United States
Department of
Agriculture

Forest Service

Engineering Staff

Washington, DC

Engineering Field Notes

Engineering Technical Information System

Volume 22
May-June
1990

Data Needs for Strategic & Project GIS

Wayne H. Valentine
Group Leader, Photogrammetry
Geometronics Service Center

The status of the Forest Service Geographic Information System (GIS) is progressing and gathering momentum. Procurement processes are well under way. Request For Information (RFI) responses showed where to improve system specifications. The last cycle of RFI enabled fine-tuning procurement documents. Our Request For Proposal (RFP) reflects characteristics needed by our GIS. The Washington Office will issue a procurement RFP soon, so that first systems will probably arrive in 1991.

An interdisciplinary team is developing a benefit-cost analysis for GIS. Primary benefits identified are "value added benefits," which reflect GIS's ability to increase effectiveness in mission accomplishment. To do this requires accurate, consistent, and timely information about land-based resources.

To reap the full benefits of a Service-wide GIS, Forest Service units need to share and integrate their information. Washington Office staffs are working with task groups from the field to develop standards for widely shared and commonly used data. Units that choose to collect such information will have these standards available for guidance. Controlled Evaluation units are already well along the learning curve through sharing, integrating, and digitizing their data. They will pass lessons learned to the remainder of Forest Service personnel, helping to implement GIS. Expectations are better land management plans, decisions, and resource allocations, along with faster response to resource crises.

Expectation is a key word. Another great expectation for GIS is that it will provide personnel the ability to quickly analyze many alternatives—by predicting effects of management direction over space and time. This speedy and thorough analysis of cumulative effects is just not possible with manual means. Improved ability such as this also will give more visible and supportable reasons for management decisions. Forest Service personnel can be more effective in communicating and interacting with the public by using statistical and graphical products of GIS.

GIS needs data. Activities to develop digital data for GIS are gathering steam. By the end of the first quarter of fiscal year 1990, the Geometronics Service Center (GSC) had approximately 3,500 quads of Primary Base map planimetric digital data. In addition, work on gathering three-dimensional terrain data is progressing. GSC has an agreement with the U.S. Geological Survey to trade Digital Elevation Model (DEM) data. GSC exchanges models produced by the Forest Service for the same number produced by the Geological Survey. Under this agreement, GSC is adding approximately 1,400 quads of DEM data each year.

Data for Forest Plans

Main sources of data for resource planning GIS are Primary Base Series (PBS) maps, along with their resource overlays. PBS represents the best source of digital geographic data available for a Service-wide GIS in a reasonable timeframe. Moreover, PBS data are probably at a higher level of consistency and accuracy than resource data. These data are applicable to such uses as strategic forest planning, cumulative effects analysis, and so on, where practical limits to map accuracy and content are of no consequence.

Data are needed that are appropriate for the level of planning and analysis. PBS will accommodate strategic levels of planning, such as Forest Plans. However, GIS is a powerful tool that we can use for more than Forest Plan-type activities. The Forest Service also expects to use GIS for project planning.

Data for Project Planning

What level of data resolution is required for project planning? This depends on the meaning of the term. If it means determining harvestability of a sale by cable logging, then current PBS data resolution should work. This is project planning in a strategic sense (or the "first kind").

However, if project planning means determining specific placement of yarders, then are data of better accuracy required? If data suitable for high-level planning (the "second kind") are used for this type of application, there might be difficulty carrying out project designs on the ground. Frustration will result from project planning decisions made with data inappropriate for this level of planning.

Digital data cannot be more accurate than its source. Most of our PBS maps were constructed to meet National Map Accuracy Standards. These standards call for well-defined, checked points to be within 40 feet (horizontally), at 90-percent probability. This is a practical limit for graphical mapping technology at PBS scale. Note that this is a "point" standard, applying to "well-defined, checked points" only. GSC estimates that few linear features on PBS maps have an actual continuous horizontal position quality that everywhere meets this point standard. The actual position error of parts of features may exceed 100 feet. Moreover, the digitizing process itself degrades accuracy, especially hand digitizing.

The vertical position accuracy of DEM's is widely variable, ranging from a few to over 100 feet. Factors such as age, photography, and instruments and techniques used affect DEM quality.

Project planning of the second kind depends on data with better accuracy or resolution than provided by PBS, which is more suitable for strategic decisions than project designs. While of little or no consequence at the strategic planning level, it is clear that, in general, PBS data are not suitable for most project design purposes.

The implied accuracy of data also is a concern. Data files commonly show coordinate values to 1 foot or less. This is fictitious resolution, better than the source. Disregarding concepts of significant figures and error accumulation in digitizing and GIS software causes misleading resolution. Resulting computer printouts to more decimal places than warranted hide the true accuracy of computed or derived data such as acreage.

Users of GIS-based information must be aware of these limitations. The level of decisions based on GIS analyses must be consistent with true data accuracy.

Graphical maps are visible and tangible. Their accuracy limitations are readily obvious. In contrast, digital data are invisible and intangible, making them more susceptible to misuse. Wrongly implied high accuracy exacerbates problems and risks of misuse. We must be careful to properly use high-level data for project planning of the second kind.

GIS is an excellent tool for project planning of the second kind. Realizing its full potential requires quality, accurate, homogeneous data. Fortunately, current technology is equal to the task. We do not need to wait for "better" sources.

Pictographs, GPS, & Analytical Photogrammetry: Serendipity for Project GIS

Of the many recent technological advances, four that occurred within approximately the past decade provide significant opportunities for land management. A synergistic relationship exists among them. The four are the wide coverage of high-altitude photography, the deployment of Global Positioning System (GPS) satellites, the maturing of analytical photogrammetry, and the development of GIS. The first three of these technologies propitiously provide an ideal foundation for the fourth.

GPS is a superb means of providing geodetic control for large blocks of small-scale high-altitude photography. This controlled photography can be processed by analytical photogrammetry to provide a splendid source of quality, low-cost data suitable for project GIS. The process yields highly accurate, three-dimensional position of *every image* on such aerial photographs. Therefore, every photograph becomes a source of accurate geodetic coordinates of a virtually unlimited number of points and objects. Position accuracy is ample for nearly all practical land management needs, reducing or eliminating requirements for ground measurement to gather project-level data.

Experience with GPS control and analytical photogrammetry demonstrates results that are better than anything possible with traditional methods. Region 6 has extensive experience with this technique, having controlled more than a half dozen such blocks of 1:40,000-scale photography by GPS. The average fit of the analytical bridges is less than 2 feet (1 sigma) in NAD-83. This is abundant accuracy for project GIS, well suited for all but only a few very special cases.

[This photograph block is a ready source of control points for other uses, virtually ending geodetic control needs (even the need for additional GPS). With this source, users can control larger scale or newer photography for projects needing ground measurements or surveys. With analytical plotters, one can measure to any practical level of *relative accuracy* by merely using photographs of different scale. For example, about 1-foot relative accuracy is possible from 1:24,000 photographs, approximately 5 inches from 1:10,000. Another advantage is that measurement accuracy is homogeneous. All features visible on the photograph are measurable for whatever purpose, including project GIS.]

A few thousand dollars will pay for controlling a block of high-altitude photography covering an entire National Forest, by GPS and analytical photogrammetry. The proper use of analytical photogrammetry bundle adjustments and intelligent control positioning is very cost-effective. For example, horizontal control for a square 200 photograph block is possible with just 20 judiciously placed stations. This means that we can provide control for 100 PBS quads (more than 5,000 square miles) covered with 1:80,000 photography (or 25 quads with 1:40,000 photographs) for about $20,000. Forests can easily save in excess of $70,000 over conventional methods of control and placement.

For project GIS, it is good business to use GPS controlled and analytically triangulated high-altitude photography. Technicians using analytical plotters can then directly digitize roads, streams, and other features from the best source of data: recent photographs. This yields data of extremely high accuracy (less than 2 or 3 meters) and homogeneity. These data are useful for project planning of the second kind GIS. Moreover, the improved data will be usable for a long time, thus saving money in the long run. The technique provides a better reference frame for resource information. Better decisions and more reliable plans and designs derived by GIS will result.

In 1983, Potlatch Corporation of Lewiston, Idaho, digitized 81 quads covering its Idaho timberlands at a cost of only a few cents per acre. Using 1:80,000 photography and analytical photogrammetry, Potlatch developed a highly accurate GIS data base of roads, streams, ridge lines, and other important features. Potlatch foresters now use these data for second kind project planning of harvest and other operations.

The Forest Service should give similar attention to quality data, at least in critical areas. There are many special areas requiring higher quality data, and it is possible to collect them before the arrival of GIS. The Forest Service should identify those areas and consider digitizing them for project GIS.

Forests now have high-altitude photographic coverage at 1:80,000 scale, and many are getting coverage at 1:40,000 scale. The only missing link is GPS control. A typical Forest covered by 50 to 70 quads can easily afford necessary control, especially if willing to enter cooperative programs with neighboring Forests or other agencies. Cadastral personnel can help with this phase.

Several Regions and GSC have the capability and capacity to perform analytical photogrammetric digitizing for those who want to make investments in quality data for project GIS. Forests should acquire these data on selected areas of high value and on activities requiring intensive planning. Regional Geometronics Leaders can make arrangements to have this work accomplished. GSC can provide counseling and information on requirements, program matters, cost estimates, and scheduling.

The Winema National Forest Chunkwood Project

Karl Buehler
Civil Engineering Technician, Chemult Ranger District
Winema National Forest, Region 6

Introduction

The chunkwood chipper was originally developed for producing hog fuel for the electrical cogeneration market. It recently has been used to determine the feasibility of chunkwood as an alternative to traditional road-building materials in the construction of low-volume forest roads. The major advantages of chunkwood are (1) conservation of nonrenewable rock sources and (2) utilization of a low-value renewable resource (unmerchantable timber).

The Winema National Forest Chunkwood Project was coordinated by the San Dimas Technology and Development Center with support from the Missoula Equipment Development Center. It was part of a Service-wide effort to demonstrate the use of chunkwood as a lightweight roadfill and road-surfacing material in low-volume road construction (see the box on page 8 for a listing of project personnel and equipment used).

Previous roads applications of chunkwood were the following:

(1) Chequamegon and Superior National Forests, Region 9—in combination with geotextiles as a lightweight fill to bridge swampland crossings.

(2) U.S. Army Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi—as a surface course in segments of the central tire inflation test track.

(3) Mississippi National Forest, Region 8—in combination with geotextiles to bridge areas of fine silt having a high water content.

(4) Kisatchie National Forest, Region 8—as an alternative to pit-run rock in wet areas.

The Winema National Forest Chunkwood Project was funded to demonstrate the feasibility of chunkwood as a dust-palliative surface course and roadbed material in typical Region 6 "Eastside" conditions.

Winema National Forest Chunkwood Project

Equipment

Chunkwood chipper—modified Morbark model 18 whole-tree chipper, developed by Missoula Equipment Development Center

Support equipment—Fremont National Forest C&M

Case W18B loader

JD 770A motor grader

Three 10CY dump trucks

Mechanic's service vehicle (which never seemed to have the part needed)

Personnel

Chunker operators/mechanics—Toby Kilger (Chequamegon National Forest, Region 9) and Ron Theall (Fremont National Forest, Region 6)

Swampers—Rob Kemry and Bill Jacobs (Fremont National Forest)

Equipment operators—Rick Dollarhide, Sam Steward, Bob Bennett, Mickey Dugan, Tony Swinney, and Roland Glade (Fremont National Forest)

Project coordinator/parts chaser—Karl Buehler (Winema National Forest)

Technical and moral support—Jim Bassel (San Dimas Technology and Development Center) and Dick Karsky (Missoula Equipment Development Center)

General Description, Eastside Conditions

South-central Oregon is located in the northern Basin and Range Province. Landforms are shaped by Pliocene Epoch faulting, which produced north-south trending basalt rims and sediment-filled basins, overlaid by airborne deposits of pumice and ash from the eruption of Mount Mazama about 7,000 years ago during the Pleistocene Epoch.

To the west, the maritime influence of the Pacific Ocean is tempered by the Cascade Range. Climate of the "Eastside" is characterized by warm dry summers and cold wet winters. Annual precipitation for the Winema ranges from 15 to 40 inches, mostly in the form of snowfall. Elevations of the higher plateaus average 5,500 feet, with the snowpack lingering until early June.

Pumice soils have rapid infiltration and permeability rates. Most runoff is subsurface; few stream courses are evident. With sideslopes generally less than 25 percent, subsurface runoff collects in the flat basins, which are characterized by stringer meadows located on poorly drained pumice soils.

The major timber communities are the ponderosa and lodgepole pine types, the ponderosa occupying the well-drained slopes and the lodgepole occupying the poorly drained basins. Ponderosa pine has historically been high-value sawtimber. Until the recent development of the chip market, the demand for lodgepole was minimal, and large stands had reached stagnation. A result of this stagnation was the mountain pine beetle infestation, which has devastated thousands of acres of eastern Oregon in the past decade. An intensive harvest plan was initiated to salvage the beetle-killed trees and to rehabilitate the lodgepole stands, using chipwood sales and commercial firewood sales.

The following two criteria were established for selection of the project location:

(1) Source of readily available, low-value timber.

(2) Road segment(s) within economical haul distance that would receive adequate commercial traffic for evaluation.

Project Description

Walker Rim, located on the Chemult Ranger District approximately 75 miles north of Klamath Falls, is typical of the Basin and Range landform previously described. This area was selected for the project.

A material source for the chunker operation was located in a stand of ponderosa and lodgepole pine that in 1985 had been precommercially thinned, sheared, and bunched. The diameter of the material ranged from 3 to 12 inches, with an average diameter of 4 inches. The bunched treelings were preskidded to designated chunker landings. Average haul distance to the project road was maintained at 5 miles.

A collector road (Forest Development Road 9409) was selected for the project. Paralleling Sellars Marsh, a large semiwet stringer meadow, Road 9409 is constructed of native pumice soils. With sweeping horizontal and vertical alignment, haul speeds on the double-lane road average 15 to 20 miles per hour (mph). Unsurfaced, the roadbed has deteriorated to a "trough" condition under heavy commercial traffic (log trucks and chip vans averaging 80,000 pounds gross vehicle weight). In its current location and condition, drainage of the roadbed is impossible because of the flat topography.

Typically, the haul season runs from late May through mid-November. A 5-foot snowpack and 15-mile haul to paved roads generally discourage winter operations in the area. With the snowpack lingering into early summer and the high water table of the adjacent meadow, the roadbed becomes saturated. Road use when the roadbed is wet tends to further deepen the trough effect. Then, with the receding water table during the dry summer, the area's sparse water sources dry up. The roadbed is pounded to foot-deep, talcum-fine pumice flour. Heavy traffic creates visibility problems as the fine pumice dust hangs in the air.

Figure 1.—Road 9409 in May 1988 (typical of saturated conditions, trough condition).

Although the current road management objectives and character of the existing road are contradictory to the vision of a low-volume road, Road 9409 was chosen for the Chunkwood Project because of its poor condition and anticipated heavy commercial use for the 1988 operating season (figure 1). Expected commercial traffic was 50 average daily traffic generated from several lodgepole chip sales in the area.

Conventional reconstruction methods to improve the existing facility would be (1) to relocate the road out of the trough to higher ground, taking advantage of cross-slopes for drainage, or (2) to raise the existing grade through turnpike construction and/or the hauling and placing of borrow material. The pumice subgrade would be reinforced by a 6-inch lift of screened or grid-rolled cinders, a common surfacing material on the Winema National Forest. The nearest identified source is 30 miles from the project area. Because of the lack of adequate water sources in midsummer, dusting would be abated by chemical palliatives (for example, magnesium chloride, lignon sulfonate, and so forth). Total reconstruction would be about $40,000 to $50,000 per mile.

Rather than use conventional methods to reconstruct the road, it was decided that the road would be turnpiked in its existing location, using wood chunks as subgrade material and as surfacing.

The original intent of the project was to produce two grades of chunkwood: a coarse grade for roadfill in areas of inadequate drainage and a finer grade suitable as a surface course. The chunker is equipped with constant-speed and variable-speed mechanisms; this configuration permits some latitude in the control of particle size produced (figures 2 and 3). By operating at maximum cutter rpm's, the Forest had anticipated that a small chunk size (3-inch maximum) suitable for the surface course would be produced, which would allow traffic to maintain 15-mph haul speeds typical of the existing facility. Although varying the cutter speeds does affect chunkwood size, the Forest was not able to produce a material meeting the surfacing criteria (particle size was 2 to 6 inches, 8-inch maximum).

Unable to produce a chunkwood suitable for a dust-palliative surface course, the Forest refocused the project on using chunkwood as a subgrade reinforcement and roadfill material in selected road segments. Roadway sites identified for treatment were characterized by areas in the high water table with drainage impeded because of the flat topography.

The work included the placement of chunkwood in 4- to 6-inch lifts to varying depths, depending on roadbed condition, and the development of a surface course. Two techniques to develop a suitable surface course were (1) road-mixing with the native pumice subgrade and (2) placing a surface layer of native pumice over the chunkwood base.

Segment I—Length 0.3 Mile

This segment of the road is in a trough condition with inadequate drainage.

Initially, chunkwood was hauled and placed to a 4-inch depth on the existing roadbed. A 300-foot segment was left exposed for compaction by hauling equipment and for evaluation as a running surface. The large chunkwood size and loose texture restrained truck speeds to less than 10 mph. The chunkwood was road-mixed with the pumice subgrade and compacted by repeated haul. A disadvantage to this road-mix method seemed to be the rough surface created by the chunkwood, and an alternate construction technique was employed.

The existing travelway was excavated approximately 6 inches, and material was windrowed to the limits of the roadbed (figure 4). Chunkwood was hauled and placed to a 6- to 8-inch depth and compacted by hauling equipment (figures 5 and 6). The windrowed material was then folded back over the chunkwood lift, bladed to the design template, and compacted (figure 7). A local native pumice borrow source was developed, and additional pumice was placed to bring the total cover to 6 inches. The additional material was placed to increase rideability and to provide a depth of cover sufficient for maintenance blading without disturbing the chunkwood base (figure 8). The roadbed elevation was raised approximately 1 foot by this procedure (figure 9).

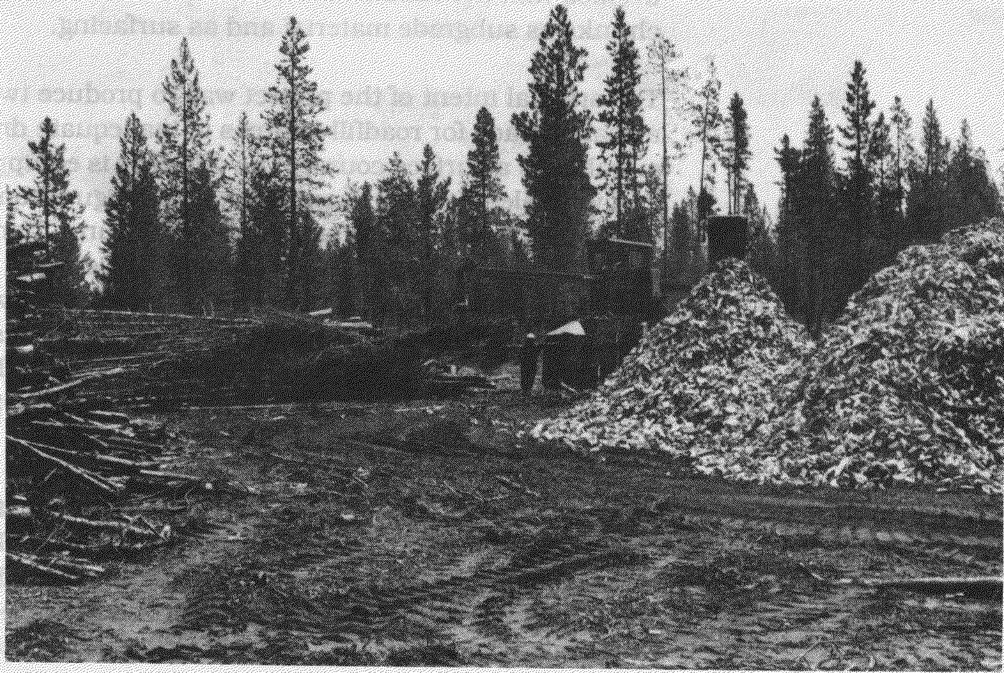


Figure 2.—Chunker operations.

Figure 3.—Chunker operations on small-diameter material.

Figure 4.—Roadbed preparation and excavation (windrowing to shoulders).

Figure 5.—(left and right) Placement of chunkwood.

Segment II (Two Sites)—Length 0.1 Mile

These segments of the road are sag vertical curves with no drainage.

Chunkwood was hauled and placed to a 1- to 2-foot depth and compacted between layers by hauling equipment. The chunkwood was capped with a 6-inch lift of pumice surfacing, bladed to the design template, and compacted (figure 10).

Observations

At the time of construction, there was adequate moisture for the roadbed to retain its template under repeated loads. Some rutting and deformation did occur as the chunkwood sections continued to compact under heavy traffic, but the integrity of the roadbed was maintained.

As the summer of 1988 progressed, the water table receded. Continued heavy traffic (83 peak daily traffic, 80,000 gross-vehicle-weight chip vans) pounded the roadbed into a dusty trough. In the chunkwood segments, the pumice surface course had dried out and had lost its cohesiveness and support. Further rutting had occurred, and the chunkwood layer had been exposed as the trucks plowed into treated areas. Conditions were further compounded by improper user maintenance in attempting to backblade with a dozer.

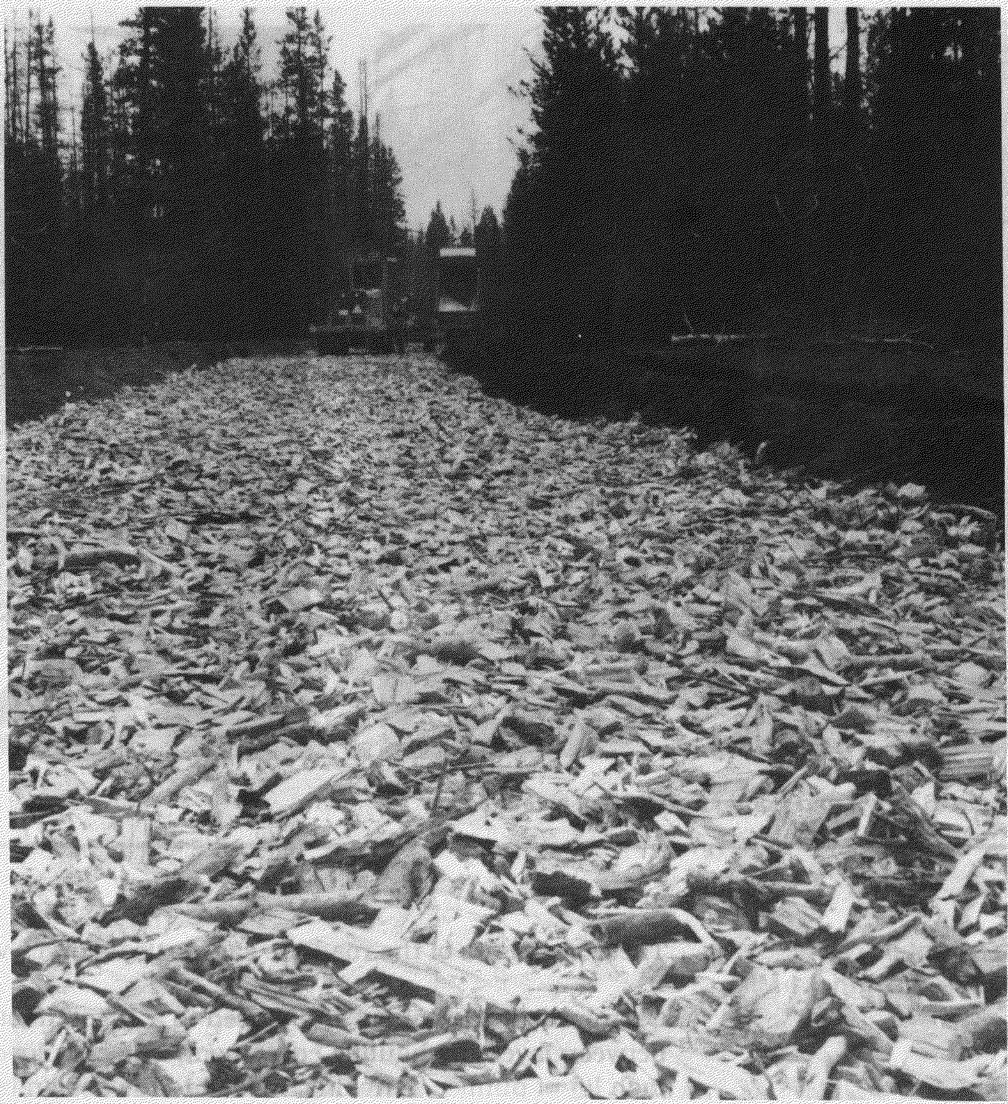


Figure 6.—Chunkwood lift after spread compaction.

These problems could have been mitigated by the trucks reducing speeds before entering the chunkwood segments, splitting their wheel tracks to heal the rutting, and proper grader maintenance. Watering was not a viable option, as water sources in the area had dried up.

As of mid-June 1989, there was still adequate moisture in the roadbed to prevent dusting. The chunkwood segments seem to have held up well under spring haul. Although the chunkwood has become exposed, repeated traffic has compacted and stabilized the mass. Rutting and washboarding has been reduced by driver education and proper blading. It is envisioned that the chunkwood segments again will deteriorate as the moisture goes out of the roadbed.

Figure 7.—Folding back windrows over chunkwood lift.

Evaluation

Although the chunkwood performed adequately as a roadfill material under heavy load, the major disadvantage of current chunkwood technology is the high projection costs associated with new technology. Operating at 60-percent efficiency because of mechanical breakdowns of the chunker, in-place costs for the chunkwood project was $60 per cubic yard ($150,000 per mile versus estimated reconstruction costs of $45,000 per mile using rock).

The chunker is capable of processing material up to 12 inches in diameter. A lot of time was wasted handling the small-diameter thinning slash; online production was 12.5 cubic yards per hour. Another problem encountered was dry wood, which generates more heat and stress on the chunker blades than green wood (figure 11). Most breakdowns were blade failures from heat buildup (warping and heat-stress cracks). Processing large-diameter green material would increase production and reduce wear-and-tear on the chunker. Currently, however, this material is in high demand for the wood chip market.

Dust abatement of low-volume roads is not normally required. These roads are constructed and maintained for low-traffic densities and haul speeds. Dusting becomes a critical safety problem when traffic densities and haul speeds increase. As a surface treatment, the chunkwood did effectively reduce dusting by forcing the trucks to lower their speeds. The use of wood chips as a dust-palliative surface course would have been preferred, as the

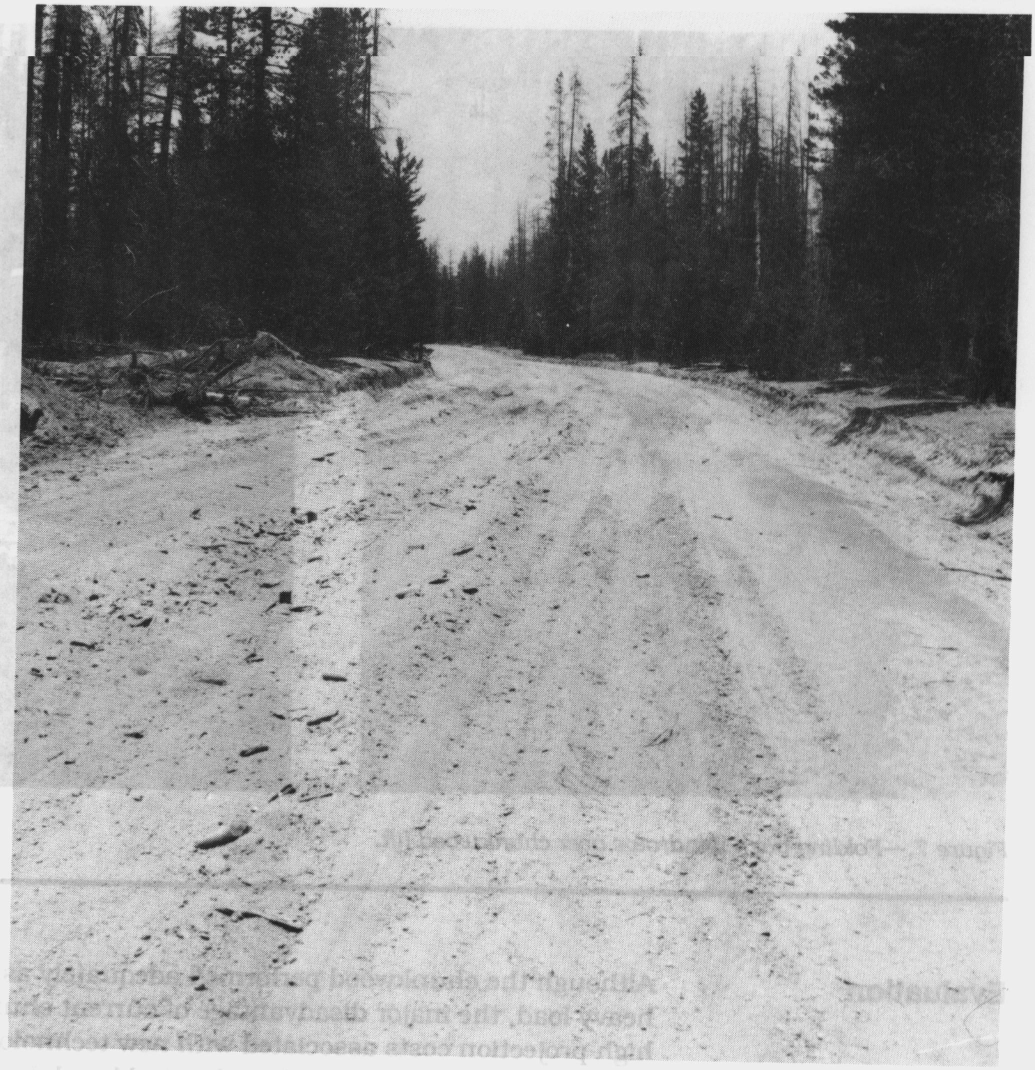
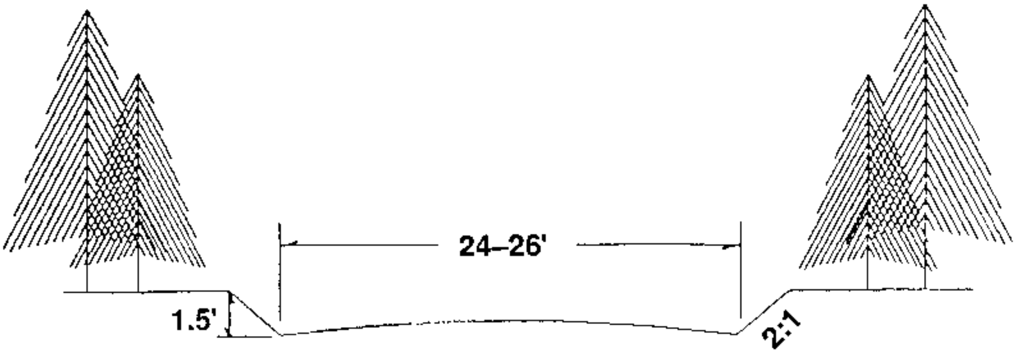


Figure 8.—Segment I 2 weeks after placement (note the dry conditions, rutting, and exposed chunkwood).

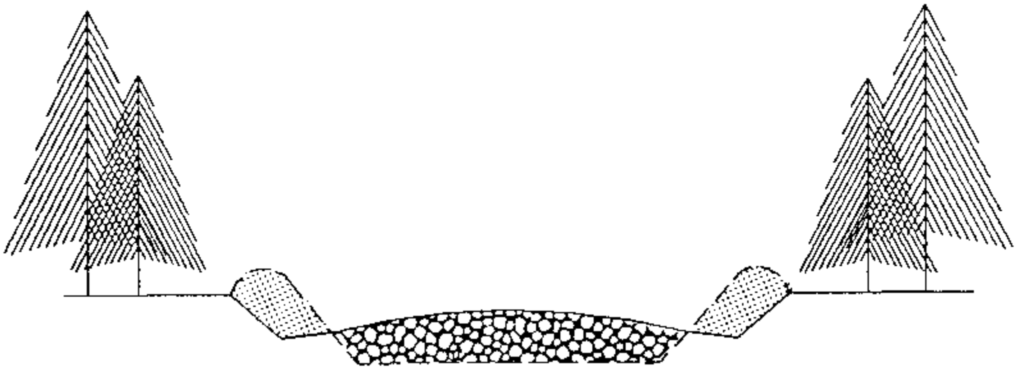
smaller particle size would not impede the existing traffic flow and also would be cheaper than chunkwood.

Conclusion

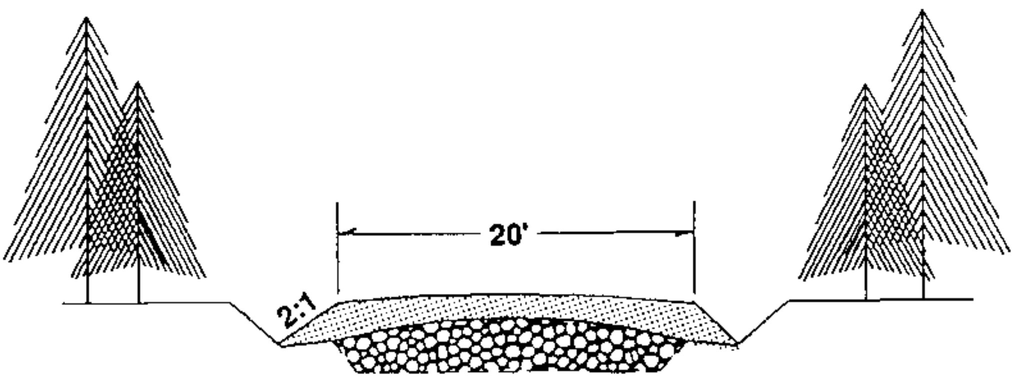
The effective use of chunkwood has been demonstrated in low-volume road construction in the wetlands of Regions 8 and 9. The most notable advantage is the use of low-value renewable timber resources, conserving high-value nonrenewable rock resources for the construction of collector and arterial roads. With the current high cost of the chunkwood technology and relative availability of borrow material in Region 6, the Winema National Forest foresees limited application for chunkwood.



Existing Roadway In "Trough" Condition



Subgrade Excavated Approximately 6 feet and Windrowed to Shoulders; Chunkwood Placed in Excavation Zone, Depth Approximately 8 feet



Windrows Folded Back Over Chunkwood; Additional Material Placed To Achieve 6-foot Surface Course

Figure 9.—Typical construction details of Road 9409, Segment I.

Figure 10.—(left, middle, and right) Segment II 2 weeks after completion in June 1988. Chip van approaching chunkwood segment (note the dust and rutting of the chunkwood section).

Figure 11.—Chunkwood deck (note small-diameter, dry material).

Swing in the Backcountry: Removable Suspension Foot Bridges

J. Heather Woll
Civil Engineer
Mt. Baker-Snoqualmie National Forest, Region 6

Introduction

In August of 1988, the Mt. Baker Ranger District trail crew completed construction of the Mt. Baker-Snoqualmie National Forest's first removable suspension foot bridge. It was an exciting project, filled with new challenges for all personnel involved. Its proven success has made it a prototype for bridges planned in two other locations on the District.

What is so special about this bridge? First, it is removed over the winter so snow loads are not a design consideration. Second, it is composed of small lightweight materials, which can be easily packed or flown to remote sites. Third, it looks rustic, with no orange-painted steel or shiny aluminum to destroy a lovely backcountry setting. Finally, visitors love it! It adds a challenge (they must concentrate) equal to the trail difficulty level; yet it is a structurally sound facility.

Removable cable foot bridge over Rocky Creek.

Background

The Rocky Creek crossing on the Park Butte Trail on the south side of majestic Mount Baker has long been a problem area. Nearly every year, the creek changes its channel within a wide floodplain, and fording the creek is never easy. The previous aluminum channel bridge that had to be repositioned each year with a 12-plus-person crew had been lost to flooding during the winter of 1985–86. A positive aspect of this site was that it was not in a Wilderness Area, so helicopter assistance could be used.

Looking for a solution, the removable swinging bridge idea came from the Stehekin Area of the North Cascades National Park. Requesting information from the National Park Service, the Forest learned that these bridges were common in the Glacier and Mt. Rainier National Parks as well. However, only a rough conceptual design was available, and to gain Forest-level support for the project, the Forest needed an engineered design.

Survey & Design

Using the Park Service drawings and some handwritten notes, the District Engineering group calculated design loads, cable tensions and sizes, and anchor sizing and design, and personnel checked the adequacy of the 2 by 4 decking. Under Engineering direction, the trail crew surveyed the proposed bridge site. Various pier designs were drawn up, and each was examined carefully. The design had to relate to the landscape in scale and proportion. It had to be something the trail crew could build. Finally, it had to be transportable with easy assembly at the site. Table 1 details the primary design elements determined in the design (figure 1).

The east pier of Rocky Creek Bridge.

Table 1.—Design specifications.

Clear span	50 feet
Design live load	100 pounds per lineal foot
Design sag	4 feet
Freeboard	2 feet
Main cable tensions	5,550 pounds
Size	0.5 inch (use improved plow steel)
Handrail tension	1,000 pounds
Size	0.25 inch (use plastic-coated cable
Handrail cable height	42 inches
Anchor block size	5 feet by 5 feet by 3 feet
Weight	11,250 pounds

Hardware

The actual hardware used was determined by the construction foreman in cooperation with Engineering (figure 2). With two possible exceptions, all these materials are customarily stocked by local hardware stores and available at a reasonable cost. One exception, the 5-foot eyebolts, which had to be specially fabricated (four bolts at $50 per bolt were $200), were the most expensive items. J-bolts are often available, but these were fabricated (72 bolts at $2 per bolt were $144). It is crucial that these J-bolts tightly hold the decking to the main cable to preclude slippage and buckling of the deck sections.

Hydraulic hose has proven very effective as a collar for the main cable to protect the pier logs. It also was inserted in the handrail post holes to prevent downward splitting of the cedar posts.

Construction & Installation

The construction schedule, labor effort, and approximate out-of-house costs are shown in Table 2.

Costs

The total cost for this project was $10,000. This included $5,250 for a force account construction crew; $3,050 for materials, helicopter, and concrete truck; and $1,700 for survey, design, inspection, and administrative costs.

Yearly Maintenance

In the fall, just before the first snow, a two-person crew spends just 2 hours dismantling the cable structure. The 6-foot deck sections (figure 3) are rolled up and carried away from the stream channel and public traffic. On top are placed the cables and a 5-gallon bucket containing j-bolts, some replacement items, assembly and disassembly instructions, and a few handtools. A black plastic tarp covers the hibernating bridge until it is restrung the following summer.

Table 2.—Work schedule.

Work completed	*Time and labor*
Fell, bucked, and peeled 20 cedar trees (8-inch to 12-inch diameter) for piers; transported logs to warehouse shop	3 days, 2 persons
Bought decking 2 by 4's, cables, rebar, and hardware ($1,200)	2 days, 1 person
Built piers, log cabin style, in warehouse shop; drilled for spikes and numbered pieces when tearing down; fabricated decking in 6-foot sections	9 days, 2 persons
At bridge site, leveled for piers and dug or blasted holes for anchors; built forms and rebar cages for concrete anchors	6 days, 4 persons
Transported materials to trailhead and tied in sling loads of 700 to 800 pounds for helicopter transport	2 days, 2 persons
Concrete delivered to trailhead ($650); Hughes 500D helicopter delivered concrete (40 trips) and sling loads to bridge site ($1,200)	3 hours
Completed deadman anchors; assembled piers, spiking and filling with rock; strung main cables and placed deck sections; strung handrail cables and zigzag lacing; buried deadmen, cleaned up site, and dug new trail to bridge; signed for foot bridge versus horse ford	3 days, 4 persons

Assembly takes two people a half day. First, the main stringer cables are attached. Then the decking sections are fastened with J-bolts to the main cables as O-rings are strung out for later attaching the zigzag cable. The handrail cables go on next and finally the zigzag cable.

Installation Experience

A sag of 5 to 10 percent of the clear span length is recommended. This past year, the bridge was installed with a 2-foot sag. This put considerably more tension in each cable, and the crossing was much too springy. When the deck was dropped to the designed 4-foot sag, the bridge was much more stable. If even more stability is desired, lateral guylines to the bank could be tried. Vertical bars between the main and handrail cables also would increase stability but must not inadvertently shift the load to the handrail cable through improper tensioning.

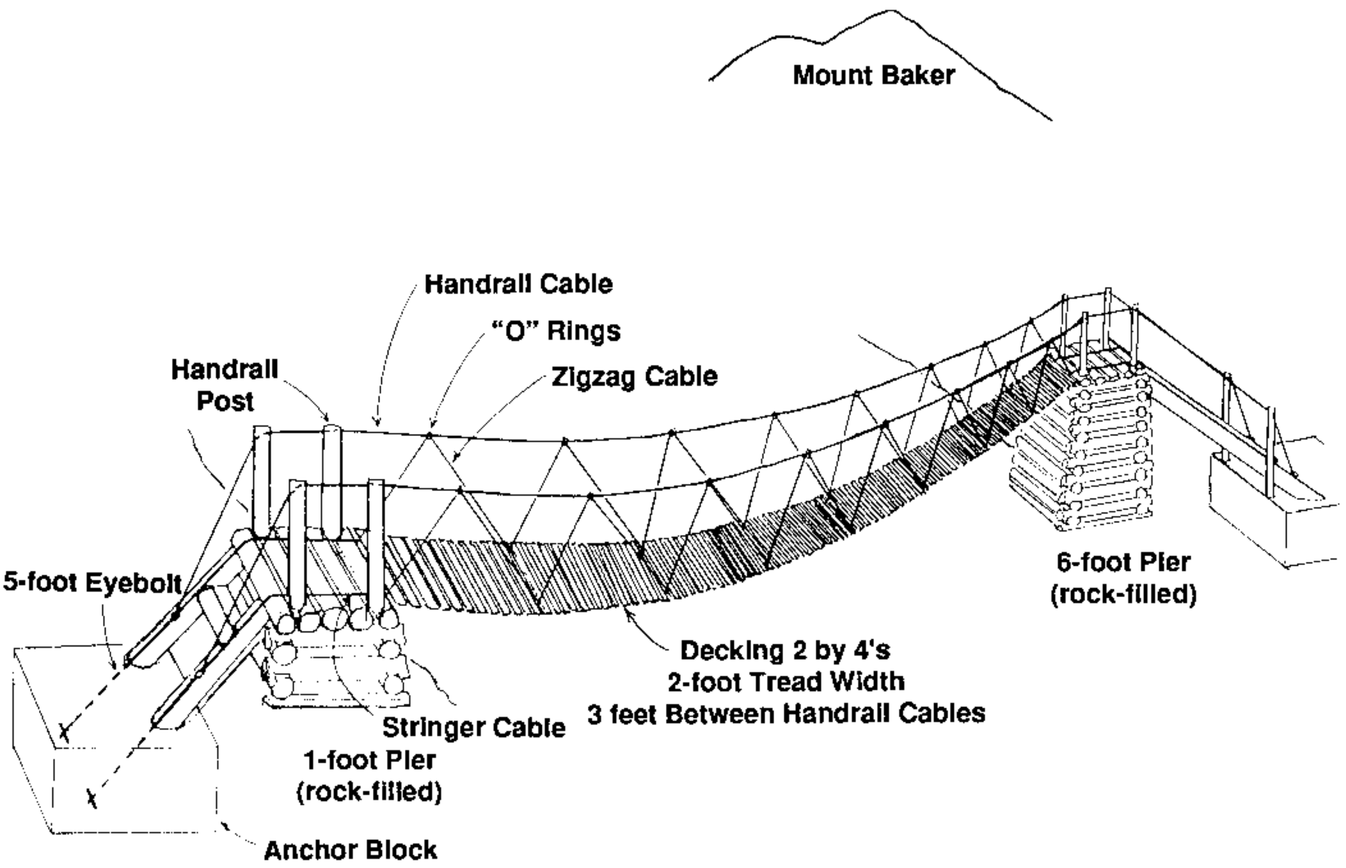


Figure 1.—Design plan of the Rocky Creek Bridge.

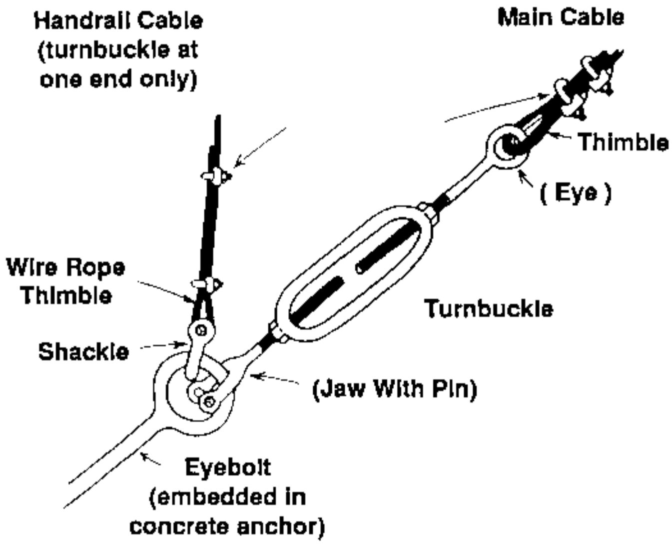


Figure 2.—Hardware assembly.

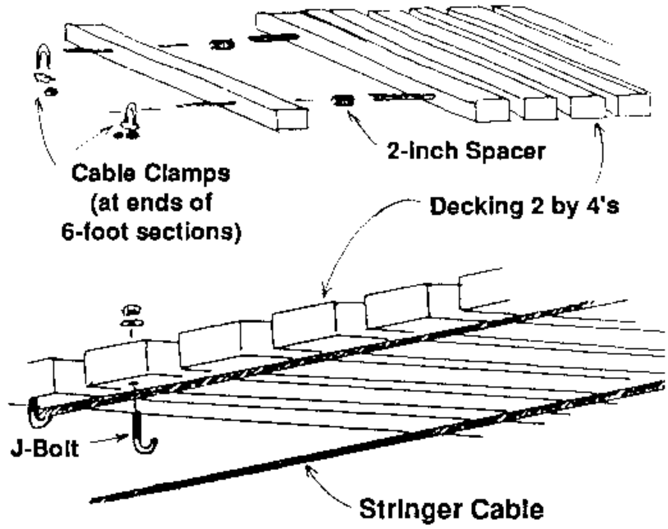


Figure 3.—Decking sections.

Hardware assembly at the west pier of Rocky Creek Bridge.

Looking west from the east pier of Rocky Creek Bridge.

One of the important lessons learned was the necessity of installation instructions. Trail crew personnel are apt to change over the years, so clear and detailed instructions will help circumvent the need for repeated attention to the structure during the busy summer recreation season.

Conclusion

This removable bridge can be a perfect answer in some localities where it is undesirable to design for snow loads or excessively high streamflows and where a separate ford can be provided for stock. Yearly installation and removal are quick and easy, and bridge parts can be stored near the site. Most rewarding for the Forest has been the positive public feedback received. In these times of less funding, this in-house project not only saved money, but also provided a fertile ground for motivation, working together, and creative problem-solving ideas.

Appreciation is extended to members of the District Engineering and Recreation Staffs who provided detailed information and drawings and who reviewed this manuscript and provided many useful suggestions.

Status of the Fiscal Year 1989 Timber Bridge Initiative in Region 2

Royal M. Ryser
Assistant Director
Region 2

On November 3, 1988, a Service-wide meeting was held to discuss the then upcoming Timber Bridge Initiative. Some of the stated objectives of the Initiative were (and are still) to develop and demonstrate new timber bridge technology, use local timber species, provide economic bridges, diversify local economies, and develop new industries.

In late November 1988, the Chief's Office notified the Regions that the program was approved and that project proposals were being solicited. Proposals were sent to the National Timber Bridge Information Resource Center in Morgantown, West Virginia. Region 2 immediately began to solicit proposals from the National Forests. In addition, contacts were made with the State foresters' offices to increase the possible number of submittals. From the beginning of the program, Engineering and Timber Management personnel cooperated in the effort, with Engineering taking the primary lead. Engineering worked through the National Forests in the Region, while Bill Ripley, from Timber, worked through the State foresters' offices. In addition, Clare Mitchell, the Zone Forest Products Utilization Specialist from Region 4, helped a great deal.

This solicitation resulted in 12 proposals, of which 6 were received for Colorado projects, 1 for South Dakota, 2 for Wyoming, 2 for Nebraska, and 1 for Kansas. The 6 best were forwarded to Morgantown. The proposal from Kansas was tentatively approved in the first round of selections. The other proposals needed some additional work, and 2 were resubmitted. In the second round of selections, the Kansas bridge received final approval, and a bridge in Colorado and one in Nebraska also were approved.

During the final proposal preparation stage, Regional Structural Engineer Dick Kasel and I visited the proponents to help them refine their submittals. This was vital to final selection, because the proponents were rather uncertain as to how to follow the somewhat incomplete direction that had been issued to us. By working together at the bridge sites, proposals were developed that met the criteria and objectives of the program. Local entities were very interested in the program, and particularly in the use of timber as a bridge-building material. Also, during this development period, we learned of an unwritten criterion—the direct involvement of U.S. Senators and Representatives in the projects. All three selected projects had high-level interest by their respective delegations, as evidenced by phone calls from several of them.

The three bridges selected are fascinating. All are on county roads; none is within National Forest boundaries.

The Kansas bridge is located in Neosho County in southeast Kansas (figure 1). It will be a three-span bridge, 116 feet long. One span is being constructed with native Red Oak, using a posttensioned, longitudinally laminated deck. The other two spans will be dowel-laminated Douglas-fir. Construction will be completed in the summer of 1990, and a workshop will be held sometime shortly thereafter, in conjunction with the Kansas Technology Transfer Center and others.

The bridge in Nebraska is in Hall County (figure 2) and will have three spans making up its 100-foot length. The 50-foot center span will be posttensioned, longitudinally laminated Douglas-fir, placed on top of steel stringers. The two 25-foot approach spans will be of similar construction, without the stringers. It will be completed in the spring of 1990, and a workshop will be held with the assistance of the Nebraska Technology Transfer Center.

In Colorado, the bridge project is located in Pueblo County (figure 3). The bridge will have a single-span, longitudinally laminated, posttensioned deck, 32 feet long, made of Douglas-fir. It will be completed during the annual meeting of the National Association of County Engineers on March 29, 1990. A field day and workshop will be developed around that completion, in co-

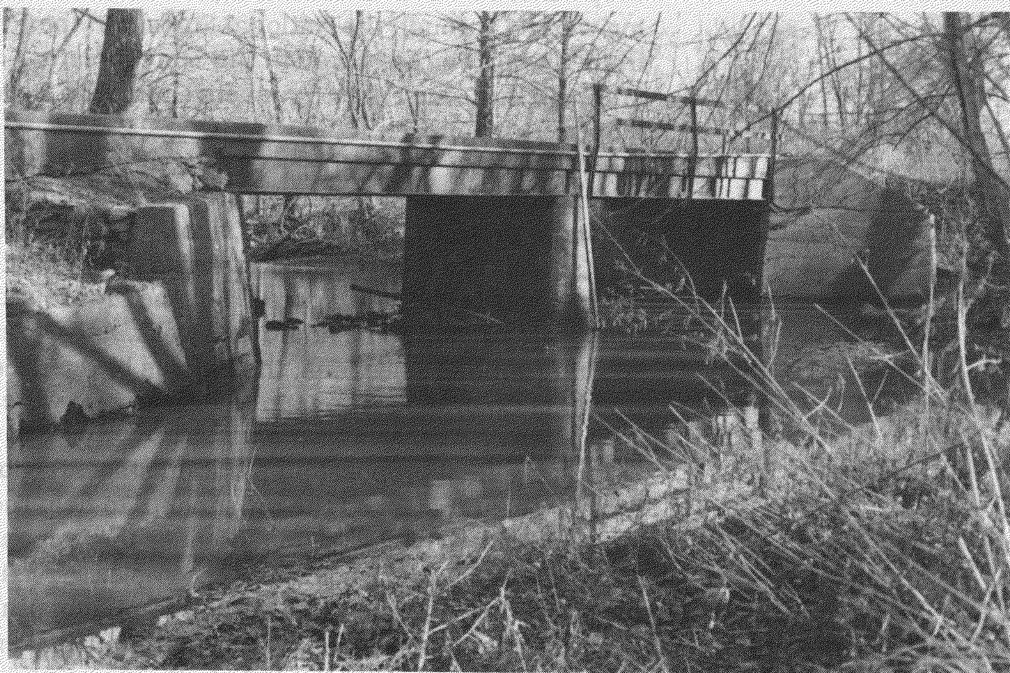


Figure 1.—The Kansas bridge before replacement.

Figure 2.—The Nebraska bridge before replacement.

Figure 3.—The Colorado bridge before replacement.

operation with the Colorado Technology Transfer Center. By incorporating the demonstration into the annual meeting of this particular group, a very large number of interested engineers will be exposed to the Timber Bridge Initiative and its objectives.

We learned some useful points about both the process of this program and the technology to be implemented. The expectation that these projects be completed in calendar year 1989 was too optimistic for a number of reasons. First, there are few engineering firms that can provide modern timber bridge designs, because they are unaware of current technology and not experienced in its use. Second, timber materials and treatment facilities are scarce in some parts of Region 2. For example, it takes 200 days to locate, manufacture, and treat red oak of this size and volume. Although the State of Kansas harvests some 54 million board feet of hardwoods per year, there is no pressure treatment facility in the State, so treatment has to be done elsewhere. The cooperators had to be contacted periodically to help them adhere to a completion schedule. A seed money program such as this is interesting to the county organizations with which we worked, particularly those that do not have much funding.

Finally, county engineers, in particular, are interested in using timber as a bridge-building material. While the Forest Service has continued to build timber bridges over the years, many governmental agencies stopped doing so years ago. This program reintroduces the material, and it has been well received by those who are participating in it. We were gratified that the cooperators put up $2 of their money for every $1 of Government money.

We were pleased that the Kansas sponsor set up a meeting with the Kansas Department of Transportation and others to share information about the Timber Bridge Initiative and timber as a bridge construction material. Ken Johnson, of Wheeler Consolidated Industries, and I were the program speakers. Some 35 people attended, including the State forester of Kansas, a number of Kansas Department of Transportation engineers, Soil Conservation Service employees, Federal Highway Administration employees, several university people, county engineers, and some county commissioners. Since the meeting, I have had two followup contacts regarding the use of timber.

It seems that the Timber Bridge Initiative is well under way. If it continues after fiscal year 1990, it is likely that significantly more agencies will begin to build timber bridges, particularly counties. Therefore, it seems that the primary objectives will be reached.

Removal of Vinyl Asbestos Floor Tile

Robyn Horner
Environmental Engineer
North Central Forest Experiment Station

Introduction

Vinyl asbestos floor tile is a nonfriable form of asbestos that is found in many buildings constructed in the 1960's. It can be identified by its characteristic 9-inch by 9-inch size. When the tiles are sanded, chipped, or broken up, the asbestos can become friable and create a potential health problem. Often, the mastic used to adhere the tile also contains asbestos.

The Problem

Floor tile removal was required in the renovation of approximately 850 square feet of office space at the North Central Forest Experiment Station Headquarters. Before removal, the tile and mastic were first tested to determine whether they contained asbestos. The tile tested positive (5 percent chrysotile asbestos), and the mastic tested negative. The next step was to determine appropriate removal procedures. The Station consulted with various asbestos abatement contractors and State agencies, all of which had differing opinions. No one was willing to recommend a procedure, only to give suggestions. Most suggested extremely conservative approaches, such as those required for removing much more hazardous friable types of asbestos. However, the potential hazards from removing floor tiles did not seem to warrant such extreme precautions or the attendant high costs. One contractor quoted $10,000 for the 850 square feet of tile removal.

Guidelines

Late in the planning stages of our project, the Minnesota Department of Health came out with guidelines for removing tile. These guidelines stated that tile could be removed under the supervision of a competent person using wet removal methods. Air monitoring also was required for the first tile removing job to determine whether the work procedures being used generated area fiber levels greater than 0.01 fiber per cubic centimeter (f/cc), which is the area clearance level, and personal breathing zone levels greater than 0.1 f/cc, which is the OSHA action level. Air monitoring on similar tile removing jobs is not required if the monitoring on a prior job showed acceptable levels lower than those outlined above.

Ministudy

To determine how much asbestos would be generated during tile removal and what level of precaution was needed, the Station turned this project into a research ministudy. Station personnel were used so the Station could have complete control of procedures, adopt a conservative approach, and perform extensive air monitoring. In this way, the Station would be protected should the airborne asbestos levels prove high, and personnel would have good information for planning similar projects in the future.

Workers

Three people were used to remove the tile, two of whom had at least 24 hours of asbestos training. Delta Industrial Hygiene was contracted to perform the air monitoring, which included background samples, area and personal samples, and final clearance samples.

Removal Process

Two days before tile removal, the entire area was wiped with water to eliminate any excess airborne nonasbestos fibers. The ceiling, doors, air vents, and radiators were polyed. A decontamination area also was set up at the entry. It consisted of two overlapping sheets of plastic, 4 feet of space, and two more sheets of overlapping plastic. This created a dead air space between the plastic sheets. The floor was flooded to aid in loosening the tile. One day before removal, Delta Industrial ran background air samples on the removal area and adjacent areas to determine a reference level. Again, the floor was soaked with water.

On the day of removal, the air supply vents to the removal area were turned off, as well as any electrical outlets in or near the floor. All the equipment needed for the removal was placed inside the abatement area. For protection, workers wore half-mask respirators and disposable suits. Removal began by wetting the tile with a wetting agent. Tiles were then removed by using wide wood chisels and hammers to pry them up without breakage. The tiles were wet down as they were removed and then boxed and bagged for disposal. Work area and personal breathing zone samples were collected, as well as adjacent area samples.

After all the tiles were bagged, the excess water was mopped up off the floor. The floor was then encapsulated with a commercial asbestos product to lock down any loose asbestos fibers. Contaminated suits were removed in the decontamination space and bagged. After the encapsulant had dried, aggressive air samples were taken.

Results

The background samples showed less than 0.01 f/cc. The personal sample taken during removal was at 0.01 f/cc, which is much less than the OSHA action level of 0.1 f/cc, and the area sample was less than 0.01 f/cc, which is the clearance level required. All the clearance samples were below 0.01 f/cc, so the plastic was removed from the abatement area. The following is a summary of air monitoring results:

Type of sample	*f/cc of air*
Background (5 samples)—before work	<0.01
Personal sample—during work	0.01
Adjacent areas—during work	<0.01
Work area—during work	<0.01
Final aggressive samples—after completion	<0.01

The total cost of the removal project was approximately $2,000, which included the protection equipment, the removal and sealant products, and the worker salaries.

Conclusion

The best way to prevent fiber release is to use plenty of water and gentleness. Provided that difficult tiles are not encountered, very little fibers are released during removal. The wet removal method (with a wetting agent, poly containment on air ducts and entries, protective clothing, and half-mask respirators) will be used on future projects. Because of the low level of fibers released, similar floor tile removal jobs throughout the Station will not require the use of air monitoring. These precautions are still quite conservative but within a reasonable cost range for Forest Service purposes.

Control for Block Analytical Photogrammetry at GSC

Wayne H. Valentine
Group Leader, Photogrammetry
Geometronics Service Center

Introduction

Analytical stereoplotters can form perfectly good stereomodels without any control. But without some means of relating models to ground, such models are useless for survey purposes. Everyone who needs to, knows this. Included in what everyone knows is a lot of folklore on the subject of ground control for block photogrammetry. It comes as a holdover from the analog/strip adjustment days. The advent of rigorous bundle adjustments brought about by analytical photogrammetry has necessarily deepened our understanding about control sources, reliability, treatment, and so forth. Some of our new understanding is contrary to folklore.

Purpose

The four functional purposes of control are to provide scale, orientation, position, and level for stereomodels. Horizontal ground distances provide scale in both horizontal and vertical directions, grid coordinates provide orientation and position, and vertical control provides level. In reality, one may derive useful measurements for a particular purpose from a stereomodel with "inadequate" control. Measurement need should dictate control adequacy.

Analytical photogrammetry yields very precise *relative* measurements, even when control elements are not very accurate. This was overlooked in the past when eliminating individual control points from aerial triangulation solutions, solely because of comparatively large residuals. If project needs are for relative accuracy—for example, a road survey job or a site map—then a large root mean square error (rmse) in an aerial triangulation bridge need not necessarily be of special concern, providing individual residuals are related to position quality of control and not blunders. Even with a large rmse, scale may be accurate enough for relative measurements. However, if the project objective is to develop a coordinate data base for Geographic Information System (GIS) purposes, then functions of positioning and orienting with respect to a grid system are actually more critical. In this case, weighted rmse is more important than individual residuals.

Horizontal Control

Density

In the strip/polynomial adjustment days, the theory was "more control points are better." A block completely saturated with horizontal points offered opportunity to manipulate the bridge. Photogrammetrists spent much time eliminating "bad" points to lower overall rmse and reduce high residuals.

The folly of this practice is disclosed by bundle adjustments. Bundle adjustments are mathematically rigorous, as opposed to polynomial adjustments, which allow (or introduce) warping of solutions to fit spurious points. The chance for blunders in location or coordinate values increases with many points. It takes much time to isolate and remove mistakes of this nature. If they are not found and removed, the validity of the whole process is unknown regardless of the rmse. In addition, it takes time to incorporate points into bridges. Unnecessary control wastes time and money. Moreover, an erroneous sense of quality often comes from performing many iterations of a mathematical process. The overall scale, position, or orientation by these manipulations is not necessarily improved.

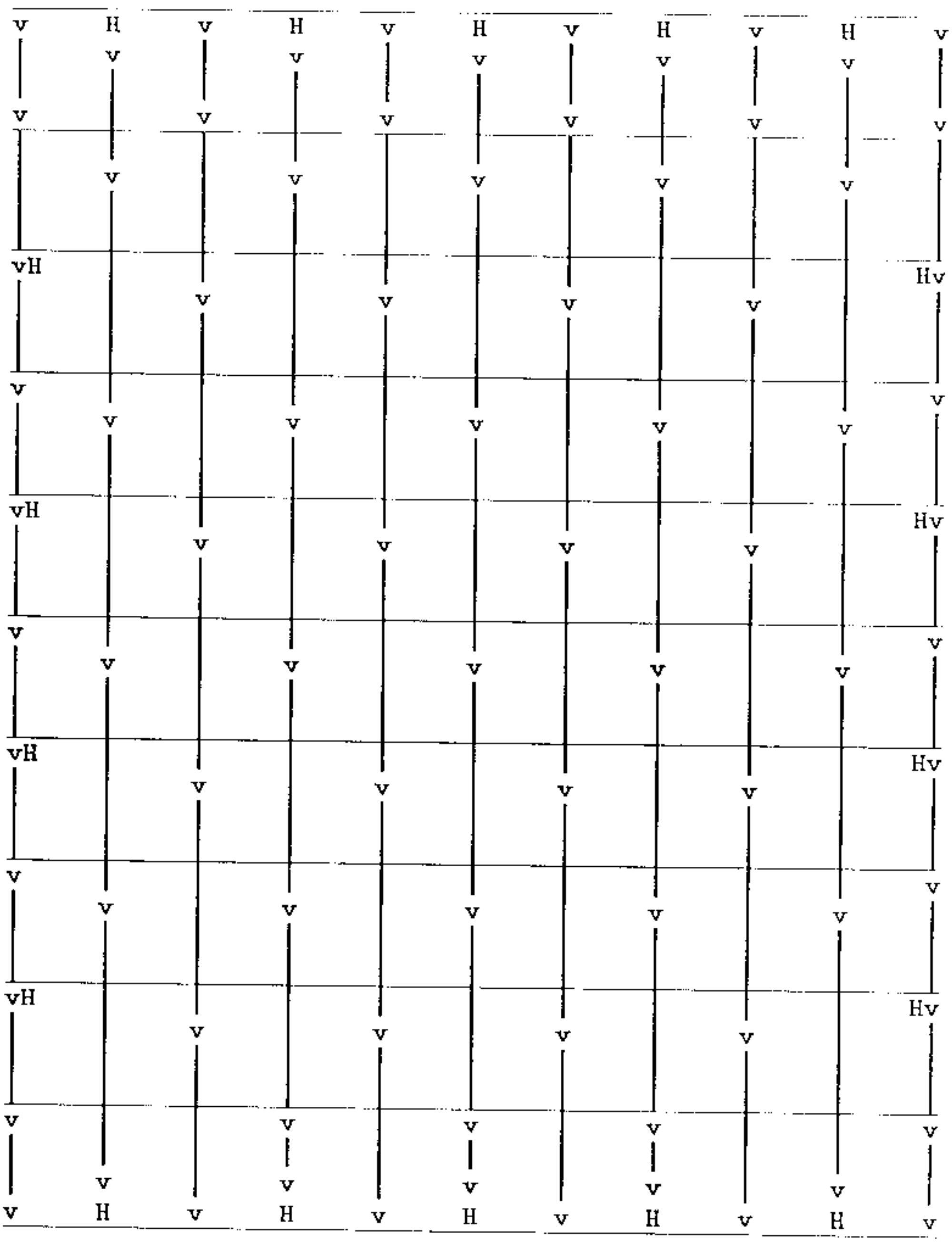
Research has amply shown that point-saturation is unnecessary with bundle adjustments. Perimeter control achieves excellent results in scaling, orienting, and positioning, with *no* interior points. This is so because of internal precision possible with analytical photogrammetry. Two single points common to two strips, one on each end, suffice for control along flight lines. Edge points about every five models are enough for sides. See figure 1 for a control diagram showing minimum needs for a 200-model block (which, at 1:80,000 scale, will cover 100 quads). Note that this is substantially fewer points (75 to 80 percent) than formerly employed in a block of this size. We spend time more profitably by ensuring that control is blunder-free and properly weighted than by garnering a great number of points of unknown quality for purposes of later computer games.

The Geometronics Service Center (GSC) recently verified this by computing a bridge on a large block two ways, once with traditional horizontal point saturation and once again with only perimeter control. Rmse was actually improved and interior discrepancies were no worse with perimeter control. Perimeter control required only 53 points versus 380 for full interior—an 86-percent reduction.

Sources

The best source of horizontal control available today is Global Positioning System (GPS) stations in NAD-83. Absolute position quality of such points can be 1 foot or less, providing proper procedures are used. This is much better than first-order stations in NAD-27, primarily because of 27 network distortions that are especially prevalent in mountainous areas. Unfortunately, GPS-83 is not yet widely available. However, the situation is rapidly changing as more satellites are being launched and cheaper receivers are becoming available.

MINIMUM HORIZONTAL PERIMETER CONTROL REQUIRED
MINIMUM VERTICAL CONTROL REQUIRED



H = Horizontal 18 Positions
v = Vertical 83 Positions
2 Models of 80K per quad (each rectangle = a quad)

100 Quads
200 Models
210 Photos

Figure 1.—Control placement diagram (quad centered 1:80k).

NAD-27 is the datum on which our maps are built and that will be used for GIS in the near future. The best source of NAD-27 data is HAP (1:80,000-scale high-altitude photography), bridged using first- and second-order control. The position quality of such points is 5 to 10+ feet. The U.S. Geological Survey has several large blocks of this bridged photography available.

The points digitized from Primary Base Series (PBS) quads are satisfactory if points are "well defined" (from original mapping) and of recent vintage. The position quality of such map points is probably no better than about 20 to 25 feet. The results from this control source will at least be compatible with current GIS data.

The points from modern field surveys are generally precise, but geodetic ties are often lacking or of unknown quality. Nevertheless, a competently performed field survey will provide excellent control for scaling. The point quality of such surveys is often less than 1 foot. The key word here is *competently*. Much trouble has occurred with field surveys containing embedded blunders, which are extremely difficult to detect.

Vertical Control

Overview

Vertical measurements are fundamentally different from horizontal ones. The vertical is one-dimensional and unidirectional, and the range of values is much smaller. Thus, it is possible to measure with greater practical precision. Therefore, it is probably much more accurate overall. Moreover, blunders in values and positions are less likely. Gross mistakes in values are easier to spot. Figure 1 also shows placement of vertical control points. Notice the pattern of internal distribution, which is necessary to prevent twisting of strips.

Sources

Some have wrongly placed map elevations in the same quality category as horizontal control scaled from maps. This is unfortunate, because even for general large-scale site mapping and for all small-scale work, the best source of readily available vertical control is "map black" found on quads. Elevation values given in black are from spirit leveling conducted along rivers, railways, and highways, to high standards of precision. They have an accuracy better than 1 foot. Values shown in brown are of lesser accuracy, but even these are probably within 3 feet or less.

GPS is not, at this time, a good source of vertical control. This is because GPS gives spheroidal heights, and not geoidal (sea-level) elevations. All our current topographic mapping refers to sea level defined as National Geodetic Vertical Datum (NGVD) of 1929. Relationships between GPS heights and NGVD-29 have not been well modeled, especially in mountainous areas.

Elevations from field surveys are generally reliable. Elevation busts are detectable, providing that enough redundant points are available.

Weighting

The proper weighting of all control used in bundle adjustments is essential. Otherwise, results suffer a loss of validity. The control from different sources has different accuracy. With differentially weighted control, individual residuals have less meaning, unless residuals are excessively beyond accuracy values specified. Because of this, unweighted rmse also is of little use in assessing the quality of results.

Weights vary inversely as the square of point accuracy. Therefore, it is important to assess accuracy values carefully, because they significantly affect weights and consequently the validity of results. Accuracy is expressed in terms of 1 standard deviation.

Table 1 provides some typical accuracy values for common sources of both horizontal and vertical control.

Summary

The best horizontal control for block photography is GPS in NAD-83. If results are required in NAD-27, the conversion is made after bridging. This avoids introducing NAD-27 warpage into the bridge. The next best is HAP bridged in NAD-27. The least accurate in position are points scaled from maps, but even these can provide adequate scale, and positions will be as good as source maps. Control placed on the perimeter of blocks is the preferred technique.

Map black elevations provide a ready, accurate source of vertical control. GPS is not used for vertical control, unless the geoid-spheroid relationship has been competently modeled locally.

Table 1. Typical accuracy values for horizontal and vertical control sources.

Control	*Typical accuracy (feet)*
Horizontal	
GPS	1.0
HAP bridge	5–10
7.5-minute quad meeting NMAS	20 +
15-minute quad meeting NMAS	60 +
Field survey	Use rmse from least-squares adjustment
Vertical	
HAP bridge	<3.0
MAP black	<1.0
VABM	<2.0
Map brown	<3.0
Field survey, spirit levels	<0.1
Field survey, trig levels and EDM	<0.5
Survey altimeter	10 +

It is folly to overcontrol; it is better to strategically place perimeter control of consistent quality than have large numbers of variable quality points scattered throughout. For a typical 200-model rectangular block with ten strips, approximately 20 horizontal perimeter points and 85 to 90 well-positioned vertical points are enough. Any more is a waste of time and energy (figure 1).

Individual residuals are examined against expected point accuracy. Discrepancies greater than approximately 3 times the expected point accuracy are checked for possible blunders. Rmse of several points of different accuracy is of no value in assessing the overall aerial triangulation quality. The standard deviation of unit weight is the proper criterion for this assessment.

Naming the Land We Care for: Centennial Celebration of the U.S. Board on Geographic Names, 1890–1990

Roberta M. Quigley
Staff Cartographer, Washington Office
Deputy Member, Board on Geographic Names

The Centennial Celebration of the Board on Geographic Names marks a significant milestone in the history of our country. The geographic names document the westward expansion and exploration of western territories.

After the Civil War, mapping programs and scientific investigations conducted by the Government increased dramatically. Maps and reports were written and contained many place names that showed variations. The problem of inconsistent geographic name usage among Federal maps and other publications became a subject of discussion among several cartographers, geographers, and publications personnel. The accuracy of the large number of names, their spellings, and their applications became a serious problem to mapmakers and scientists who required nonconflicting geographical nomenclature.

President Benjamin Harrison was approached by the concerned professionals about establishing a special organization to arbitrate questions about names and to establish official or standard names used in Federal publications. As a result, President Harrison signed an executive order on September 4, 1890, establishing the U.S. Board on Geographic Names and provided that, "To this Board shall be referred all unsettled questions concerning geographic names which arise in the Departments, and the decisions of the Board are to be accepted by these Departments as the standard authority in such matter."

In 1906, President Theodore Roosevelt expanded the responsibilities of the Board, including not only adjudicating name conflicts but standardizing all geographic names for public use (such as name changes and new names).

Forest Service Involvement

U.S. Department of Agriculture participation began with John Hype on November 20, 1899, and Forest Service representation began with Fred G. Plummer on June 4, 1908. The Forest Service has been active on the Board for many years and has been influential in many name cases. The Forest Service will be participating in the Centennial Celebration by displaying an exhibit in each Region depicting unique features specific to that Region. The exhibit will be displayed at each Region for a 2-week period and will be on display at the USDA Administration Building during the week of September 3, 1990. The Library of Congress and the U.S. Department of the Interior will host two receptions commemorating the Centennial of the Board on Geographic Names.

The Centennial Celebration schedule is as follows:

Thursday, September 6

10:00 a.m. to noon—Symposium, Library of Congress

1:30 p.m. to 4:00 p.m.—Opening of Exhibit, Library of Congress

5:00 p.m. to 7:00 p.m.—Reception, Library of Congress

Friday, September 7

10:00 a.m. to noon—Symposium, Library of Congress

2:00 p.m. to 4:00 p.m.—Tour Exhibition, Department of Agriculture

5:00 p.m. to 7:00 p.m.—Reception, Department of the Interior

Saturday, September 8

10:00 a.m.—Toponymic tour of Washington

In 1991, Americans will celebrate the 100th Anniversary of the National Forest System. More importantly, we will celebrate 100 years of natural resource stewardship—caring for the land and serving the people. Those two centennial celebrations mark a significant period in the history of our Nation and reflect our organization's mission of wisely using our natural resources and carefully establishing a consistent nomenclature to help facilitate naming the land we care for.

Period of Evolution

The growth and change of the U.S. Board on Geographic Names can be observed as six periods.

First Period

During the first period, which began in 1890, the general framework of name policy was established. The Board worked to standardize names before they caused serious confusion. The responsibility of coordinating mapping and establishing the first set of standard symbols for topographic maps was assigned to the Board. During the first period, cumulative lists of standardized names were published.

Second Period

The second period began in 1927 and showed an increase in the activity of the committees and staff members. The "First Report on Foreign Names" was published, and it contained many important name changes of the post-World War I era. Many names from Hawaii and the Philippines were made official. In 1933, a cumulative report was published containing 25,000 domestic and foreign names.

Third Period

The third period in the history of the Board was greatly affected by World War II. The standardization of foreign and domestic names was diminished by the war effort. An executive committee of three took over the functions of the Board. Between 1941 and 1944, this committee did not meet, and only a few hundred names were made official.

Fourth Period

The fourth period began in 1943 and saw a marked increase in the activity of the Board. At the request of 15 Federal agencies, the U.S. Department of the Interior organized and assembled a huge effort to meet the needs generated by the war. The preparation of indexes of names on maps used during the invasion of Europe were generated quickly by the staff and proved to be quite helpful to the war effort. Over 3 million Chinese, Japanese, and Korean names were romanized (transcribed into roman letters), most of them for the first time. Guides to the geographic names from China, Japan, and Korea were prepared by the Board and were used by a wide range of people.

During this period, intelligence studies were conducted by Federal agencies and showed the necessity for individual name standardization on a large scale. The Board's assistance was sought for this endeavor. The Gazetteer Program, which lists all names within a specific country, was initiated to help stop problems before they developed. Domestic name standardization was greatly increased, and a recording system for the decisions was established and adopted.

Fifth Period

The fifth period began on July 25, 1947, with the enactment of legislation authorizing the standardization of geographic names. The large quantity of foreign names processed each year made it impractical for the Board to examine each name individually. The Board would treat names that raised policy questions, illustrating policy problems or situations involving names previously acted on. Files of names from countries and States were approved and made official standard names. This process was used when naming features in Alaska and Hawaii.

The docket list procedure was adopted to better brief the Board members on local usage, recommendations, and descriptions. The docket was released to the public with an invitation for comment within a 30-day period. Any names questioned would be considered individually and approved or disapproved accordingly.

In the late 1950's, terminology was examined and found to have discrepancies. The variety of terms and connotation of terms used in names was far greater than anticipated. These findings helped clarify the evolution of both names and terms and how to identify named things so that communications would not be disturbed.

After funding was cut in 1958, the U.S. Geological Survey (USGS) took over staff work and recordkeeping. Many changes were introduced to help facilitate classified names using the Gazetteer of Official Names. Three advisory committees were established to deal with Antarctica, Arabic and Persian names, and undersea features.

The Antarctica committee faced the monumental task of organizing the geographic nomenclature of a huge, inaccessible land area. A standard set of policies was established to accommodate the special navigation and observational problems in the polar area. The committee brought order to the chaotic confusion in names in Antarctica and helped establish an orderly geographic nomenclature generally accepted worldwide. A committee was formed to answer questions concerning dialectical variations involved in processing Arabic and Persian names. The advisory committee on undersea features was established to name ocean features.

International cooperation has been stressed, and cordial relations with similar agencies in Canada and Mexico have been established. The Permanent Canadian Committee on Geographic Names suggested naming a feature on the border between the United States and Canada to commemorate the Centennial of the Board.

Sixth Period

The sixth period in the history of the Board included the establishment of domestic geographic names policies, the continued publication of the Gazetteers from each State, the computerization of the names data base, the Geographic Names Information System (GNIS), and the formulation of a wilderness policy.

The principles, policies, and procedures of the Board on Geographic Names continued to give guidance to the Board. The principles have been used since 1890 and reflect the underlying philosophy and primary guidelines used in national standardization. The committee and the Board are guided by these principles when establishing policies and procedures and making decisions on domestic names. The Board has established five principles: (1) use of the Roman alphabet, (2) names in local usage, (3) names established by an act of Congress, (4) names established by other authorities, and (5) one name for one geographic feature.

The first domestic names policy was approved by the Secretary of the Interior in 1981. Eleven policies have been established to give uniformity in the decisionmaking process and to assist in the national standardization. Each policy was formulated to deal with particular naming problems or issues.

The Primary Source for Identifying Official Names

GNIS represents USGS, which, in cooperation with the Board, maintains the system. The data base currently contains 2.5 million name records, which include names of natural features, populated places, cultural features, and civil divisions, areas, and regions. The National Gazetteer is a product of GNIS and consists of a complete reference to the names of places, areas, and features in the United States.

The Board has been involved in naming features that have been controversial—the best known being when the Board changed the name *Cape Canaveral* in Florida to *Cape Kennedy*. The name change request was made by the Administration during the emotional atmosphere following the assassination of President John F. Kennedy. The use of the older European name *Cape Canaveral* was preferred by the local people, and a storm of protest was raised and intensified over the years. The people of Florida sought to reinstate the commonly used descriptive name meaning "reedy or grassy." The use of this word *Canaveral* could be traced back to Spanish cartography of the 1540's. The Board restored the historical name *Cape Canaveral* in 1973.

A controversial situation regarding another president, William O. McKinley, took place in 1896. William A. Dickey, a prospector, wrote of his adventures in Alaska. He related in his article in *The New York Sun* that he had named a high mountain in the Alaska range after William O. McKinley of Ohio, who had just been nominated to the presidency. The Board and USGS did not agree with the use of the name *Mt. McKinley* because it violated the Board's living person policy. The proposal was submitted before the president was assassinated, but after the assassination, *not* using the name seemed inappropriate. The public had been applying consistent pressure to change the name back to the original Athabascan Indian name *Denali*, meaning the "large or greater one." In December 1977, the matter was taken up by Congress for decision and is still pending in Congress. It is the policy of the Board not to act on any name before Congress.

The public reaction to naming major landscape features for people is displayed in the cases of Cape Canaveral versus Cape Kennedy and Mt. McKinley versus Mt. Denali. Susan Fenimore Cooper, daughter of the American novelist, stated in the mid-19th Century that she saw no reason why the names of distinguished and honorable men could not occasionally be given to towns and counties or to any mark drawn by the hand of society on the face of a country. However, other words are more appropriate for natural features of the land: "consider a mountain peak stern and savage, veiled in mist and cloud...and say it be not a miserable dearth of words and ideas to call that grand pile by the name borne by some honorable gentlemen...close button to chin." This attitude is expressed in the Board's policy concerning wilderness areas. The Board states that names detract from the wilderness character of the region.

Another example of the Board's action on the naming of a significant geographic feature was illustrated when the name *Challenger Point* was suggested as a commemorative name honoring the crew of the space shuttle Challenger. The Forest Service disagreed with this name request for a number of reasons. The peak that was to be named was a secondary peak—the main mountain was named Kit Carson Mountain. The naming of a secondary peak went against Board policy. The "Colorado Fourteeners" has special significance for climbers and others interested in the Colorado Mountains. Naming a secondary peak when the primary peak had been named complicates the definition of the "Fourteeners," which represent significant peaks in the Colorado Rockies with elevations greater than 14,000 feet.

A name for a lake in Florida, *Challenger Lake*, already had been approved by the Board, and that seemed more appropriate to the Forest Service because it is located very close to where the disaster occurred. The Board approved the name to commemorate the crew. The Forest Service did not want to conflict with existing longstanding names. The Board agreed with the proposer that "mountain peaks symbolize the spirit of adventure, a spirit our lost seven so boldly displayed."

Conclusion

The Board has grown from a small organization concerned principally with domestic names in the United States to an international organization with interagency affiliation. The staff has grown significantly and includes toponymists, linguists, and geographers interested in solving naming dilemmas on a worldwide basis. As the Board moves forward, it can be proud of the participation it has had in naming geographic features in the United States and worldwide.

Naming the land we care for symbolizes the history of our country and its changing face and the Forest Service philosophy of caring for the land and serving the people. Geographic naming reveals the rough and brawling nature of the West. Geographic naming also profiles the United States in a unique and exciting way that cannot be matched by any other medium.

For more information, contact R.Quigley:WO1A or FTS 453-9431.

Bibliography

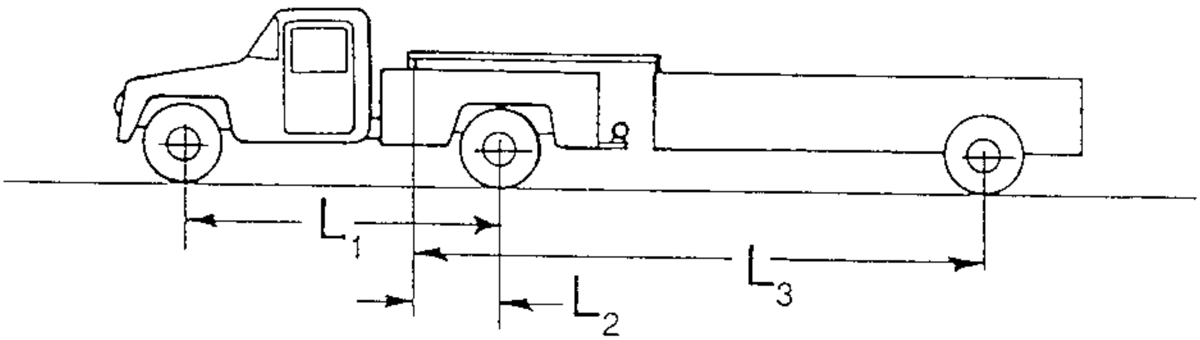
Principles, Policies and Procedures: Domestic Geographic Names (1989 Edition). U.S. Geological Survey, Reston, Virginia, 1989.

"The Mountain Was Wronged; The Story of the Naming of Mt. Rainier and Other Domestic Names Activities of the U.S. Board on Geographic Names." *Names*, Vol. 32, No. 4 (December 1984).

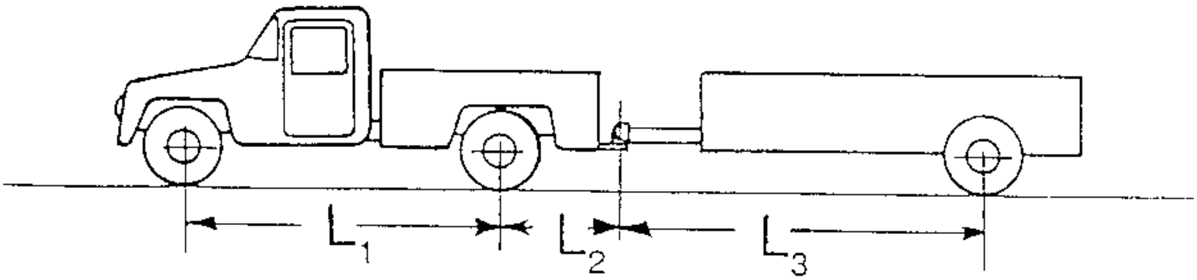
"Colorado Peak to Honor Shuttle Victims," *Rocky Mountain News*, April 10, 1987.

Errata to the "Off-Tracking: Forest Service Formula, Vehicles, Roads, & Simulator" Article in the January-February 1990 Issue

Two of the equations shown on page 25 of the January-February 1990 issue of *Engineering Field Notes* and Table 3 on page 30 had errors in them. The corrected information appears on this and the following page.



$$L_s = \sqrt{L_1^2 - L_2^2 + L_3^2}$$



$$L_s = \sqrt{L_1^2 - L_2^2 + L_3^2}$$

Table 3.—Off-tracking lowboy and simulator, reverse curves. Off-tracking was measured toward the center of the curve. (On the reverse curve, the first nine measurements for each run were measured in one direction; the remainder were measured in the opposite direction.)

PC	19°	30°	46°	64°	90°	116°	150°	180°	20°	30°	45°	60°	90°	120°	180°
50-ft radius															
4.2	8.3	9.7	11.5	13.0	14.5	15.2	15.1	8.2	1.5	4.1	6.8	8.2	12.1	13.5	11.5*
4.3	8.4	10.0	10.2	13.5	14.8	15.5	15.8	9.5	0.5	3.6	6.9	8.6	12.4	13.4	11.4**
3.6	8.1	9.5	11.6	13.1	14.9	15.8	16.5	10.3	0.4	2.9	6.1	7.9	11.5	12.1	11.4***
3.8	8.0	9.5	11.3	12.8	14.1	14.8	14.8	8.0	2.0	5.0	8.0	9.7	13.2	13.9	11.8****
75-ft radius															
1.8	5.5	7.0	8.0	8.9	9.2	9.6	9.4	4.2	3.6	5.5	7.3	8.2	8.9	9.0	6.5*
2.5	6.1	7.3	8.4	9.1	9.7	10.0	10.1	5.3	2.4	4.1	6.5	7.8	8.8	9.4	6.7**
2.0	5.7	7.0	8.1	9.0	9.7	10.1	10.2	5.6	2.0	4.0	6.2	7.4	8.4	8.8	7.0***
2.0	5.5	6.7	8.0	8.5	8.9	9.1	9.0	4.0	3.5	5.4	7.5	8.7	9.7	10.1	7.0****

	Tractor	Coupling Distance	Trailer	L_s
*Lowboy	L_1=16.5'	L_2=33.25'		37.1'
**Simul. w/pickup	L_1= 9.5'	L_2= 3.75'	L_3=36.08'	37.1'
***One simulator	L_1=37.1'			37.1'
****Two simulators	L_1=16.5'	L_2=33.25'		37.1'

☆U.S. Government Printing Office : 1990 - 717-013/27511

Engineering Field Notes

Administrative Distribution

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.

Submittals Field personnel should send material through their Regional Information Coordinator for review by the Regional Office to ensure inclusion of information that is accurate, timely, and of interest Service-wide.

Regional Information Coordinators

R-1 Jim Hogan	R-4 Ted Wood	R-9 Fred Hintsala
R-2 Don Loetterle	R-5 Rich Farrington	R-10 Dave Wood
R-3 Harland Welch	R-6 Bob Yoder	WO Lee Collett
	R-8 Pauline Cahill	

Inquiries Regional Information Coordinators should send material for publication and direct any questions, comments, or recommendations to the following address:

FOREST SERVICE--USDA
Engineering Staff--Washington Office
ATTN: Mary Jane Baggett, Editor
Sonja Turner, Asst. Editor
P.O. Box 96090
Washington, DC 20090-6090

Telephone: (202) 453-9420
