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The 1990 *Engineering Field Notes* Article Award Winners

The votes have been tallied, and we are pleased to announce the top three *Engineering Field Notes* articles for 1990.

Article	*Author*
Tire-Retaining Structures	Ozzie H. Cummins, Santa Fe National Forest, Region 3 (previously of Plumas National Forest, Region 5) Gordon R. Keller, Plumas National Forest, Region 5
NAD-27 Versus NAD-83	Vic Hedman (retired), Regional Office, Region 9
Treatment of Acid Mine Drainage by Wetland Construction	Michael Tripp, P.E., Daniel Boone National Forest, Region 8

Congratulations! Because of the many excellent articles submitted this year, it was a close race. We appreciate everyone who took the time and effort to write and send in an article. Your colleagues in the field also appreciate your efforts. According to the comments received, *Engineering Field Notes* articles are saving the Forest Service time and resources. Many articles this year reportedly saved their readers thousands of dollars.

We are also grateful for those who took the time to fill out a rating sheet and send it in. Without your help, it is impossible for *Engineering Field Notes* to continue as a valuable resource for personnel in the field. Your input, whether it is in the form of voting, comments, or articles, helps us provide information Service-wide.

Please continue to show your support. Write an article, and perhaps next year you will be one of the few winners of an *Engineering Field Notes* award.

Impoundment Control Structure Design for the Mechanical Removal of Beaver Dams & Debris

Glen R. Anderson
Civil Engineer
Cass Lake Engineering Zone
Chippewa National Forest, Region 9

Background

Beavers present the most difficult problem in operating and maintaining wildlife impoundments on the Chippewa National Forest. Various control structure designs have been used, but none have been successful in preventing beavers from plugging the inlets. Removing this material is costly and only a temporary solution because the beavers soon—usually overnight—have the inlet plugged again.

Debris removal is normally performed with handtools. At times when the plugging is severe, such devices as backhoes and logging trucks have been used. The end result is a partial removal, with the base of the dam still intact and a large, unsightly pile of debris left on the slope of the dam. The beavers rapidly replace the portion that has been removed; thus the work is undone.

In the past, the principal consideration in structure design was directed at "fooling the beaver" and preventing plugging from occurring. None of these designs ever proved totally effective.

Control Structure

A type of control structure now being used on the Chippewa National Forest focuses on the ease of cleaning rather than on the prevention of plugging. Four of these structures are in place; the first was constructed in 1986. Figures 1 and 2 show a bowstring impoundment and a cloverleaf impoundment, respectively. Some of the design features are as follows:

(1) A sliding gate constructed of galvanized pipe that is opened with an electric winch installed on the front of a vehicle.

(2) A large (minimum of 36 inches in diameter) outlet pipe to permit the passage of debris.

(3) Concrete construction for strength and durability.

Operation

The stoplogs are first removed to permit an unrestricted flow and passage of debris through the outlet pipe. The vehicle is then aligned and the winch cable-hooked to the sliding gate. As the gate is pulled up, the beaver dam is

Figure 1.—Bowstring impoundment.

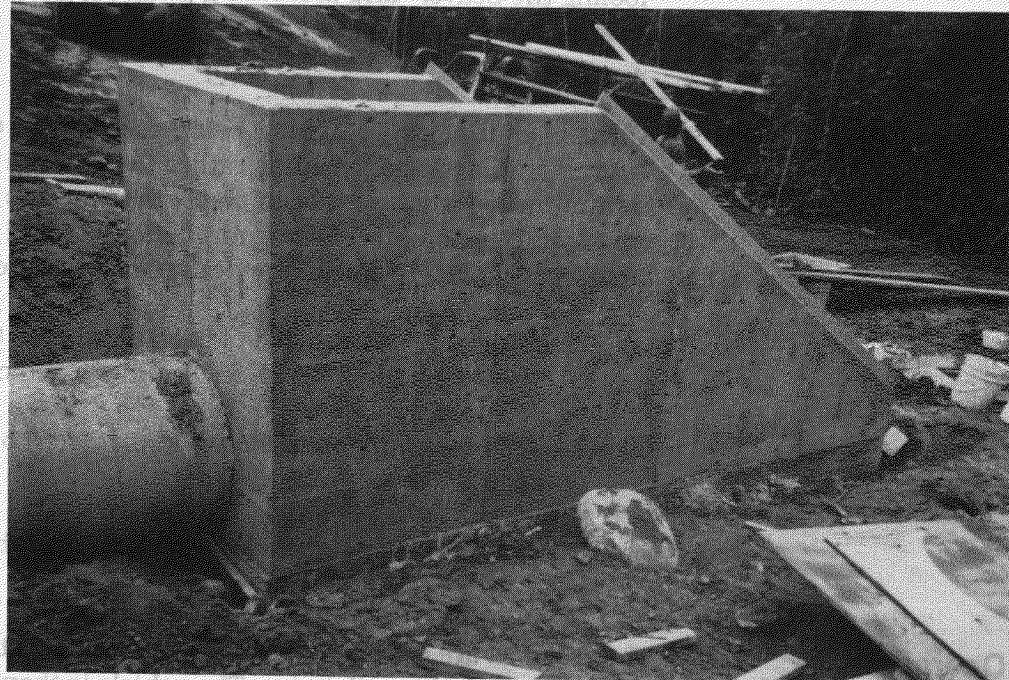

Figure 2.—Cloverleaf impoundment.

flushed through the structure. A pike pole or similar tool is useful for dislodging or removing larger pieces of debris. Figure 3 shows a side-view plan of a control structure.

Conclusion

This structure design for the most part eliminates the use of handtools, which are time consuming, costly, and sometimes dangerous. The beaver dam is destroyed from the bottom up, leaving the beaver with no base of materials on which to build. The material is flushed through the pipe; therefore, no piles of debris are left on the embankment slopes. Note that the effect of flushing debris downstream must be considered in the selection of this type of structure.

For design details, contact Glen R. Anderson at (218) 335-2283 or DG at R09F03D02A.

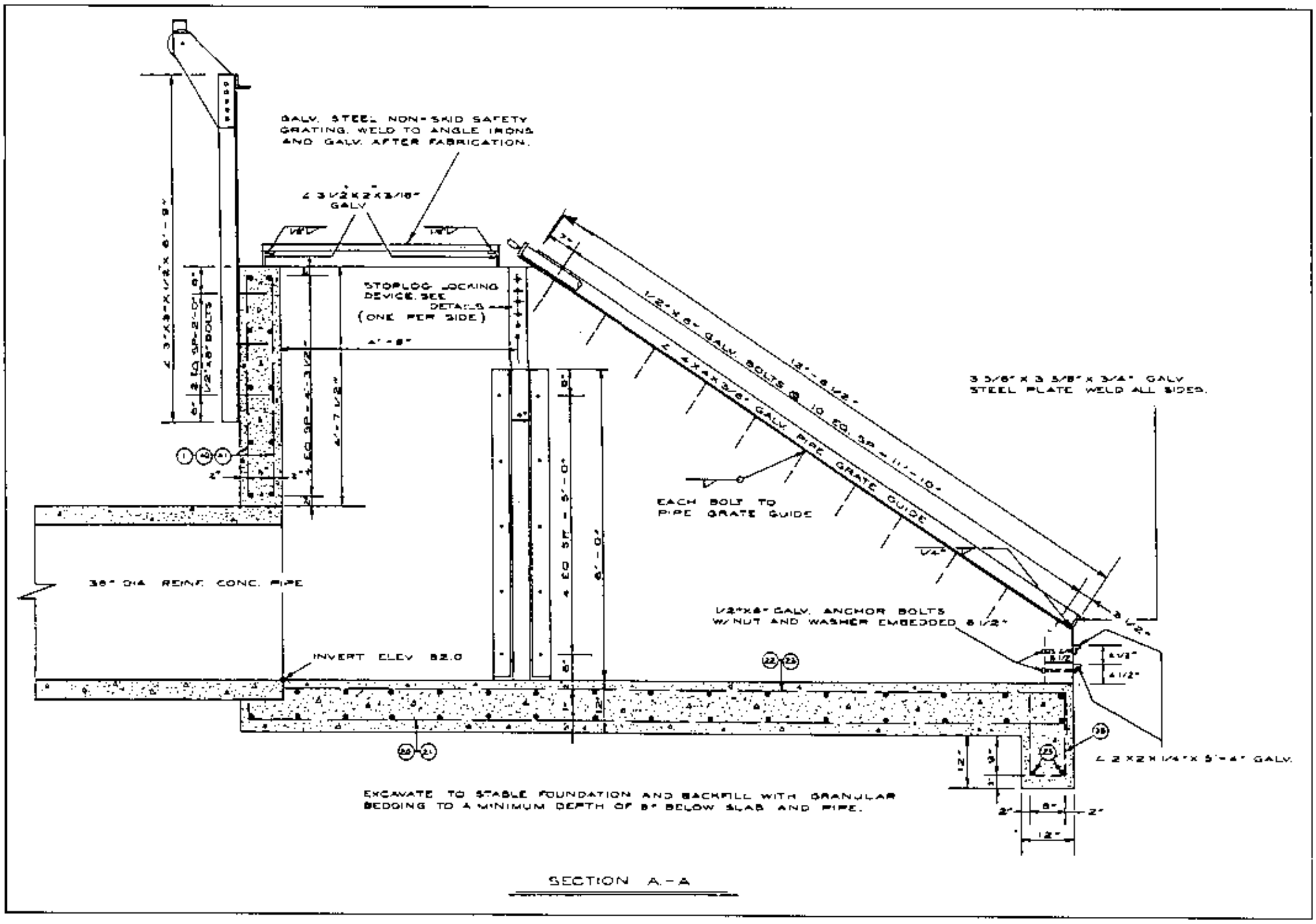

Figure 3.—Side-view plan of a control structure used on the Chippewa.

The New & Unique Fall Lake Dam

Roger Pekuri (Project COR)
Ron Haakensen (Inspector)
Fall Lake Dam Project
Superior National Forest, Region 9

Fall Lake Dam is located within the limits of the Boundary Waters Canoe Area Wilderness, 6 miles northeast of Ely, Minnesota, on the Superior National Forest. The project for a replacement dam required that the new structure must function with hydraulic characteristics similar to the old logging dam. In addition, the structure must be compatible with its wilderness setting, and the construction activities must be unobtrusive to wilderness users.

Forest personnel worked closely with the public, the Minnesota Department of Natural Resources, the architect/engineer design firm, and the construction contractor to successfully visualize, define, and implement these requirements. The two seemingly opposing forces involved—wilderness and heavy construction—made for a unique project.

Background

When the loggers originally constructed Fall Lake Dam to assist logging activities near the turn of the century, they probably did not realize the long-term impact the structure would have on Fall Lake, nor were they concerned with its esthetic quality. After all, they were still taming the wilderness.

The original dam was constructed of a rock-filled log crib, with a wood plank deck and upstream facing. The building materials were natural enough, but the structure still resembled a dam—that is, straight lines running 250 feet across the north outlet of Fall Lake. It also acted like a dam, maintaining an artificially raised water level in Fall Lake and restricting fish passage up the river into the lake. For its era, it was a good structure; it served a purpose and was compatible with the social environment of the times.

In the 90 plus years since construction, however, the harsh border lakes environment caused considerable damage and decay to the dam. Some repairs have been done. In 1959, for example, the Minnesota Department of Natural Resources replaced the wood decking and front facing, but this repair could not stop the increasing deterioration of the dam and its effect on lake levels. In the 1970's, the west third of the dam was partially washed away, and drought conditions made the dam unable to hold a minimum lake level. The timber cribbing had shifted and sagged, and water permeated through the structure and underlying streambed gravels. In recent years, lake levels have varied by as much as 6 feet, making it difficult for boat launching and travel from resorts, lake homes, and campgrounds.

The drastic fluctuation in lake levels finally spawned discussion and political support for the eventual replacement of Fall Lake Dam. In 1984, Forest Service personnel visited the dam with replacement in mind. The commitment was firmly established in 1986, with the approval of the Superior National Forest Plan, which specifically singled out Fall Lake Dam for replacement.

The concept of replacing the dam was not merely a technical one. Much had happened over the decades in the area, both politically and socially. The dam site was now within the boundaries of the Boundary Waters Canoe Area Wilderness, and the public had become much more sensitive to esthetic and social issues. Consequently, the design of the new dam had to take into account its compatibility with its wilderness setting, environmental concerns, and technical considerations. To accomplish this, Forest Service personnel worked with public individuals and groups to formulate a design concept that would address all the issues and concerns while best serving the public.

Design

The basic objectives of the new dam were to use as much of the original dam as possible, to construct a low-profile structure, to maintain the hydraulic characteristics of the old dam as much as possible and hold a minimum lake level, and to be esthetically compatible with the wilderness setting. To accomplish this, the Forest Service contracted with Enviroscience, Inc., of Minneapolis to study the hydrologic characteristics of the watershed and to prepare design alternatives to achieve these objectives. A final design from Enviroscience was accepted in the fall of 1988 after much interaction between Forest Service resource and technical professionals and public groups.

The final design was simple. A 12-inch-wide concrete wall would be constructed to the ledge rock immediately downstream of the original dam to form an impermeable core wall. The top of the wall would be at a constant elevation of 1,314.5 feet to ensure that a minimum lake level would always be maintained in Fall Lake. The base of the wall would be anchored to ledge rock by epoxy grouting in #7 rebar at the designated intervals along the wall alignment. The anchoring was designed to allow the wall to withstand overturning by the anticipated hydraulic forces, so it could stand alone if need be. The wall itself would be reinforced with rebar mats.

After construction of the wall, "toe rock" would be placed 5 to 15 feet downstream of the wall and tethered to the wall by cable to prevent movement. This rock would hold the downstream rock embankment in place. The wall would then be "backfilled" and covered with rock to tie it in with the old-rock-filled crib upstream and to blend the structure into the naturally rocky streambed. In fact, this rock (having different sizes and purposes) is what would make the dam so unique.

The bulk of the rock covering, or embankment, would consist of natural streambed boulders and 6- to 15-inch-diameter rock riprap imported from offsite. Most importantly, decorative rock, ranging from 2 to 5 feet in diameter, would be individually placed below, on top, and upstream of the dam in clusters, small groups, and in random placement to match naturally occurring streambed boulders. A total of 267 decorative rocks would eventually be placed, one at a time. This combination of rock types would produce a low-profile rock embankment of irregular alignment and a water cascade effect along the length of the dam. In essence, the dam would not resemble a dam.

Construction

Through competitive bidding, the Forest Service awarded the contract to Hoover Construction Company of Virginia, Minnesota, on December 23, 1988, for $312,102. The contract allowed for either fall construction by barge access or winter construction by ice road. These time periods would avoid construction activities during the busy summer recreational months. The completion date was set for December 1, 1990. Hoover chose to start construction that winter and began developing a 2-mile ice road by mid-January 1989. By January 25, the ice road measured 100 feet wide, with an average ice thickness of 24 inches.

The ice road did not develop easily. Twice, the small grader Hoover used to plow snow fell through the ice into 12 to 20 feet of water, but it was pulled or lifted out with no permanent damage. Despite such minor setbacks, Hoover began hauling temporary dike material to the site on January 25 and poured the first segment of concrete wall by February 17.

Construction was also not without its problems. Hoover chose to haul in dike material and construct a cofferdam around the eastern half of the project. Plastic sheeting was placed on the outside fill slopes of the cofferdam to minimize infiltration. However, when excavation for the concrete wall began, it seemed that more water than the pumps could handle was infiltrating into the excavation through the porous old dam and the granular streambed material above the ledge rock. This was overcome by dividing the cofferdam in half and placing a clay cutoff wall down the center of the cofferdam dikes. The pumps—as many as seven operating at one time—could then handle infiltration adequately, although pumping at –20 to –30 °F was no easy task. Minor leaks soon became huge ice mounds, and ice coated everything. It was hard on machines and people.

Excavation for the concrete wall also revealed some surprises. The ledge rock was not as uniform and shallow as expected. Rather, it undulated sharply and on the average was twice as deep as anticipated (8 to 12 feet) (see figure 1). In fact, one 8-foot-wide cleft was never fully excavated. A special concrete cutoff wall was designed with a compacted clay backfill to bridge the gap.

The alignment of the wall was shifted as excavation progressed across the river to take advantage of shallower ledge rock areas. This shifting was compatible with the concept of the dam—a natural-looking structure allowing randomness. This shifting of alignment actually added to the natural appearance and, of course, minimized any cost overruns.

The cold weather certainly made construction more difficult, but Hoover was able to adapt to meet its time schedules. Cold weather concrete pour procedures were followed and the necessary tests taken. The concrete mix was hauled dry to the site from Virginia, Minnesota (70 miles away), in 6-cubic-yard ready-mix trucks (figure 2). Water was heated at the site to 130 to 150 °F and added at the site. An air-entrained cement mixture (Minnesota Department of Transportation Type 3, Grade A) was used, with an expected compression strength of 3,900 (figure 3). A 2- to 3.5-inch slump was allowed.

The forms for all pours were preheated to 70 to 80 °F under plastic enclosures, and all pours were kept warm until the concrete reached 60 percent of the design strength. In all, five pours were made and 56.26 cubic yards of concrete poured.

The final concrete pour was made on March 7, completing the 245-foot-long concrete core wall across the river. With the assistance of a Forest Service landscape architect, the final rock embankment and decorative boulders were placed during the next 5 days. On March 12, construction of Fall Lake Dam was complete, and Hoover removed the last items of materials and

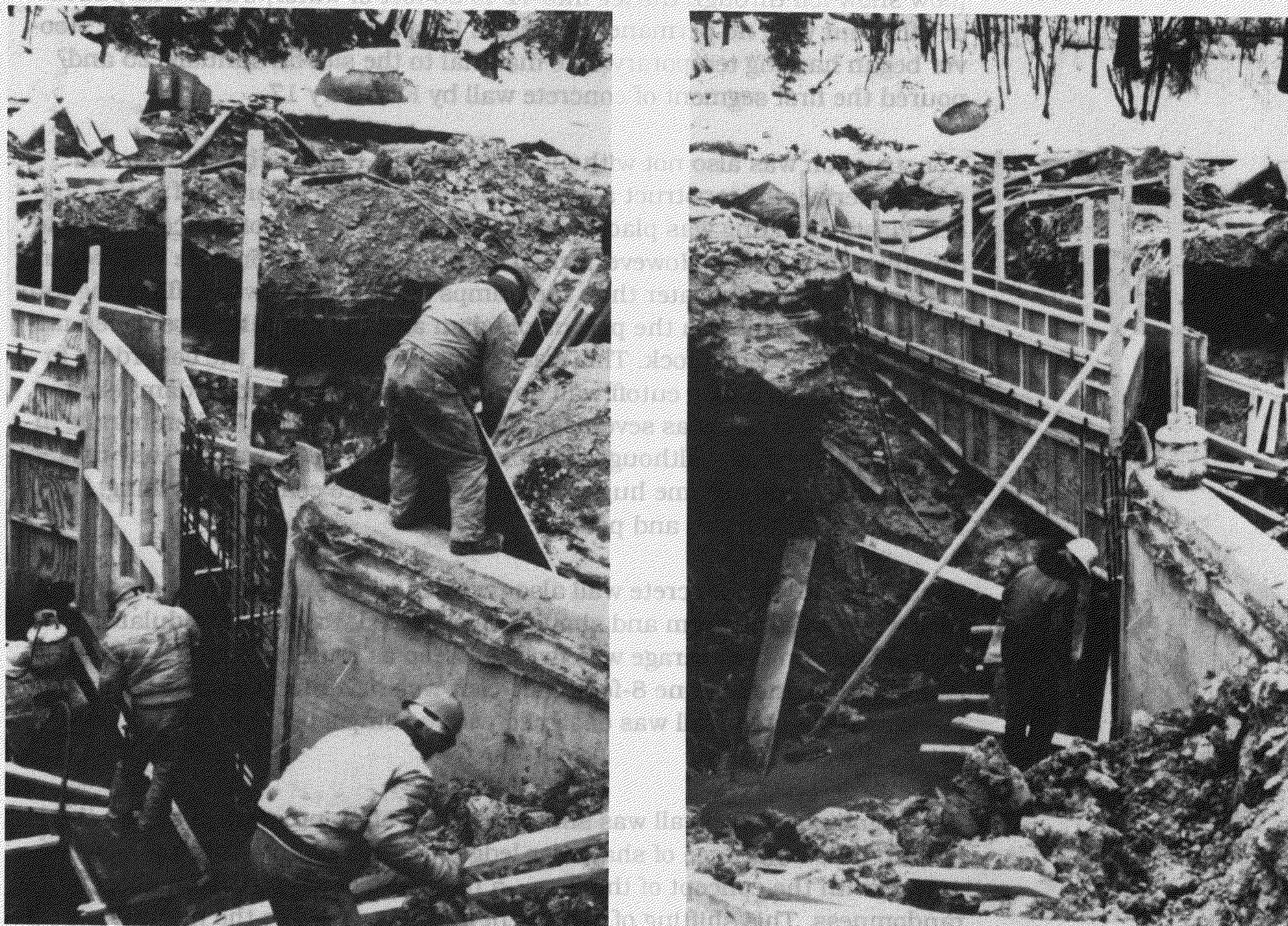

Figure 1.—Two views of the construction site. Note the depth of the rock ledge.

Figure 2.—Truck hauling in concrete on the ice road.

equipment from the site. The ice road was closed—and just in time. The advancing spring weather raised the air temperature into the upper 40's. The ice road turned to slush as the last loads of dike material, debris, equipment, and machinery were hauled out. Hoover worked around-the-clock shifts to beat the weather and complete the project.

Conclusion

Viewing the completed dam has already pleased many observers—both within the Forest Service and among the public. It was a different kind of project and a unique concept. Figure 4 shows two views of the "hidden" structure. It has shown that a functioning dam structure can be built in the wilderness and meet the technical, esthetic, environmental, and sociological concerns of the public. The dam will function as originally intended to maintain a minimum lake level in Fall Lake for boating and canoeing enjoyment.

The Fall Lake Dam project has recently received two engineering awards: the 1990 Seven Wonders of Engineering Award from the Minnesota Society of Professional Engineers and an Outstanding Civil Engineering Achievement Award from the American Society of Civil Engineers. The project also was featured in the January 1991 issue of *Civil Engineering,* in an article written jointly by Enviroscience, Inc., and its subcontractor, Barr Engineering Company (also of Minneapolis).

If your travels take you past the Fall Lake Dam site, stop to take a look. Amid the cascade of waters and lure of shooting the rapids lies a structure of much thought and purpose. But can you see it?

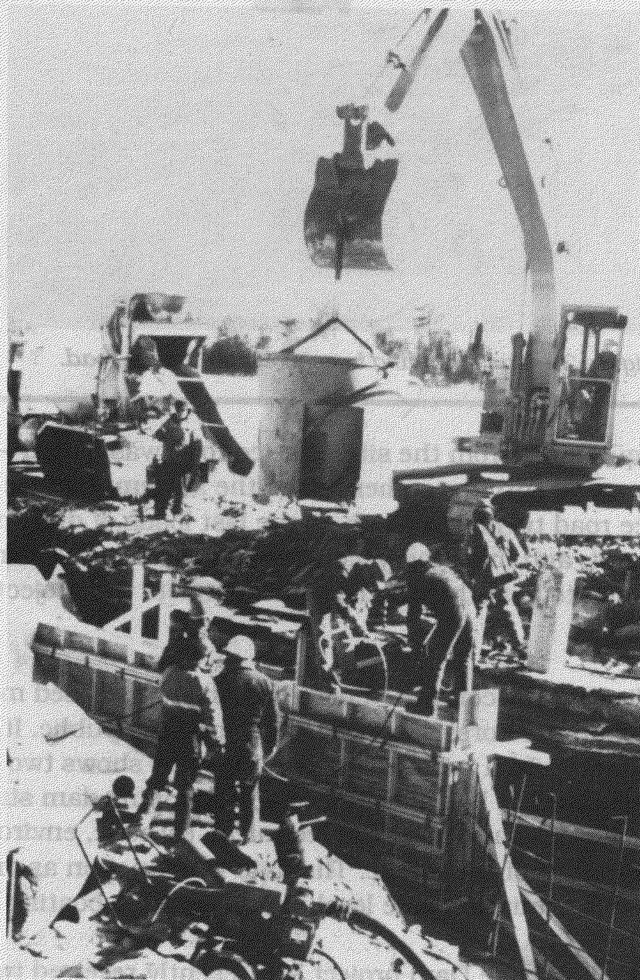

Figure 3.—Pouring the concrete at the site.

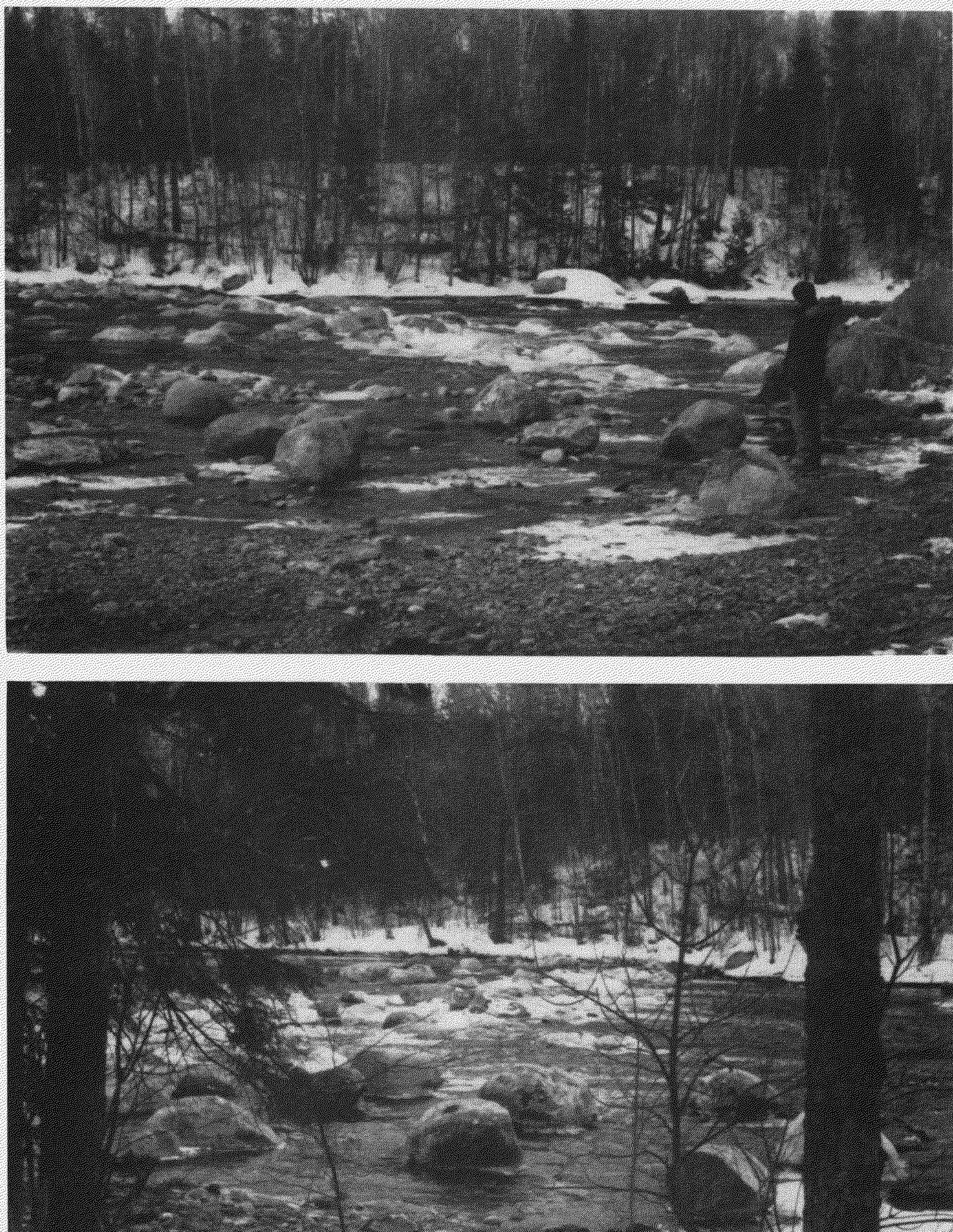

Figure 4.—Two views of the completed dam.

Two Technology Transfer Awards for the Technology & Development Program

The Technology and Development program was honored with two of the three prestigious Chief's Award for Excellence in Technology Transfer—one to Briar Cook of San Dimas and another to Dave Pierce of Missoula. The Chief presented these awards at the January Regional Foresters and Directors meeting. In response to the Federal Technology Transfer Act of 1988, each year the Chief recognizes the creativity, benefits, and effects of major technology transfer efforts. For the 1991 awards, 26 nominations were received Service-wide for the three available prizes.

Briar Cook, Recreation/Resources Program Leader, San Dimas Technology and Development Center, was recognized for his work on the "Sweet Smelling Toilet" project (figure 1). Briar had developed and transferred (using "exceptional initiative and perseverance") technology that enables recreationists to enjoy odor-free vault and pit toilets. He conducted numerous workshops on how to design and maintain restrooms so as to eliminate the offensive odors normally associated with these facilities. He also interacted with the media as part of Recreation's 1990 "Year of the Sweet Smelling Toilet" campaign, and he steered design efforts for components (vaults, risers, vents,

Figure 1.—Brian Cook, along with Shirley Cook, receives his award from Chief F. Dale Robertson.

Figure 2.–Dave Pierce receives his award in front of Director of Engineering Sterling Wilcox.

accessible buildings) so that agencies would achieve the goal of no more obnoxious-smelling outdoor toilets. Briar also has been recognized by the Park Service for this project, receiving the annual Grist Award.

Dave Pierce, Equipment Specialist, Missoula Technology and Development Center, was recognized for his work on the "Parachute Simulator" project (figure 2). Dave developed and implemented the Parachute Maneuvering Training Simulator (a computer graphics package), which bridges the gap between the classroom and actual training jumps. In contrast to traditional chalkboard lectures, the simulator allows a skilled instructor to demonstrate correct maneuvering techniques. It provides an opportunity for a trainee to simulate 50 jumps under varying weather conditions and in various terrain. It has been adopted by the Forest Service and the Bureau of Land Management for training smokejumpers in the critical safety skills required to maneuver a parachute. The device also has been adopted by the smokejumping program of the People's Republic of Mongolia. In an assistance project sponsored by the United Nations, Dave traveled to Mongolia to help implement the parachute maneuvering simulator system.

The South Branch of Kinzua Creek Bridge

Jerry J. Hinz
Operations Engineer
Allegheny National Forest, Region 9

Introduction

The Allegheny Snowmobile Loop on the Allegheny National Forest is almost complete because a permanent bridge now crosses the South Branch of Kinzua Creek, near the southeast tip of the Allegheny Reservoir. The relocation of South Branch of Kinzua Creek trail (which connects with the Allegheny State Park winter trail system) provides a legal way to enter the snowmobile loop and mitigates impacts on wildlife and wetlands. The attempts at crossing the creek on the ice or on a temporary bridge created safety hazards to the snowmobilers and sediment problems to the stream.

Background

In 1988, a local snowmobile club constructed a structure that crossed the South Branch of Kinzua Creek. In the spring of 1989, high water washed the structure downstream. The club wished to construct another crossing, but "designs" submitted would not have been adequate during any significant runoff.

The Forest Service planned to construct a crossing with Capital Investment Funds expected within the next several years. The pressure to take care of this crossing before snowmobile season promoted a cooperative effort that really paid off for the Allegheny National Forest.

The project began when some members of the Operations Section decided to list projects that could be good "teambuilding" exercises and have a positive effect on Forest Management. When this project was selected, two constraints were placed on it: (1) that it be a sound design and (2) that it be well out of the floodplain.

Outside Cooperators

The Pennsylvania Bureau of Forestry contributed approximately $6,000 worth of supplies for the bridge. An inmate crew from the McKean Federal Prison, under the supervision of the Forest Service, worked on the bridge and the 1.2 miles of trail nearby.

Design and Construction

Greg Porter, a Facilities Engineer in the Operations Section, quickly conceived a design that was relatively low cost, met the criteria, and could be constructed with the available work force. The design incorporated the use of concrete manhole sections for piers and abutments that were placed by

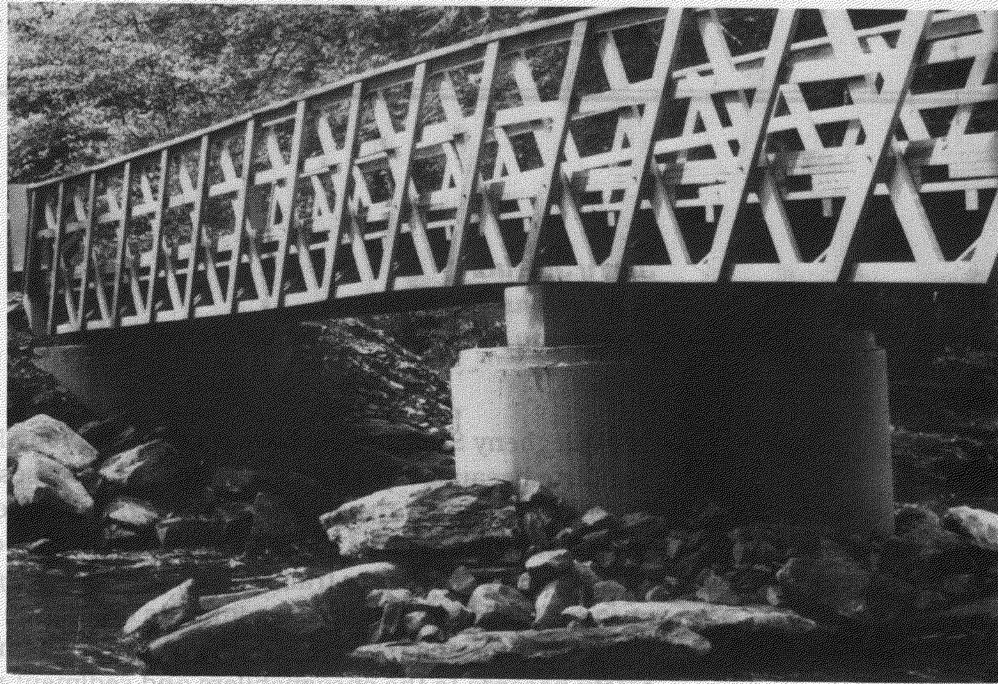

Figure 1.—A close-up view of the piers and abutments of the bridge.

the construction and maintenance crew (road crew). See figure 1. The Bradford District Resource Crew helped set up forms and placed the concrete. The steel beams were set, and the Supervisor's Office Operations Team completed the deck and rail construction.

On a spectacular autumn day in October 1989, the Operations Team began to build the bridge. This team was made up of a Timber Contracting Officer, a Realty Specialist, a Right of Way Specialist, a Land Line Supervisor, a Fertilization and Hazmat Specialist, a clerk, and many Engineering-related people under the leadership of Ernie Rozelle, the Operations Team Leader.

Safety was, of course, a primary concern, considering the relative novices that were now into bridge construction. The job hazard analysis was reviewed, the appropriate safety wear was available, and everyone was coached to exceed their capabilities. Some were more adept at kitchen duties (cooking the bratwursts, steaks, and soup), while some took naturally to the forming of the bridge deck. The Operations Team spent 2 days spent "in the field" relieving stress and working together.

Figure 2.—A view of the completed bridge.

Technical Specifications

Deck	8 feet
Design (Q=Q50)	4,000 cfs
Span	2 spans of 40 feet each
Beams	2W–12 x 30 (A–588)
Design loading	90 Psf live-load
Piers and abutments	Concrete manhole sections with spread footings
Total cost	$10,000

Figure 2 shows the completed bridge from one side.

Conclusion

This project reinforced the belief that there is a well-functioning group of people in the Operations Section on Allegheny National Forest. The Operations Team takes great pride in the accomplishment of completing the South Branch of Kinzua Creek Bridge ahead of schedule and well below expected cost. It is a beautiful bridge (figure 3). Readers are invited to try it while fishing for trout, hiking or mounting biking on the Forest—or while snowmobiling next winter.

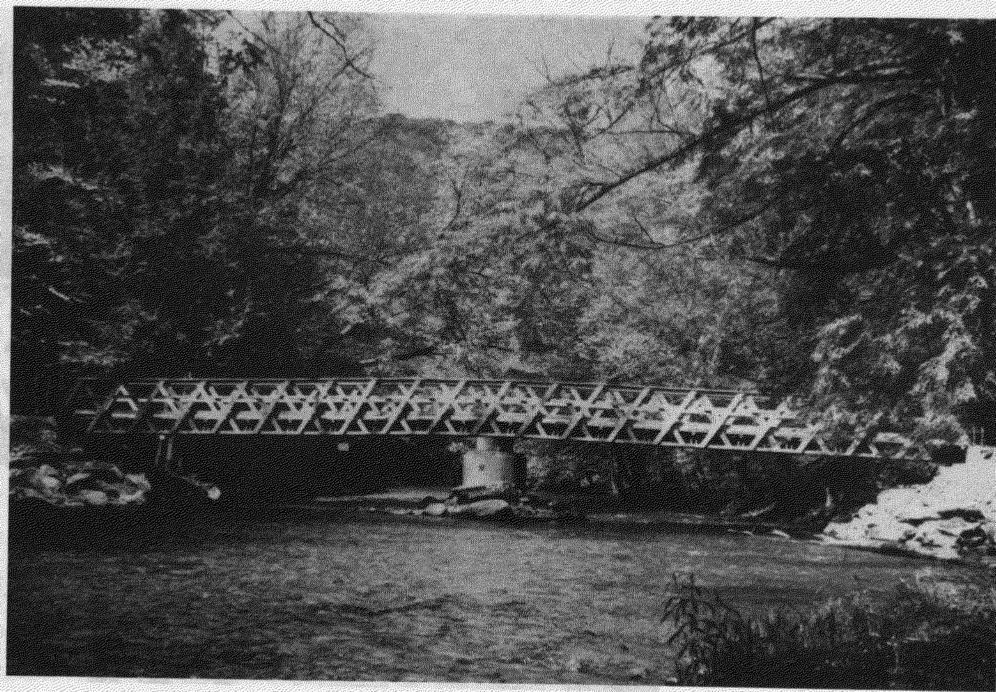

Figure 3.—A distant view of the bridge showing off its good looks.

The Hobo Engineer Revisited

(Originally published in the March 1980 issue of Engineering Field Notes*)*

Comments by Clifford Miller
Regional Engineer (Retired)
Region 4

This poem was framed and hanging in the Regional Engineer's office in Ogden when I arrived to succeed Jim Usher. I do not know whether Jim inherited it from Minor Huckeby or not. The paper on the back of the frame is brittle, and when I moved it recently, a piece fell off revealing the author and date.

The poem was written by two of Region 4's Engineers, Frank Allen and Ted Keller, in 1937. Frank was working for the Forest Service as early as 1929; both men have now "tied up to the Great Unknown." The way of life expressed in the poem that our predecessors lived still expresses some dreams of today.

The Hobo Engineer

I sometimes think I'll quit this life
And settle down and get a wife, by Jove!
Sometimes I think that I would love
To have some place I could call home
And settle down, no more to roam—
But Hell, that very thing I've tried
And found myself dissatisfied.
I've often tried to settle down
To office work and live in town
And act like civilized folks do;
Take in the shows and dances too.
But I'd no more than get a start
Till "wanderlust" would seize my heart
And in my night dreams I would see
The great white silence calling me,
And at the chance I'd never fail
To drop it all and hit the trail
Back to the solitudes again
With transit, level, rod and chain
To lead the simple life once more,
And do the same thing o'er and o'er
Day after day and week after week.
Sometimes we go to town to seek
A little fun and sometimes—well,
Sometimes we raise a little hell;
(We don't mean to, but then you see
When we've been out two months or three
In silent places where the face
Of white man seems so out of place).
Well, when we hit the "Great White Way"
Our joyful spirits get full sway;
We try to crowd into one night
The joys of many months. 'Taint right.
Well maybe not, 'tis not for me
To shape our final destiny.
But when our last survey is done
And tie'd up to the Great Unknown,
And to the Chief our records brought
Of lonely work with danger fraught,
Of hardships cheerfully endured
That best results might be secured,
Against all this our little sprees
Will seem as ponds compared to seas.
And the Angels will decide
There's a balance on the credit side,
And God, I think, will drop a tear
And bless "The Hobo Engineer."

Sixmile Bridge: A Component Structure

Don Porior
Civil Engineer
Siskiyou National Forest, Region 6

Introduction

The Siskiyou National Forest wanted a simple bridge—one that is easy to inspect, visually appealing, and adaptable for several sites with only minor engineering. Sixmile Bridge on the Illinois Valley Ranger District perhaps meets all those criteria. The bridge is constructed totally from components, except for a cast-in-place footing. The suppliers of the components were supportive and worked with Forest personnel to reduce the cost and create an affordable design.

The Forest selected the design with esthetic quality in mind. A wood superstructure was preferable to concrete. A precast concrete substructure was selected. Figure 1 shows the completed bridge.

Figure 1.—Completed bridge shown from one end.

Design

The bridge is a 40-foot-long, single-lane structure. See the layout in figure 2. The superstructure is a Micro=lam® laminated veneer lumber (LVL) bridge supplied by Trus Joist Corporation of Boise, Idaho. The substructure is a soil-reinforced concrete abutment system supplied by the Hilfiker Retaining Wall Company of Eureka, California. The design features are as follows:

(1) The superstructure sits directly on the wall panels rather than on a slab on grade, reducing the bridge length by at least 10 feet.

(2) The principal components are preengineered. (The Forest performed the layout and drafting.)

(3) Fill retainers are used at the corners and midpanel points, reducing the length of the side walls.

(4) The substructure panels adapt to various skews and heights.

(5) A minimum of construction control is needed.

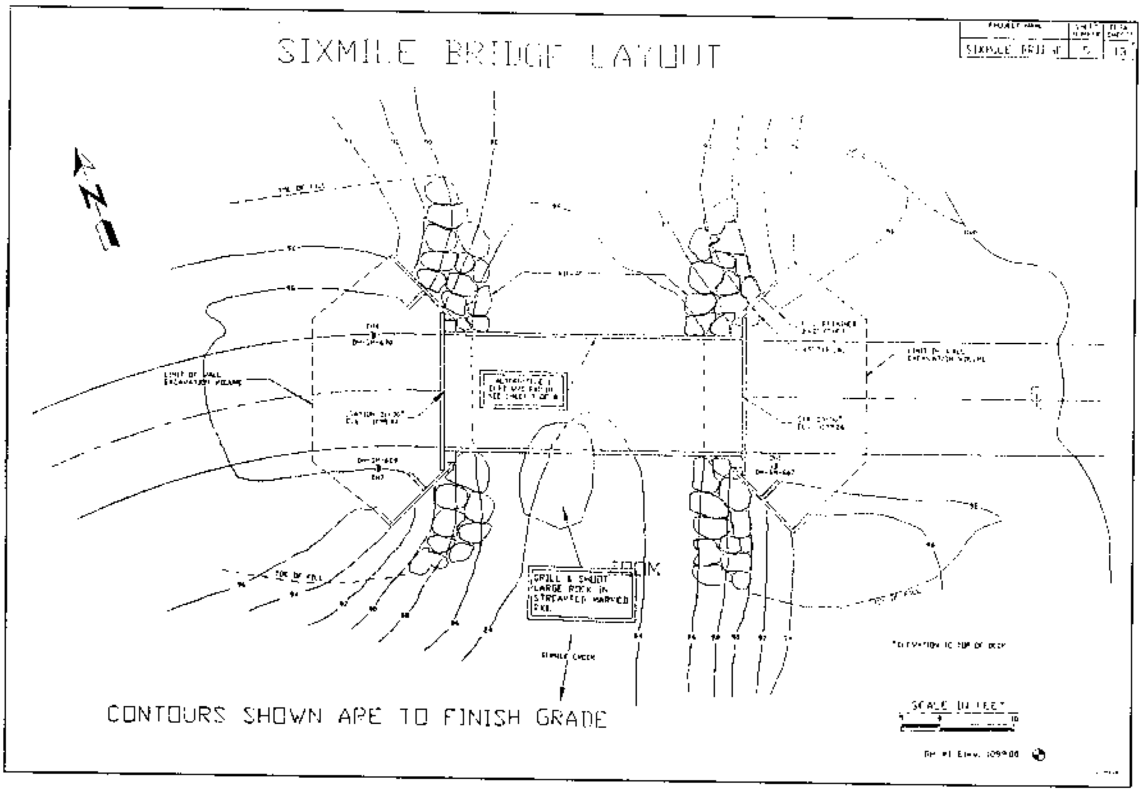

Figure 2.—Detailed layout of Sixmile Bridge.

Figure 3.—Close-up view of the bridge design.

(6) The wooden superstructure allows for the use of smaller construction equipment than a concrete alternative.

(7) The components fit together easily with a minimum of delays.

(8) Appearance is important. (The site is a campground where two streams come together, so a permanent wood structure was preferred.)

(9) Company representatives assist to minimize delays.

Figure 3 shows a close-up view of the bridge design.

Components

Six component types were used in Sixmile Bridge. Their assembly resembles that of a Lego structure.

RSE Panels

The panels placed on the sides of the substructure are RSE wall panels—the same panels used in retaining walls. The panels are set on top of each other, held in place by welded-wire, soil-reinforcing mats (figure 4). Small rods are placed between the panels to maintain a vertical face during construction. They are supported vertically with small column sections. A thin rubber pad separates the columns.

The abutment panels are under the superstructure (figure 4). Their column sections are enlarged on the back side to carry the additional vertical loads of the bridge. Wire mats are attached to their back face in the same way as the side panels. The panels are designed to the loading specified in the contract.

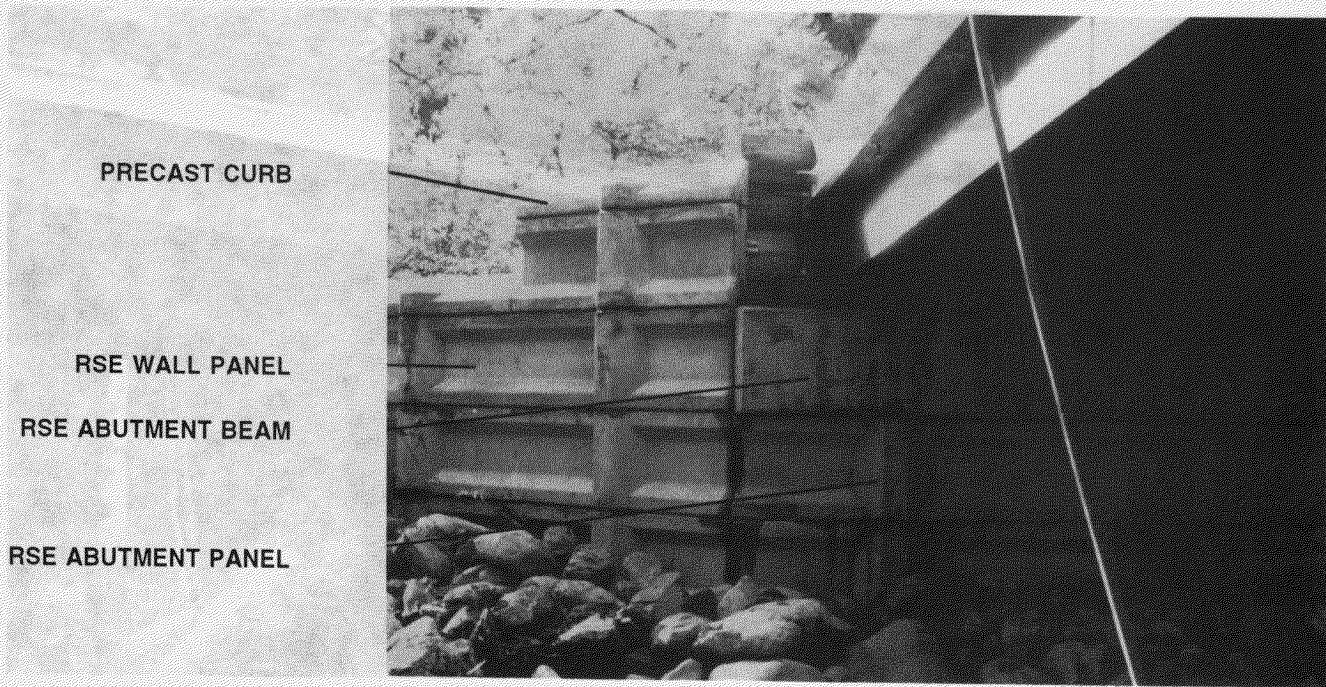

Figure 4.—Close-up view showing several components.

RSE Abutment Beam

The abutment beams distribute the superstructure load uniformly to the panel column below (figure 4). They are designed to the loading specified in the contract. The beam extends the full width of the bridge. Soil-reinforcing fabric is attached to the back of each beam.

RSE Footing

The abutment panels rest on concrete footings, which spread their column loads to the soil or rock below (figure 5). The size of the footing is a function

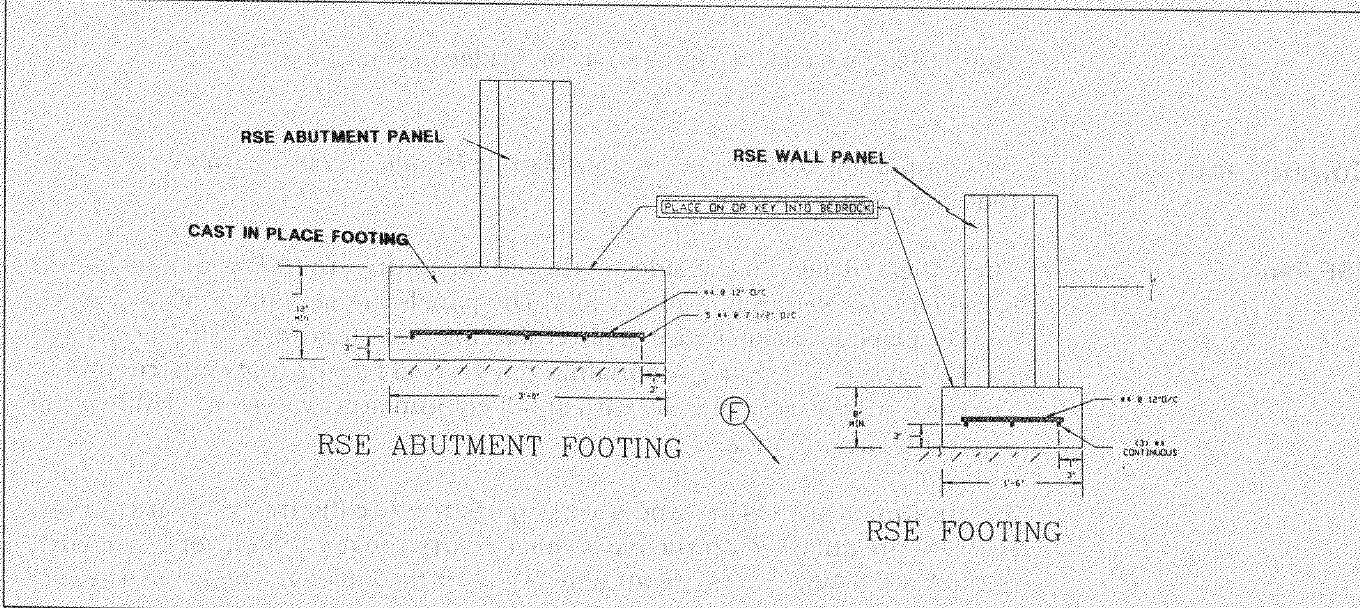

Figure 5.—Diagram of the panels and footings.

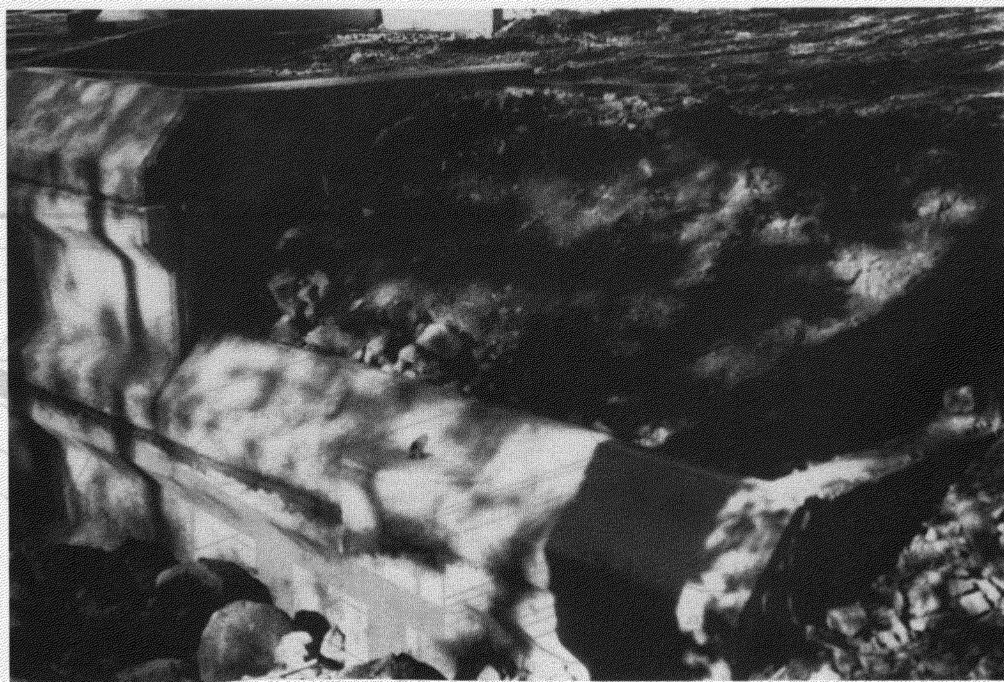

Figure 6.—Side panels with fill retainers.

of the bearing capacity of the foundation material and the column loading. Typical footing details are available for the side panels.

Precast footings are difficult to level unless supported and leveled with grout, so cast-in-place footings were used on Sixmile Bridge. Precasting is recommended if timing is critical.

RSE Fill Retainers

Fill retainers are short wall sections that attach to the upper panels at 90 degrees to the panels (figure 6). They function as ends to the wall panels, keeping the fill within the walls and reducing the size of the substructure. Contours can be blended into these ends. The length and height of the retainers match the angle of repose of the unreinforced fill. For a 1.5-to-1 slope, the 2-foot-high panels are 3 feet long. The panels do not extend into the road shoulder. For most skews, this is not a concern.

Micro=lam® LVL Tee Beam Deck

The superstructure selected was a Micro=lam® LVL tee beam deck manufactured by the Trus Joist Corporation. The deck consists of 2-foot-wide tee beams bolted into place (figures 7 and 8). The beams are posttensioned after installation with rods across the width of the bridge. The installation time was minimal, and the total time to place the beams from the time the truck arrived and left the project was approximately 5 hours. The deck requires restressing 7 and 56 days after the initial stressing. Positive features of the design include resistance to road salts, full penetration of preservatives, ease of construction, long life, light weight, and pleasing appearance.

Micro=lam® L Rail or Curb

The bridge comes with either a rail or curb option. A curb was selected for Sixmile Bridge because it best met the Forest's management plans. The traffic speeds and accident risks are low. The previous bridge had no rail. If

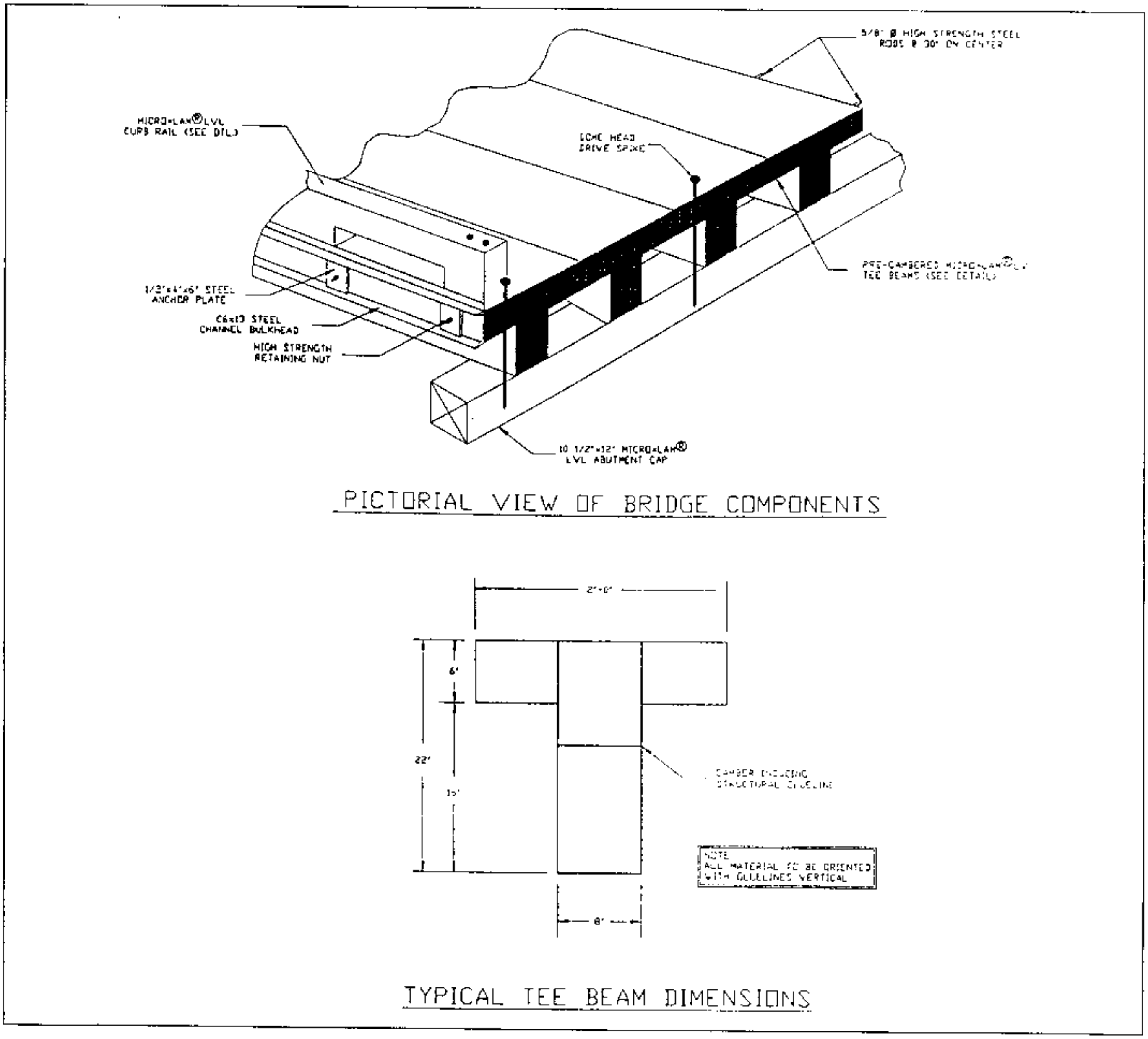

Figure 7.—Detailed diagrams of tee beam and other components.

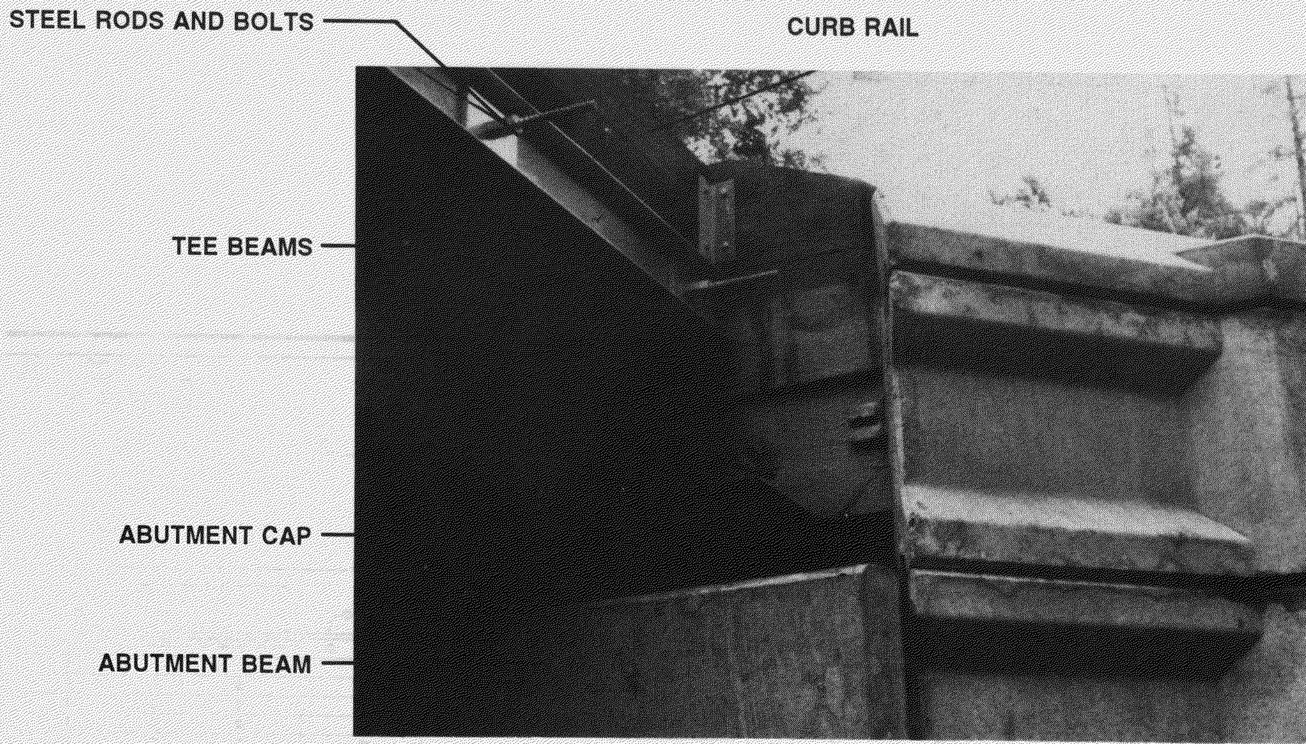

Figure 8.—Close-up view showing tee beam and other components detailed in figure 7.

desired at a later date, the curb can be easily removed and a prefabricated rail installed.

Summary

Sixmile Bridge is an easy-to-construct, attractive bridge made almost entirely from components parts. Figure 9 shows the elevation and abutment details, while figure 10 shows the completed bridge from a distance. Two manufacturers cooperated in the design and construction of the bridge. The simple design is suitable for either force account or contract construction.

Various timber deck systems are acceptable alternatives, such as glue-laminated girders, stressed timber decks, longitudinally laminated timber decks, and the Micro=lam® LVL wood bridge. Plans and specifications should allow equal opportunity in the bidding process.

Editor's Note

The reader should note that this project was constructed using proprietary bridge materials. This is not a normal contracting method and resulted in a total project cost of $10,000 to $15,000 more than other timber or concrete alternatives.

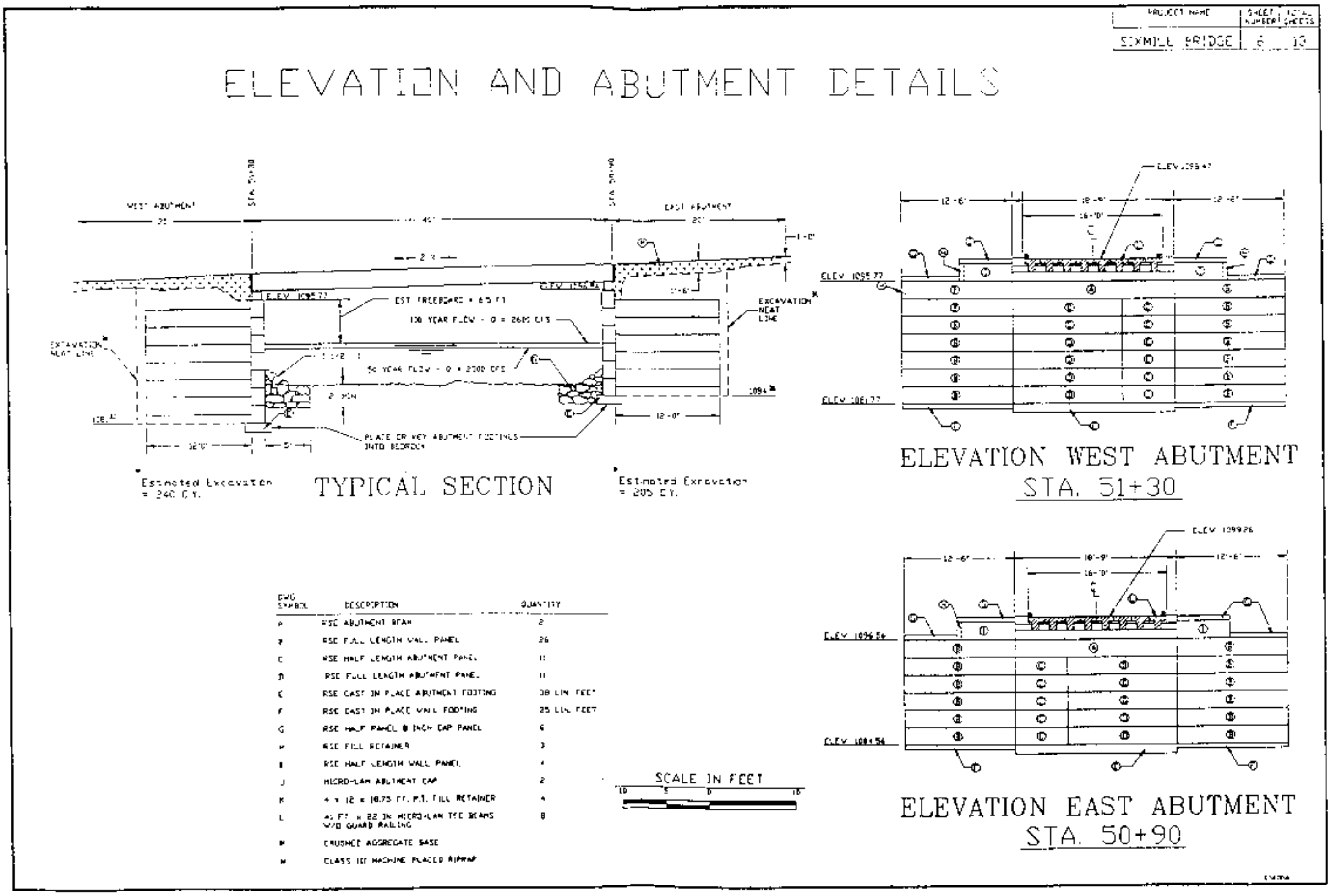

Figure 9.—Diagrams showing elevation and abutment details.

Figure 10.—The completed bridge from a distance.

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