnished	FURN.
Grade	GR.
Height	HT.
High Strength	H. STRENGTH
Horizontal	HOR.
Loading	LD.
Material	MAT'L
Maximum	MAX.
Reflectorized	REFLECT.
Structural	STRUCT.
Structural Steel	S. STEEL
Thickness	TH.
Vertical	VERT.
White	WH.
Width	W.
With	W/
Without	W/O
Woven wire	W.W.
Yellow	YE.

Figure 2.--Abbreviation List.

FOREST SERVICE STANDARD SPECIFICATIONS

ERRATA SHEET

SECTION 102-DEFINITIONS

Between the definition "Timber Sale Contract" and "Traveled Way", add the following definition:

> Tops and Limbs -- All bushes and vines and all that portion of a tree less than 6 inches in diameter.

201.05(b)(7)-PILING AND BURNING

After the words, "shall be", in the first sentence, add the word, "piled".

211.03-METHOD OF MEASUREMENT

Add the following statement at the end of the paragraph:

> "A unit is 1,000 square feet."

401.11 WEATHER LIMITATIONS

In the first sentence of the first paragraph, after the words, "The bituminous mixture shall not be placed," add the phrase "on any wet surface".

401.21-ACCEPTANCE SAMPLING AND TESTING OF BITUMINOUS MATERIALS (GRADATION AND BITUMINOUS CONTENT)

In the second sentence of the second paragraph, substitute "ASTM" for "ASM".

407.03-MAINTAINING TRAFFIC

Change "103" to "104".

554.06-PLACING AND FASTENING

Paragraph 3 - Substitute D1.4 for D12.1.

555.22-PREPARING METAL SURFACE FOR PAINTING

First paragraph, parts (a) thru (d) - substitute SSPC -SP for SSPC.

Fourth paragraph - substitute SSPC - SP for SSPC.

Figure 3.--Errata Sheet.

SPECIAL PROJECT SPECIFICATIONS

FOR

ROAD NAME	ROAD NUMBER
Kim's Spur	637A
Kim's Creek	637

104-1 (6/82)

SECTION 104 - MAINTENANCE FOR TRAFFIC

Delete the first paragraph and add the following requirement:

> "The existing road may be closed to traffic during construction."

105-2 (6/82)

105.03 - SAMPLING OF AGGREGATE

In the first paragraph, delete all but the first sentence.

106-1 (6/82)

SECTION 106 - MEASUREMENT AND PAYMENT

106.01 Second paragraph - delete "alphabetical" and add "numerical".

106-2 (6/82)

106.02 - METHODS OF MEASUREMENT

In Paragraph 6, delete the remainder of the first sentence after the word "be" and add: "reduced by moisture content in excess of _6_ per cent".

Figure 4.--Special Project Specifications.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1983 - 381-227 - 814/2250

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-4 Ted Wood	R-9 Mujeebul Hasan
R-2 Mike Clinton	R-5 Phillip Russell	R-10 Mel Dittmer
R-3 Jerry Martinez	R-6 Kjell Bakke	WO Al Colley
	R-8 Tom Poulin	

ENGINEERING TECHNICAL INFORMATION SYSTEM

Volume 15
April-June 1983

Engineering Field Notes