ENGINEERING TECHNICAL INFORMATION SYSTEM

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VOLUME 7 NUMBER 6
REVISED

Field Notes

Concrete Crib Check Dams

Fort Collins' Computer Programs

A Note to Users
Hewlett–Packard
Model 65 Calculator

Washington Office Engineering News

FOREST SERVICE JUNE 1975

U.S. DEPARTMENT OF AGRICULTURE

ENGINEERING FIELD NOTES

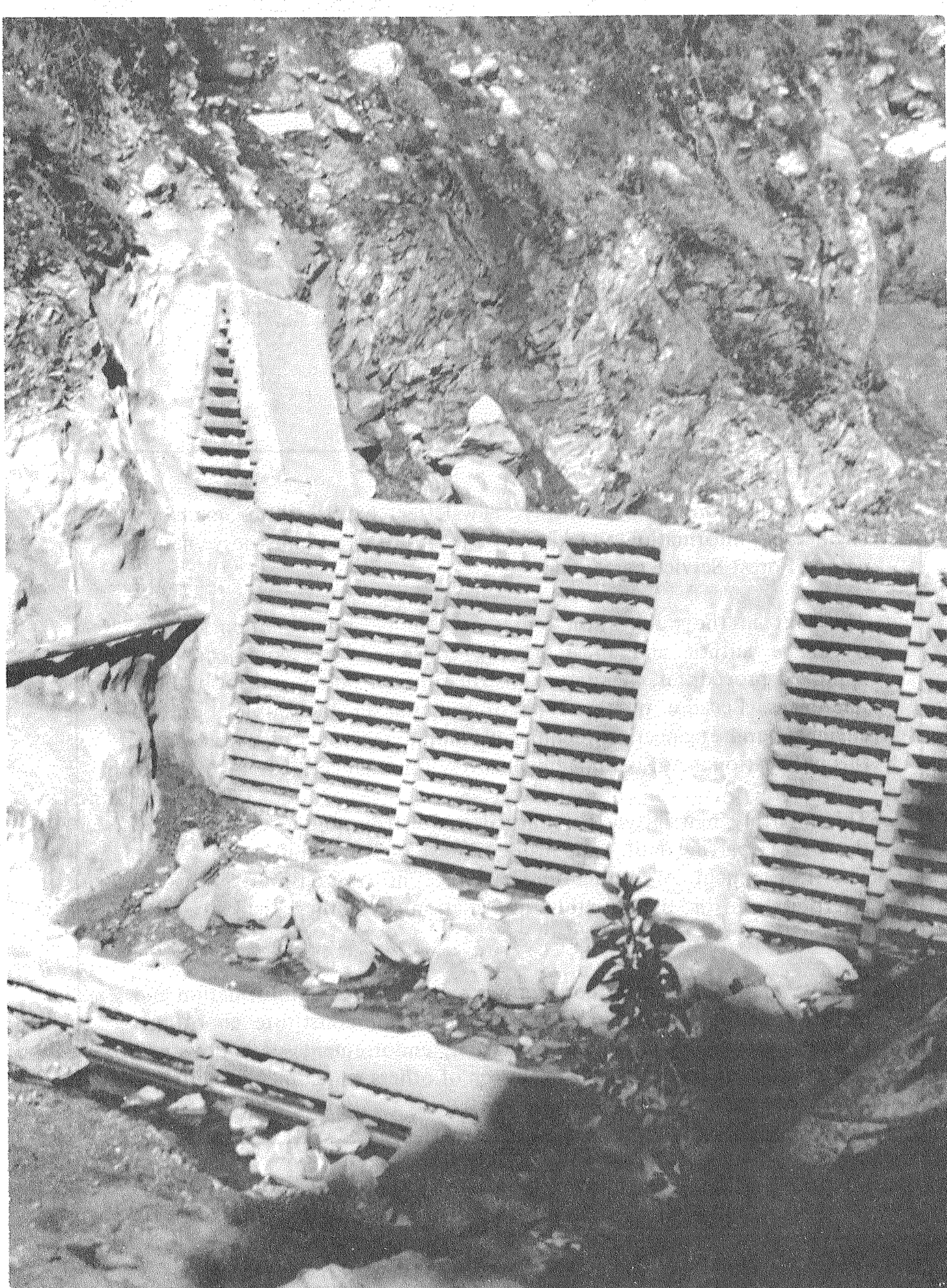

Figure 1. — Concrete crib check dam.

The editorial staff of the Engineering Field Notes apologizes to the author and readers of the article *Concrete Crib Check Dams* published in the June 1975 issue for the serious editorial and production errors. You are requested to destroy your original issue of June 1975 and replace it with this revision.

CONCRETE CRIB CHECK DAMS

Robert M. Gallup
Civil Engineer
San Dimas Equipment Development Center

BACKGROUND

A line from a recent *Top 40* song goes: "It never rains in Southern California", well, hardly ever. During the winter months periodic heavy rains are not uncommon in the greater Los Angeles area. Heavy runoffs from the San Gabriel Mountains following winter storms have long plagued the foothill communities of Los Angeles County. Just ask the folks who were living in Glendora in February 1969. Brush fires in 1968 denuded the mountain slopes of vegetation; during February, rains, mud, and debris surged down from the mountains overflowing sewers, streets, debris basins, and covered houses to their roof tops. Following this incident, about 40 concrete crib check dams[1] were built. Runoff channels were stabilized and Glendora was protected from another sudden massive land erosion with heavy sediment flow.

For centuries in the European Alps, check dams were used for stabilizing mountain streams. Their technique was brought to the San Gabriel Mountains of Los Angeles County, California in 1915. Originally, check dams in the local mountains were constructed of rock and wire or of stacked rocks. The majority of these dams failed during floods in 1932 and 1938. In the early 1940s, research work on debris (soil, rock, mud) reduction techniques was carried out by the Forest Service (Region 5). As part of this effort, a concrete arch check dam was constructed in the Angeles National

[1]*Check Dam — controls the elevation of a channel bottom. It prevents the eroding of the channel bottom and causes downcutting in channels where debris is being deposited.*
***Concrete Crib Dam** — a gravity dam constructed of reinforced beams placed in a manner to form rectangular parallelpipeds which are called cribs or bays. These cribs or bays are then filled with rock or soil.*

Forest in 1942. It is 83 feet high, stabilizing 3,800 feet of the Arroyo Seco Canyon. The dam stores about one million cubic yards of debris and has a benefit-cost ratio of 10:1, since removal of sediment from debris basins in the valley costs about $1 per cubic yard.

The Coon Canyon Stabilization Project, a pilot program, was finished in 1950. Mechanical stabilization devices were constructed and the results were monitored. These included lined streams, soil cement check dams, metal bin check dams, concrete gravity dams, concrete arch dams, concrete crib dams, and others. As a part of the pilot project, 156 structures were constructed. From the findings of this project, the concrete crib check dam (fig. 1), was chosen as the best structure.

A 20-year Los Angeles River Watershed Project was begun in 1954 and completed in 1974. This project was a cooperative program between the Los Angeles County Flood Control District (LACFCD) and the USDA Forest Service, Angeles National Forest (Region 5). There were 365 concrete crib check dams built, costing $10.5 million.

In the Los Angeles River Watershed, residential areas (Pasadena, Altadena, La Canada, and Sunland) border the edge of the San Gabriel Mountains; they are built on alluvial fans at the mouths of canyons. Water flowing from the canyons must have the debris removed to prevent lined channels, storm sewers, and streets from becoming filled and overflowing. Debris is removed from the flows by debris basins and check dams. Figures 2 and 3 are sketches of a channel before and after construction of a check dam.

Debris basins store the debris, which must be periodically emptied and hauled to disposal areas, diverting the debris-free water into spreading basins for recharging ground water storage. Check dams store debris until they are filled. The debris cone which forms behind a check dam acts as a buttress to the canyon walls and reduces erosion rate from these walls (fig. 4)..

DESIGNING CHECK DAMS

Stable or Unstable Streams

A basic consideration when designing a dam is to determine if a channel or a segment (reach) is stable or unstable. The definition of stability used in the Los Angeles River Watershed Project was "that state of channel regime at which all downcutting is halted and bank erosion is reduced to an absolute minimum."[2]

[2] *Ferrell, W. R., and W. R. Barr, 1963.* ***Criteria and Methods for Use of Check Dams in Stabilizing Channel Banks and Beds,*** *LACFCD. Presented at Federal Inter-Agency Sedimentation Conference, Jackson, Mississippi, January 1963.*

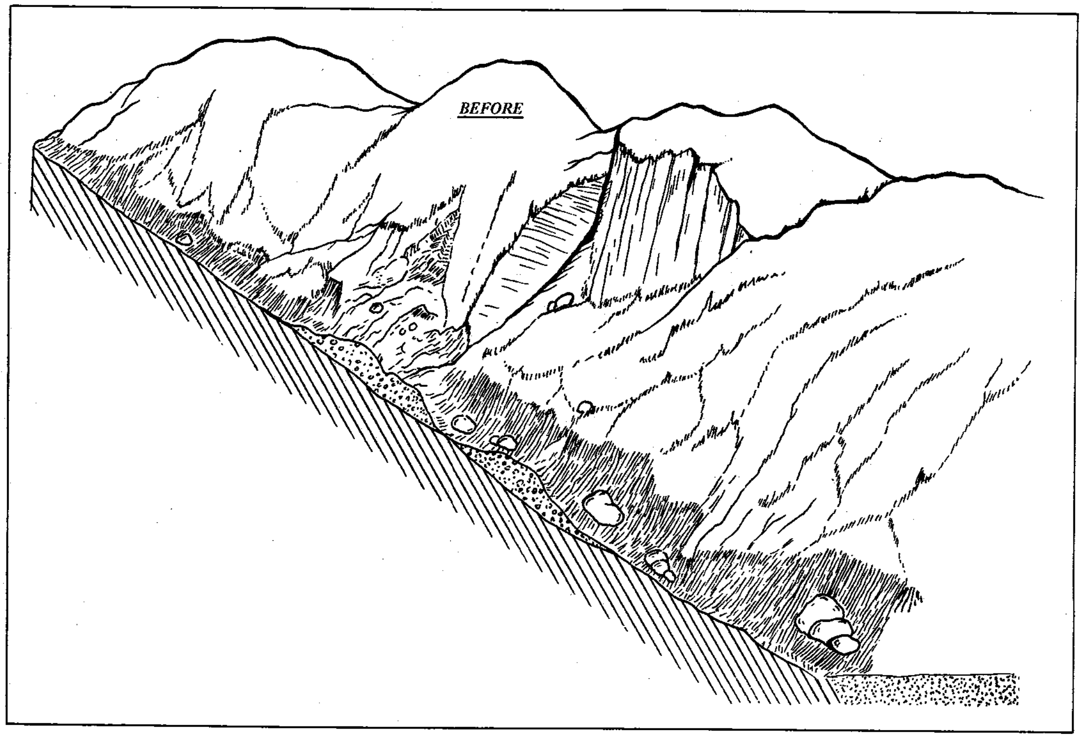

***Figure 2.** — Channel before construction of a concrete crib check dam.*

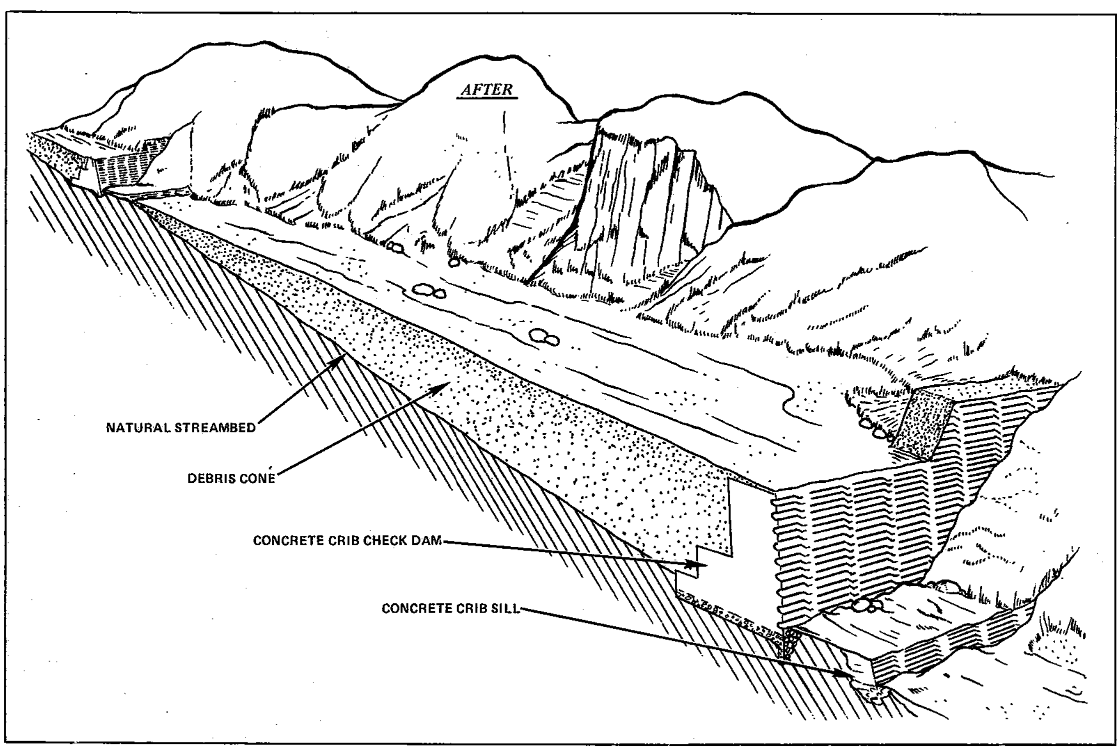

***Figure 3.** — Channel after construction of a concrete crib check dam.*

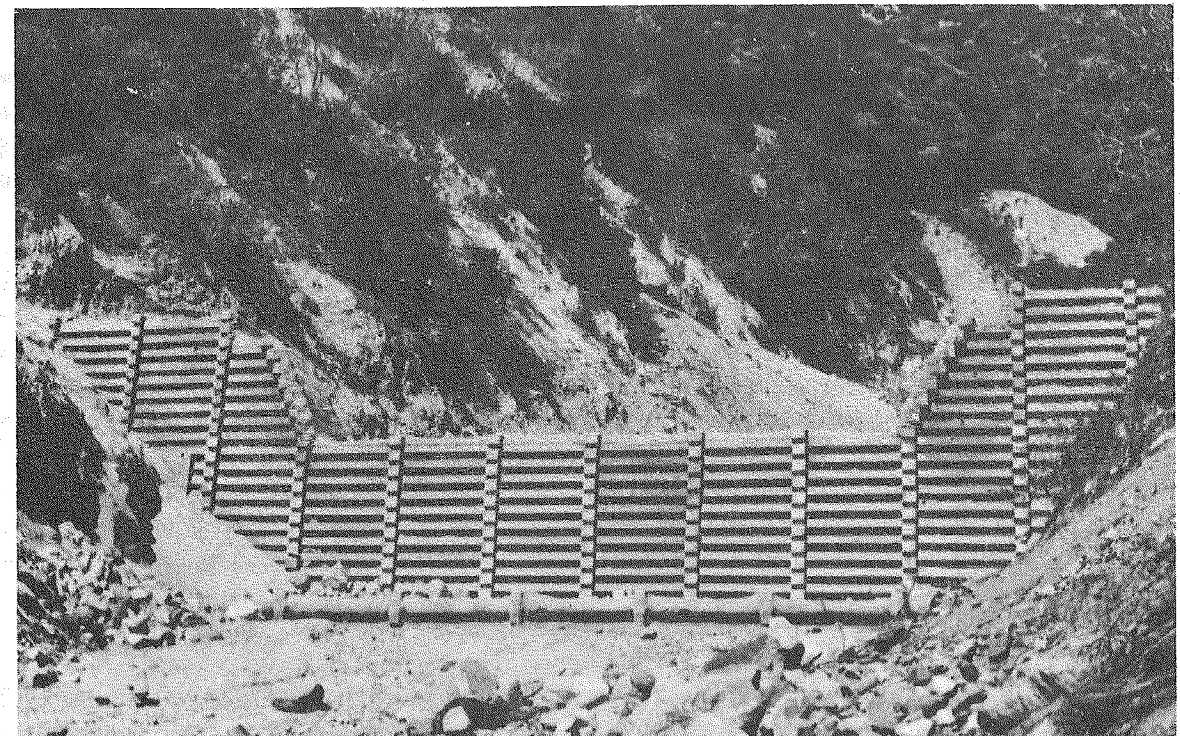

***Figure 4.** — Formation of a debris cone behind a check dam.*

***Figure 5.** — An unstable channel showing effects of dry erosion.*

In very steep mountain streams the presence of solid-rock outcrops in the stream bottom and on the canyon walls is considered a stable condition. Large quantities of debris, debris movement, and steep channel-bottom grades are evidence of an unstable stream. Loose, sloughing, steep canyon walls of soil with an absence of rock outcrops are also conditions of instability. A further evidence of instability is the dry erosion of loose soil on hillsides caused by gravity and wind (fig. 5).

Debris Production and Reduction Rates

The LACFCD determines debris production rates from dam and debris basin surveys and cleanout records. The Forest Service, San Dimas Experimental Forest, also conducted research in erosion and debris production rates. These rates in the Los Angeles River basin range from 1,000 to 9,000 cubic yards per square mile per year. LACFCD uses a value of 37 percent reduction in debris production after the check dams have become filled with debris. This percentage figure is only used for channel segments that have check dams.

Debris Cones

Debris — including boulders, rocks, soil, mud, and other substances — end up being stored behind the check dams. Unlike a pond of water which lies level behind a dam, the surface of the debris cone forms a gradient which is 0.7 of the original gradient of the channel (fig. 6). The 0.7 value was obtained from projects in the Alps and has been verified in profiles taken of channels in the Los Angeles River basin. The debris cone is very stable at the spillway, but fluctuates at the upper end. Figure 7 shows a debris cone in a side channel (background) and the upper end of a debris cone (foreground) from a check dam which is further downstream.

Site Selection

Factors to consider when selecting a dam site include: channel segment stability, channel profiles, direction of visible flow lines, measured flow rate, and ground stability for a good foundation. For example, the upstream flow lines should not flow directly at an abutment but should be normal to the dam. Flow discharging from the dam should not be directed toward the canyon walls.

After sites with good foundations are found, the channel's profile shows where the debris cones will end for different spillway heights. Although spillway heights may be varied so that debris cones fit good site locations, the most economical size of dam (construction cost, debris storage and debris reduction) must be considered. In selecting the height and determining the economics of the dam, the channel flow rate and spillway size should also be considered; this, in turn, relates back to the site selection.

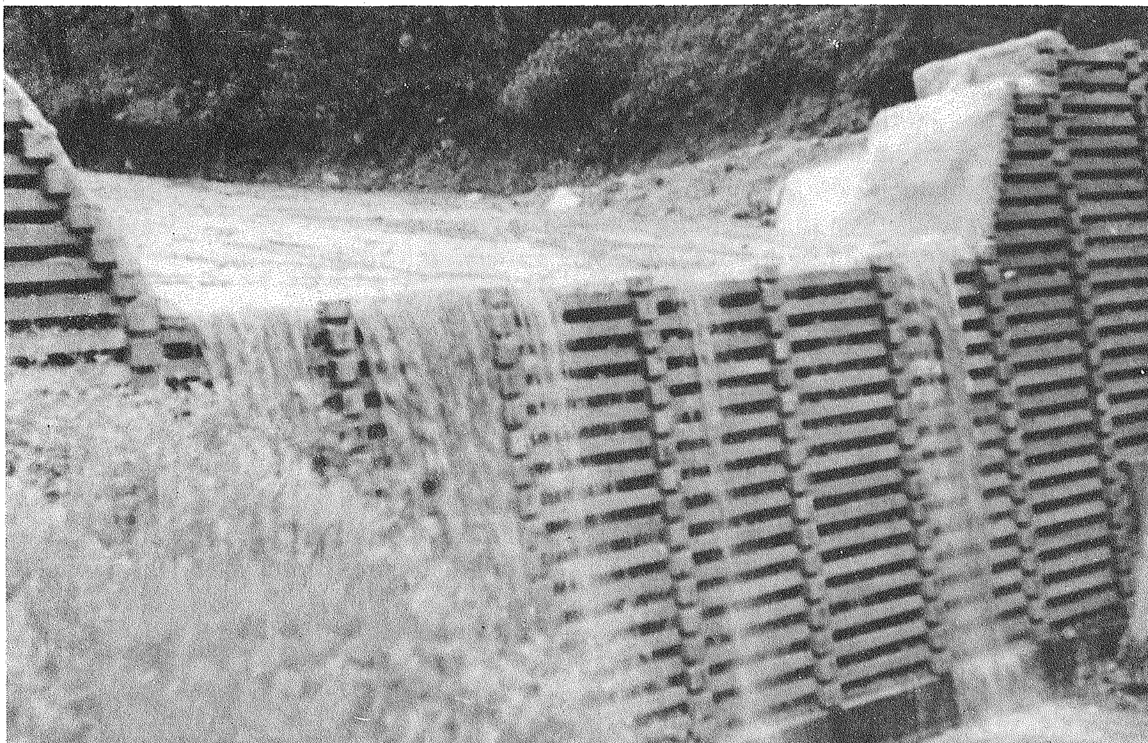

Figure 6. — Debris cone of a 0.7 gradient that has formed behind check dam.

Figure 7. — A debris cone in a side stream and upper end of a debris cone.

Dam Size

The cutoff wall and slab are the same size for a low or high crib dam. The most economical size of a crib dam (from the standpoint of construction cost) is the maximum spillway height for the configuration of the cross section (single, double, triple, etc., bays) of the dam. Figure 8 shows the cross section of a crib dam through the spillway. The highest concrete crib dam constructed in the Los Angeles River basin was 27 feet high to the top of the spillway, and was five bays thick.

Spillway Size

Spillway flow rate capacities are computed using the general weir formula $Q = CLH^{3/2}$. These capacities are computed by using a value of $C = 3.0$ for broad-crested weirs with an assumed approach velocity of 10 fps. Figure 9 shows water flowing through a spillway.

Sills and Stilling Pools

Sills are used to prevent undercutting of the dam and to provide stilling pools to dissipate the energy of water flowing over the spillways. Sills are located downstream from the dams at distances equal to spillway height plus 18 feet.

The elevation of the top of the sill is based[3] on a stable pool of one third of the spillway height plus the water depth in the spillway, $1/3\ (h_s + h_d)$. The elevation of the bottom of the cutoff wall is the datum base for computing the elevation of the sill.

Structural Design

Concrete cribs, slabs, and cutoff walls are designed for concrete with a compressive strength of 3,000 psi and a bearing strength of 750 psi. The reinforcing steel is intermediate-grade deformed bars. Small concrete blocks, called pillow blocks, are used to reduce bearing stress after certain heights are reached, they are placed between stretchers next to column points.

Cobble rock fill (3- to 12-inch stone) is dumped into some bays to provide fill for the dam. The native soil and rock from the channel are dumped into other bays. Cobble rock is dumped in the front, end, and center two bays to decrease hydrostatic pressures, particularly on the abutments. A cobble cone is placed behind the center two bays, allowing free drainage through the center of the dam.

Pneumatically applied concrete (gunite) is shot onto the top of the cobble-filled cribs for the length of the dam to form a protective crest. Gunite is also shot onto the bank

[3] *Criteria taken from Corps of Engineers recommendations on stilling pools.*

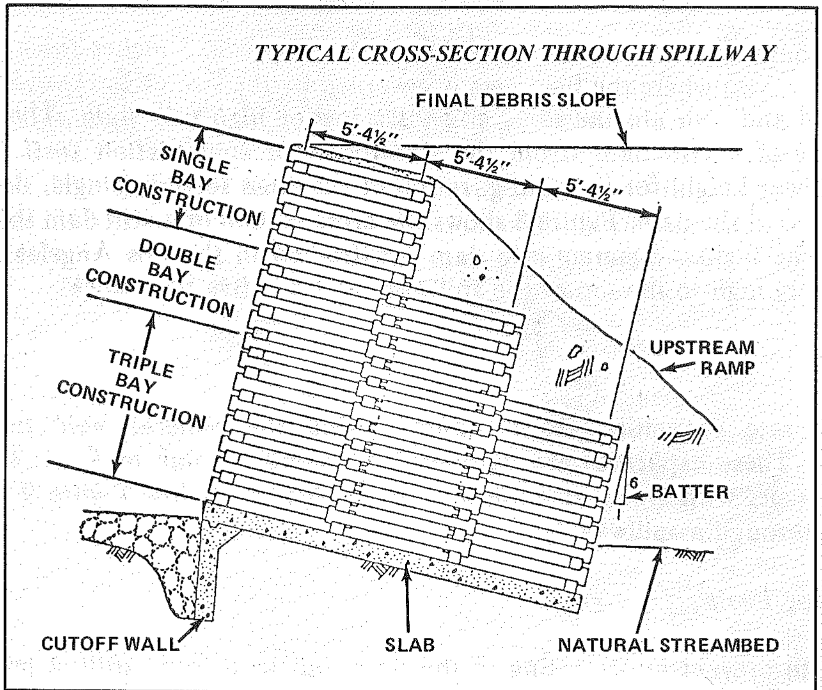

Figure 8. — Cross section of a crib dam.

Figure 9. — Water flowing through a spillway.

between the dam and the sill and onto the abutments; it is 3 inches thick, except on the spillway crest where the thickness is governed by the size of the boulders that can be moved down the channel.

A low-flow section is built into the spillway with a curtain of gunite extending from the crest down to the cutoff wall. This keeps low flows in the center of the dam and reduces erosion of the concrete crib members in the area of continuous flow.

Economy

Benefit-cost ratios are determined by comparing dollar values of cubic yard storage, cubic yard of debris reduction, and acre-foot of water conservation with the cost of construction and maintenance. Other benefits might be fisheries, conservation of top soil and vegetation, and obtaining more usable land by preventing gullying. Dollar values are difficult to assign to these benefits and thus are not included.

CONSTRUCTING CHECK DAMS

Access

Access is usually provided in the channel bottom to the uppermost structure. Channel-bottom roads are covered by the debris cones after construction. Some canyons require access from other than the channel bottom (e.g., a barrier in canyon). These access roads should be carefully located and constructed to cause as little disturbance to the terrain as possible. The roads should then be obliterated and revegetated to blend with the natural surroundings. A road that is poorly located or constructed may undo the work of the stabilization program.

Foundation

Frequent blasting is required in the excavation for slabs and the cutoff walls. A dam may be raised or lowered a foot or two (depending on the height of the dam) without changing the design of the dam to eliminate rock excavation or to obtain a better foundation.

Cutoff walls are excavated 6 feet deep unless rock is encountered. When this occurs, the cutoff wall is notched into the rock. Frequently, the ends of the cutoff are blasted to get good ties into the abutting canyon walls.

Concrete

Sills, cutoff walls, crib members, and slabs are constructed of reinforced concrete. Cutoff walls and slabs are allowed to cure for three days prior to placing the crib members. Figure 10 shows reinforcing bars being placed in the slab and Figure 11 shows the reinforced concrete crib members.

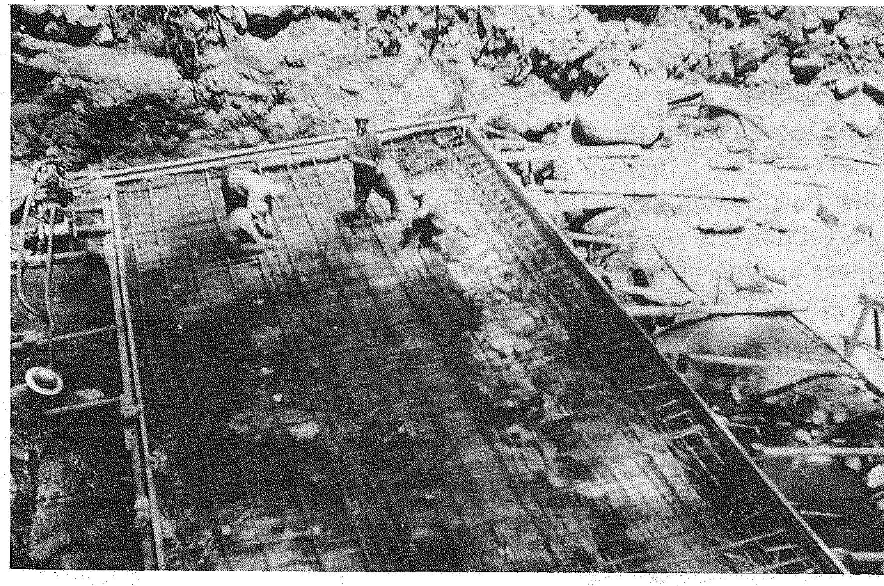

Figure 10. — Reinforcing steel placed in main slab during construction.

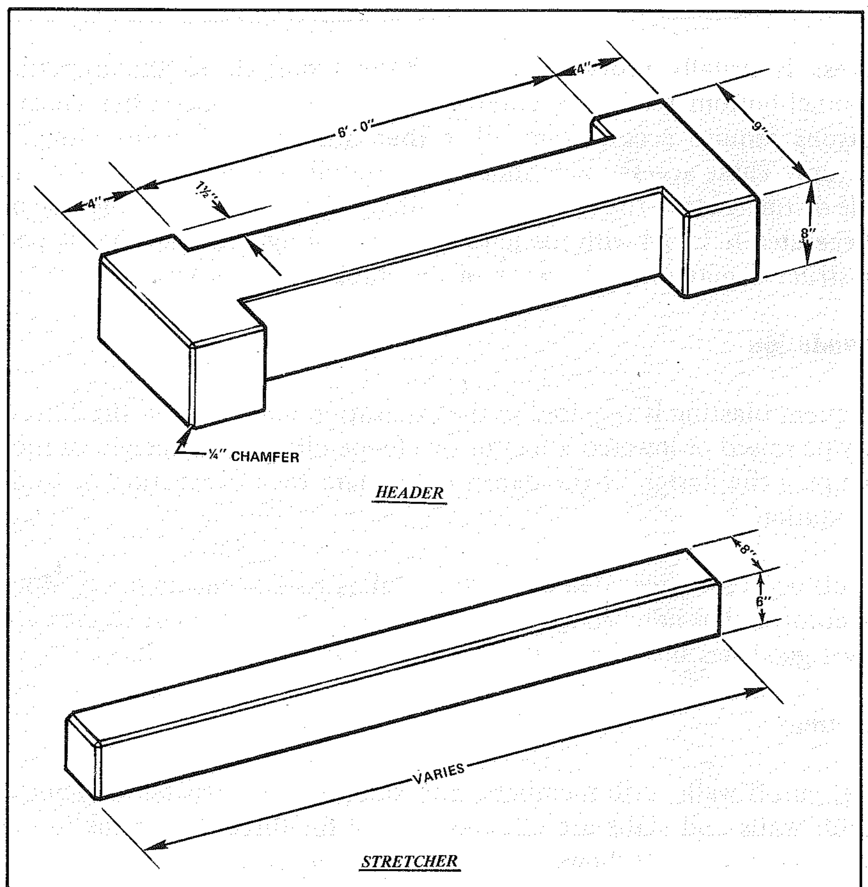

Figure 11. — Dimensions of concrete members.

Placing Cribs and Fill

Cribs are placed to form bays and are filled with cobble rock or native fill. They are filled in 4-foot high lifts. Backfill is placed in the lifts behind the dam (figs. 12 and 13). This prevents the cribs built on a batter (fig. 8) from sliding. Concrete is placed between the end bays and the canyon walls to form abutments. When the distance between the bay and the canyon wall becomes 6 feet wide, a slab is placed on top of the concrete abutment and another bay of cribs is placed above the slab. This is called a step slab (fig. 14).

Capping the Dam

After the dam has been erected a gunite cap is applied to the crest and the abutments (fig. 15).

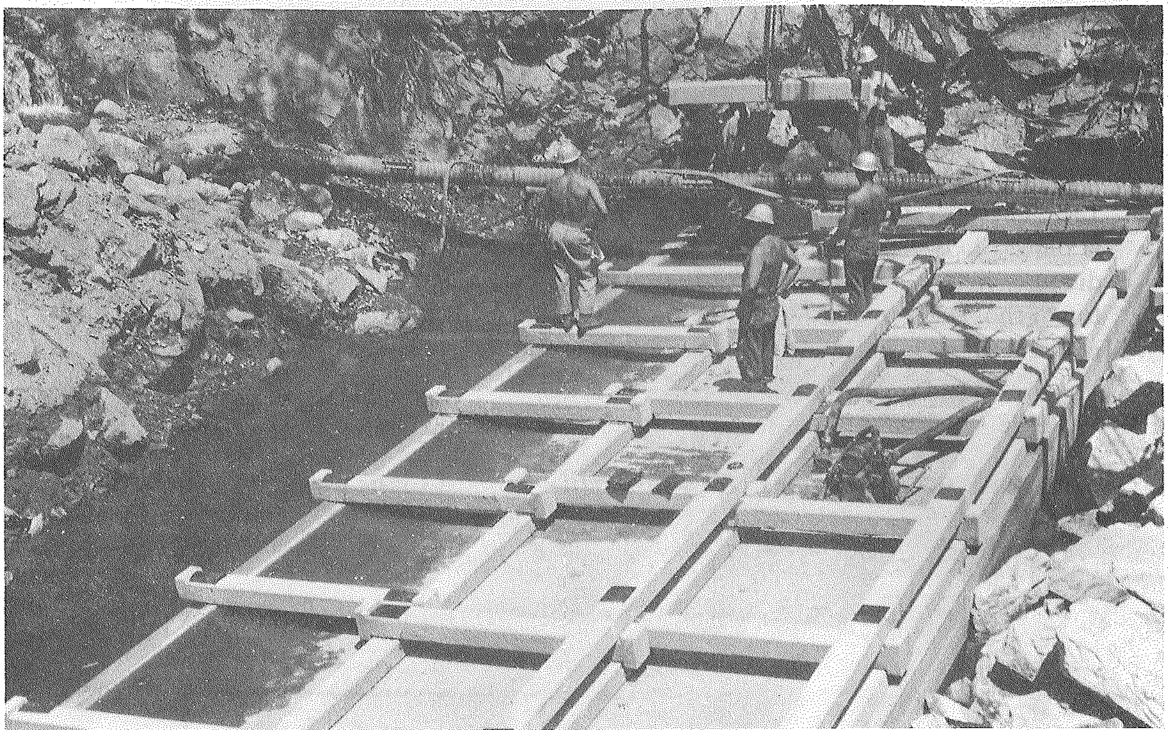

Figure 12. — First few courses of cribs in place on main slab.

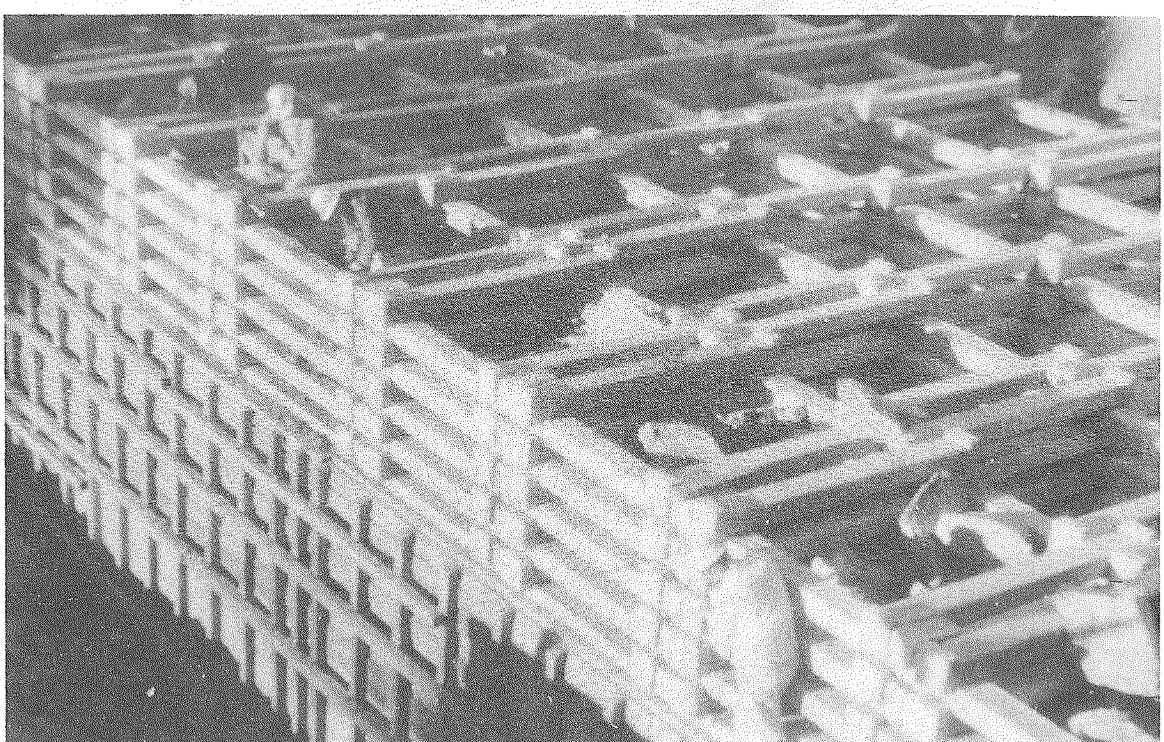

Figure 13. — Cobble rock has been placed in the first bay.

Figure 14. — Construction of step slab.

Figure 15. — Guniting top of dam.

FORT COLLINS' COMPUTER PROGRAMS

Transportation Analysis Group
Region 5

The *Timber Transport Model* is now in use at Ft. Collins. As many field people know, the model can be used for small analysis problems at a small cost, as well as for the large network analysis applications. A brief listing of directions (printout) for access to the system has been sent to all Regional Offices. This is to be used in place of the instructions in Chapter 1 of the *Network Analysis User Guide.* TAG will be publishing a new Chapter 1 in a few months.

The complete traffic-surveillance programs are now on the Ft. Collins computer. Instructions for access have been sent to all Regions. These programs are described in the manuscript *Traffic Surveillance Handbook,* sent to all Forests in August of 1973. They include data storage and a variety of computerized graphic printouts about traffic flow history. The statistical formulations contained in the Handbook have been computerized in Ft. Collins. This enables a variety of sampling and precision alternatives to be rapidly investigated to determine the best sampling method for the job.

A NOTE TO USERS OF THE HEWLETT-PACKARD MODEL 65 CALCULATOR

Michael O. Brown
Cadastral Engineer
Region 4

The field angle (H.P. 00115B) and the bearing (HP 00116A) traverse programs that are supplied by Hewlett-Packard in their survey PAC-1 give erroneous area solutions. The magnitude of the error is directly proportional to the size of the starting coordinates. Certain closure errors can cause some erratic acreage solutions. In some cases this might cause serious problems. Hewlett-Packard has been notified of the discrepancy in their program and it is assumed that they will follow up with some form of notification. Meanwhile, it seemed that FIELD NOTES would be an effective method of reaching individuals who might be using these programs without being aware of the possible problems that exist.

A solution to the problem is the following program. It gives the option of either bearing or field-angle entry for course direction and uses the double-meridian distance method to calculate area. (See figs. 1 and 2.)

HP-65 Users' Library

HP-65 User Instructions

TRAVERSE (DMD AREA)

N₀E₀	BRG.	QUAD.	FIELD	DIST.

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	ENTER PROGRAM				
2	ENTER STARTING NORTH COORDINATE	BEGINNING NORTH	A		NORTH COORD.
3	ENTER STARTING EAST COORDINATE	BEGINNING EAST	A		EAST COORD.
4	ENTER BEARING	BRG	B		
4(a)	ENTER BEARING QUADRANT	QUAD	C		AZIMUTH
Note	The first bearing entered is used as a reference bearing. If this is also the				
	bearing of the first course of the traverse, then skip to Step 6; if not,				
	continue at Step 5.				
5	IF ANGLE RIGHT	ANGLE RT.	ENTER		
		180	f-DMSt	D	AZIMUTH
5	IF ANGLE LEFT	ANGLE LT.	CHS	ENTER	
		180	f-DMSt	D	AZIMUTH
5	IF DEFLECTION ANGLE RIGHT	DEFL. RT.	D		AZIMUTH
5	IF DEFLECTION ANGLE LEFT	DEFL. LT	CHS	D	AZIMUTH
6	HORIZONTAL DISTANCE	DIST.	E		NEW NORTH COORD.
7	OPTIONAL:		R/S		NEW EAST COORD.
Note	Repeat appropriate steps 4-7 for successive courses.				
8	OPTIONAL: Compute Square Feet		R/S		SQ. FT.
9	OPTIONAL: Compute Acres		R/S		ACRES

Figure 1. – HP-65 User Instruction Form

HP-65 Program Form

HP-65 Users' Library

SWITCH TO W/PRGM. PRESS [f] [PRGM] TO CLEAR MEMORY.

Page 2 of 2

KEY ENTRY	CODE SHOWN	COMMENTS
LBL	23	
A	11	
f	31	
REG	43	CLEAR REGISTERS
STO 8	33-08	STORE STARTING NO. COORD.
STO 6	33-06	
RTN	24	
LBL	23	
A	11	
STO 7	33-07	STORE STARTING E. COORD.
STO 5	33-05	
RTN	24	
LBL	23	
B	12	BEARINGS
f^{-1}	32	
→D.MS	03	
RTN	24	
LBL	23	
C	13	QUADRANT
2	02	
÷	81	
ENTER	41	
f	31	
INT	83	
g x≠y	35-21	
GTO	22	
1	01	
g R↑	35-09	
g R↑	35-09	
CHS	42	
g R↑	35-09	
g R↑	35-09	
LBL	23	
1	01	CONVERT TO AZ
g R↓	35-08	
f	31	
INT	83	
1	01	
8	08	
0	00	
X	71	
+	61	
STO-1	33-01	
RTN	24	
LBL	23	NEW COORDINATES AND
E	15	AREA
STO	33	
+	61	
2	02	DISTANCE ACCUMULATION
RCL-1	34-01	

KEY ENTRY	CODE SHOWN	COMMENTS
g x↔y	35-07	
f^{-1}	32	
R→P	01	
STO	33	
+	61	
8	08	NEW NORTH
g x↔y	35-07	
STO	33	
+	61	
7	07	NEW EAST
STO	33	
+	61	
3	03	ACCUMULATE DEPARTURE
g x↔y	35-07	
RCL-3	34-03	DOUBLE DEPARTURE
X	71	
STO	33	
+	61	
4	04	ACCUMULATE DMD
g x↔y	35-07	
STR	33	
+	61	
3	03	
RCL-8	34-08	
R/S	84	DISPLAY NEW N. COORD.
RCL-7	34-07	
R/S	84	DISPLAY NEW E. COORD.
RCL-4	34-04	
2	02	
÷	81	
g	35	
ABS	06	
R/S	84	DISPLAY AREA SQ. FT.
4	04	
3	03	
5	05	
6	06	
0	00	
÷	81	
RTN	24	DISPLAY AREA IN ACRES
LBL	23	
D	14	FIELD ANGLE
f^{-1}	32	
→D.MS	03	
RCL-1	34-01	
+	61	
STO-1	33-01	
RTN	24	

REGISTERS	
R_1	AZIMUTH
R_2	H. DIST.
R_3	DEPARTURE X2+
R_4	DMD
R_5	STARTING EAST
R_6	STARTING NORTH
R_7	NEW EAST
R_8	NEW NORTH
R_9	USED

LABELS	
A	COORDS
B	BEARINGS
C	QUAD.
D	FIELD ∡
E	SOLN.
0	
1	QUAD.
2	
3	
4	
5	
6	
7	
8	
9	

FLAGS	
1	
2	

TO RECORD PROGRAM INSERT MAGNETIC CARD WITH SWITCH SET AT W/PRGM.

Figure 2. – HP-65 Program Form

WASHINGTON OFFICE ENGINEERING NEWS

CONSULTATION AND STANDARDS

Charles R. Weller
Assistant Director

STATUS OF THE FOREST SERVICE BRIDGE INSPECTION PROGRAM

The summary of events leading up to our current bridge inspection program began with the collapse of the Ohio River Bridge between Point Pleasant, West Virginia, and Gallipolis, Ohio, on December 15, 1967. Forty-six people died and the general public was jarred into a state of active concern over the problems of maintaining safe bridges. The President appointed a task force to investigate the collapse and to evaluate the condition of the Nation's highway and railway bridges.

At the request of the task force the Bureau of Public Roads developed a uniform highway bridge inspection guide. On July 1, 1968, the Bureau enclosed a copy of the guide with a letter to Chief Cliff. We were requested to inspect all bridges for possible weaknesses and make the necessary corrections to guarantee safe operation; we assured the Bureau that we were in full agreement with the concerns of the task force. Each Region was furnished with copies of the uniform inspection guide. On October 6, 1969, we proposed new guide material which included inspection procedures and an amendment was issued in April 1970.

In April 1971, the *National Bridge Inspection Standards* were published in the Federal Register. They were prepared by the Federal Highway Administration in consultation with the State Highway Departments and others. Since the inspection guide is now obsolete, the Forest Service Manual (FSM) 7718 was revised to comply with the Standards, which apply to all Federal-aid system structures. They have been applied by the Forest Service to the Forest Development System since they provide sound, logical procedures for maintaining a safe and economical bridge system. Furthermore, they are a national standard of care against which the courts can measure our performance in any suit claiming government negligence. Both Forest Service managers and technicians are aware of the values of an effective safety inspection program. Difficulties arise in placing this task in the proper priority with the many other tasks that must compete for funds and manpower.

The present Forest Service inspection program was officially initiated in the FSM 7718 in January 1970. Approximately 25 percent of the job was complete in July 1973. The Regions were then asked to complete the first round of inspections by November 1974; in December 1974, they were asked for the results and their comments. They reported a total of 7,101 structures fitting the bridge definition of the length greater than 20 feet in the Federal regulation. Of that number, 6,306 had been inspected and

Table 1. – Forest Service Bridge Inspection Status, January 1975.

Region	Total Road Bridges	Number Inspected	Number Rated	Number Posted	Number Closed	Inspection Cost	Total Cost to[2] Maintain or Repair
1[1]	1358	1346	684	120	24	130,000	8,000,000
2	503	503	503	320	21	150,000	4,300,000
3	349	290	276	20	0	70,000	500,000
4	1082	808	554	202	48	150,400	5,160,000
5	586	549	549	98	5	120,000	10,000,000
6	1653	1381	946	163	41	464,000	8,500,000
8	874	857	785	667	28	78,000	34,000,000
9	426	397	328	214	9	100,000	10,000,000
10	270	175	170	72	4	21,000	15,024,000
Totals	7101	6306	4795	1876	178	1,284,000	95,984,000

[1] *Region reported all bridges. Figures shown are based on an estimate of the number of bridges over 20 feet in length.*
[2] *Construction cost. Does not include preconstruction or overhead.*

4,795 rated for load carrying capacity. Many of those not inspected or rated were new structures designed for HS 20 trucks and those on closed road systems. A total of 1,876 bridges required a load limit that was less than the State legal limit and 178 required closure.

Estimated cost of the inspection program is $1,284,000. This includes Forest Service manpower, equipment and A&E contract costs. The average time per bridge was 2 man-days, 1 for inspection and 1 for rating. An estimated $96,000,000 are needed to bring structures up to minimum condition with heavy maintenance or replacement. Table I shows the breakdown of these figures by Regions.

TECHNOLOGICAL IMPROVEMENTS

Heyward T. Taylor
Assistant Director

EQUIPMENT DEVELOPMENT AND TEST BOARD MEETING

On April 16, 1975, the Annual ED&T Board Meeting was held in Washington, D.C. The meeting was opened by Russell P. McRorey, Chairman of the Board. He was followed by presentations relating to on-going programs at both the Missoula and San Dimas Equipment Development Centers. In addition, Dave Rising of MEDC made a presentation on the planning and team effort that goes into their program accomplishment from both within the Center and its cooperators.

Farnum Burbank, Vice-Chairman and Secretary of the Board, gave a brief run-down on the year-long planning required for the development of the ED&T Program. In support of this planning effort, Stan Tixier (Range Management, Washington Office), Tony Dorrell (Fire Management, Washington Office), and Ben Carson (Timber Management, Region 5) talked about the ad hoc committees in which they are involved. These committees, consisting primarily of field people, provide input during the planning process to insure that field needs are considered when setting priorities.

At the time of the meeting, the indications were that in FY 76 both Centers will be assigned more work. Increased emphasis will be placed on reduction of forest residues (including utilization), personnel safety, and rehabilitation of disturbed lands.

OPERATIONS

Harold L. Strickland
Assistant Director

EQUIPMENT COSTS CAN BE REDUCED

Forest Service equipment costs during the past few years have been increasing at a very high rate annually. These costs are appearing in both the fixed ownership and the use rate; yet they have not provided significantly better equipment over that which we had several years ago. This is especially true in the case of the light vehicles where the automotive industry trends, Forest Service vehicle ordering trends, and Government Services Administration (GSA) Specifications and Standards have gone uncontrolled.

The following is an example of how procurement specifications and standards are formulated. On April 15, 1975, we attended an Industry and Government Specification Development Conference; it covered the proposed Federal Specification KKK-T-645G and proposed Federal Standard No. 292C, Truck, Commercial 4x4 3,000 to 10,000 lbs Gross Vehicle Weight Rating (GVWR) (Gasoline Engine Powered). The Development Conference was coordinated by GSA for the purpose of considering industry and Government agencies' recommendations and requirements. This conference, as have previous ones, resulted in the formulation of specifications and standards that encompass the options available from each manufacturer. As a result, there is no standardization among the large numbers of vehicles purchased by the various Government agencies. The specifications and standards were previously designed with minimum GVWR specifications; therefore, a manufacturer could bid one size truck on several item numbers.

Our primary input was minimum and maximum GVWR's for each item number. If GSA incorporates our recommendations, the Forest Service and other agencies will be assured of receiving the appropriate-size vehicles.

With the acceptance of recommended changes, the Federal Specifications and Standards will be good documents from which to standardize the specifications for our light vehicles. But, our job is not complete; the project managers, work planners, fleet managers, vehicle operators, and Forest Service employees must take a critical look at their job requirements when selecting equipment.

The Forest Service we feel is getting to the point where a new evaluation of our minimum basic-vehicle needs must be conducted to determine what the job requires. In times of economic hardship, we cannot afford to purchase unnecessary vehicles and options. While many increasing equipment costs are a direct result of our purchasing additional or nonstandard options, inflationary prices, and increased operation and maintenance costs are contributing factors. Some of this is a result of the Occupational Safety and Health Act (OSHA) and Environmental Protection Agency (EPA) requirements placed upon the vehicle manufacturers, as well as the worldwide petroleum situation. However, we can partially reduce the effect of these factors by reducing these unnecessary requirements.

In order for us to achieve our objectives and to meet our responsibilities as set forth in the Forest Service Manual, we need to be more concerned about the rising costs of owning and operating equipment. Furthermore, our Nation's recent petroleum shortage and the enactment of energy conservation measures dictate that we must purchase more economical equipment both from the standpoint of the initial purchase price and the operating costs. This can be accomplished by purchasing, smaller equipment with fewer options, lighter duty systems, and smaller engines. Finally, we can standardize our Service-wide requirements and create a more competitive and more economical bidding situation for the equipment manufacturers.

ENGINEERING FIELD NOTES

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Each Region has an Information Coordinator to whom field personnel should submit both questions and material for publication. The Coordinators are:

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Coordinators should direct questions concerning format, editing, publishing dates, and other problems to Gordon L. Rome, or Rita E. Wright, Editorial Services, Engineering Staff Unit, Forest Service, USDA, Washington, D.C. 20250; (703) 235-8198.

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