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Field Notes

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FOREST SERVICE • U.S. DEPARTMENT OF AGRICULTURE

ENGINEERING FIELD NOTES

This publication is a monthly newsletter published to exchange Engineering information and ideas among Forest Service personnel.

The publication is not intended to be exclusive for engineers. However, because of the type of material in the publication, all engineers and engineering technicians should read each monthly issue.

The publication is distributed from the Washington Office directly to all Forest, Regional, Center, Station, Area, Laboratory, and Research Offices. Adequate copies are printed to provide all who wish a personal copy. If you are not now receiving a personal copy and would like one, ask your Office Manager or the Regional Information Coordinator to increase the number of copies sent to your office. Use form 7100-60 for this purpose. Copies of back issues are also available from the Washington Office and can be ordered on form 7100-60.

It is intended that the material in the Field Notes be primarily written and used by Forest Service Field Engineers; however, material from other publications may be used.

Field Note material should always be informative and cannot contain mandatory instructions or policy. The length of an article may vary from several sentences to several typewritten pages. Material need not be typed (neatly written or printed is acceptable), or edited before being submitted to the Washington Office. This will be done in the Washington Office to accommodate our format and allowable space.

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

R-1	Kenneth Yeager	R-6	Don Loff
R-2	Marshall Fox	R-8	Ernest Quinn
R-3	Dan Roper	R-9	Clifford Hill
R-4	Fleet Stanton	R-10	Loren Adkins
R-5	Chuck Paletti	WO	Norman Sears

F I E L D   N O T E S

CULVERT LENGTH COMPUTATIONS

by Harwell Adams, Region 8

Sometimes, following the construction of a road, there are instances of culverts too short or too long, protruding beyond fills. This happens because during construction there are instances of changing the lateral placement of a culvert relative to the centerline of the roadway, changing the road alignment to fit a culvert already installed at considerable expense, or adding extra pipe on one end and wasting pipe on the other end. Such costly changes are often associated with meandering streams or flowlines. When these conditions exist at through-fill sites, it is impossible to determine the "natural" skew between the intersections of the fill slopes and the flowline until the shoulder elevations are available after design. The natural skew is preferred since any pipe not following the natural flow pattern entails some channel changing.

There is a fairly simple method which can be used to design a culvert to fit any site and which will furnish complete information for culvert staking and pipe length computation so that the purchase of pipes is not dependent on further field work following design. The designer can use this method whether a culvert is to be laid on a selected skew to the normal or on a line between the natural fill catch points.

The task of the engineer in this work is to find the inlet and outlet, their stations and their elevations and distances from the L line. From this information, the length of pipe can be found or, on a selected skew, the fill catch points on the stream gradient can be found.

During the topographic survey, stream traverse and profile data, referenced to the P line, must be recorded (figure 1). The recording of skew or cross sections in the vicinity of the flowline is unnecessary at that time. The data recorded is them used in the following procedures:

PROCEDURE FOR FINDING THE SKEW AND CATCH POINTS

A. Setting up the Graph

1. Plot the stream or flowline traverse, the centerline of roadway (C/L), and the P line on hardshell (fig. 2).

2. Select a baseline normal to the C/L, through some ten-foot station "back" from the flowline. Step-off ten-foot stations on the C/L, ahead from the baseline (fig. 3).

3. Project the stream traverse points to this baseline. This is done radially, if on a curve, or parallel to the centerline on tangent sections (fig. 3).

4. Attach a piece of 10x10 per inch graph paper to the hardshell, below and tangent to the baseline. Index the scale of the baseline to each side of the C/L.

5. Plot the stream profile below the baseline to a convenient vertical scale.

6. Plot the road centerline profile, also on the graph paper to the same vertical scale as in (5.).

B. Finding the Normal Catchpoints

1. Find the approximate fill height on the inlet side, from the road and stream profiles (fig. 4).

2. Compute the fill width from shoulder to catchpoint for this height. Add to this the subgrade width on the inlet side.

3. Find that station on the plan where the normal distance from the C/L to the stream equals the fill width plus subgrade width.

4. From the road and stream profile elevations at this station, find the fill height to the nearest tenth foot.

STA	BS	HI	FS	Elev	AZM °	Dist Ft	
TBM				500.00			NIS 14" Pine-46' Rt, Station 17+20
Pt J			8.2	496.3	122°	87	
Pt I			7.7	496.8	121	65	
Pt H			7.0	497.5	114	42	
Pt G			6.3	498.2	120	28	
Pt F			5.9	498.6	134	20	
Pt E			5.0	499.5	226	16	
Pt D			4.2	500.3	249	15	
Pt C			3.6	500.9	260	25	
Pt B			2.7	501.8	273	40	
Pt A			1.9	502.6	283	58	
17+45	4.5	504.50					

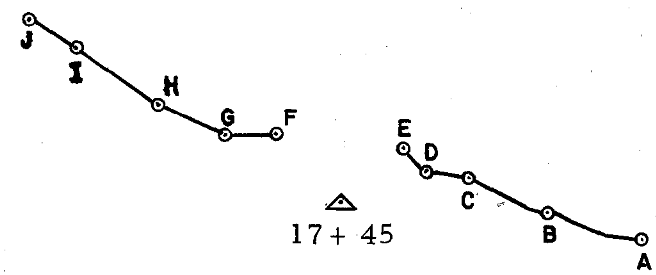


FIGURE 1

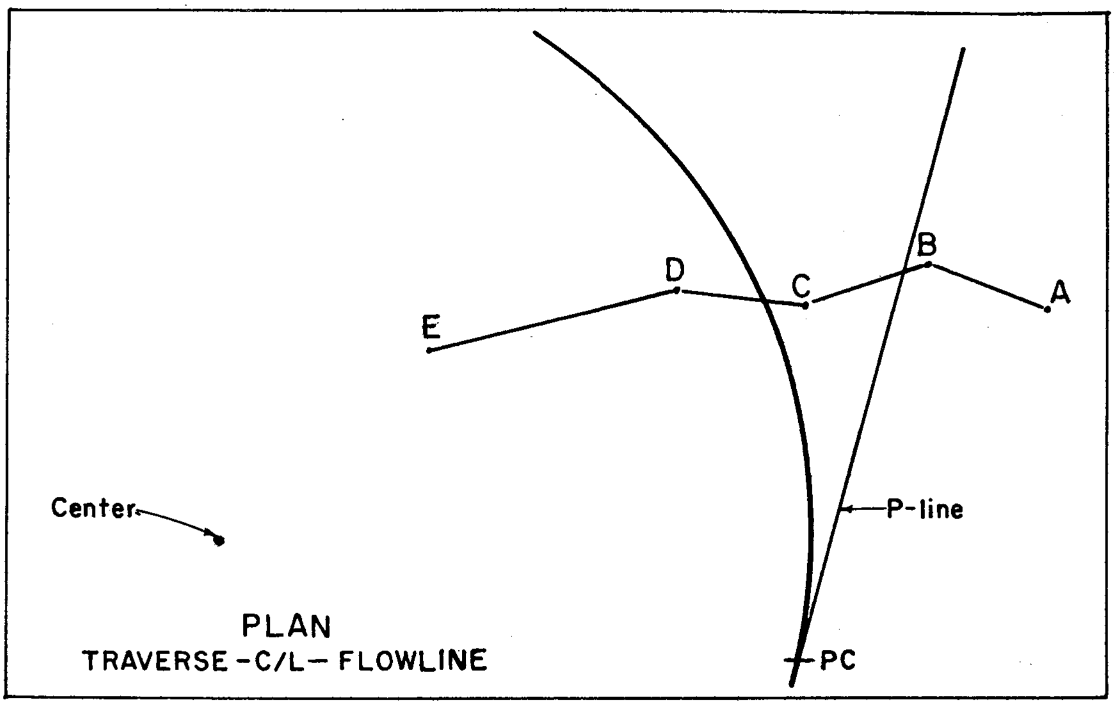


FIGURE 2

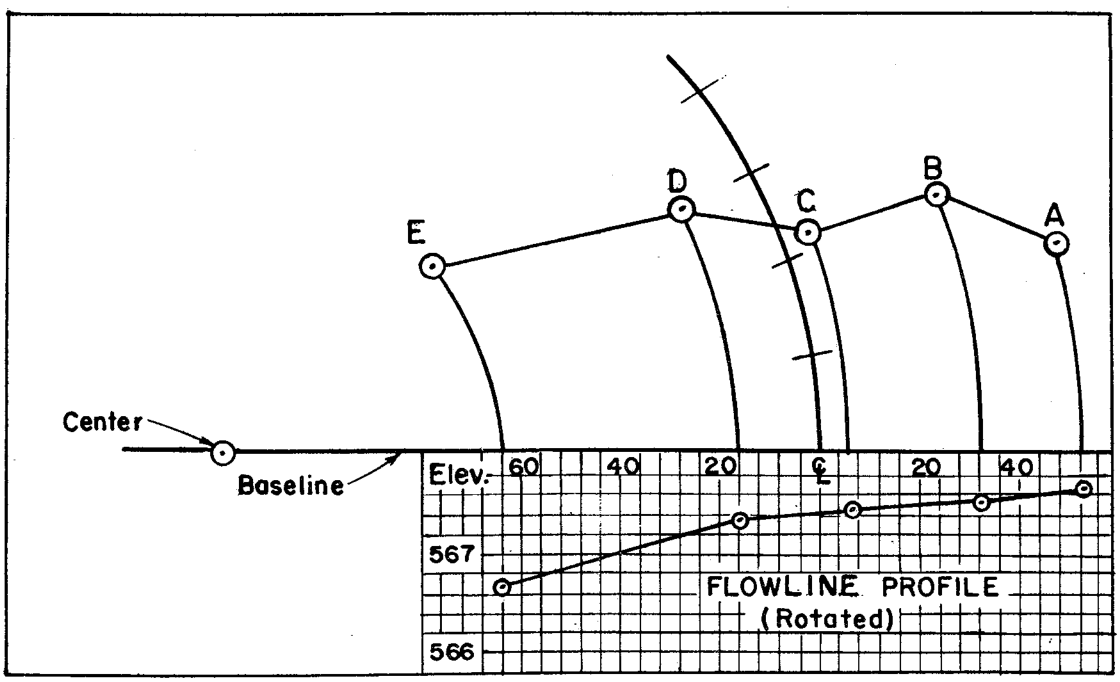
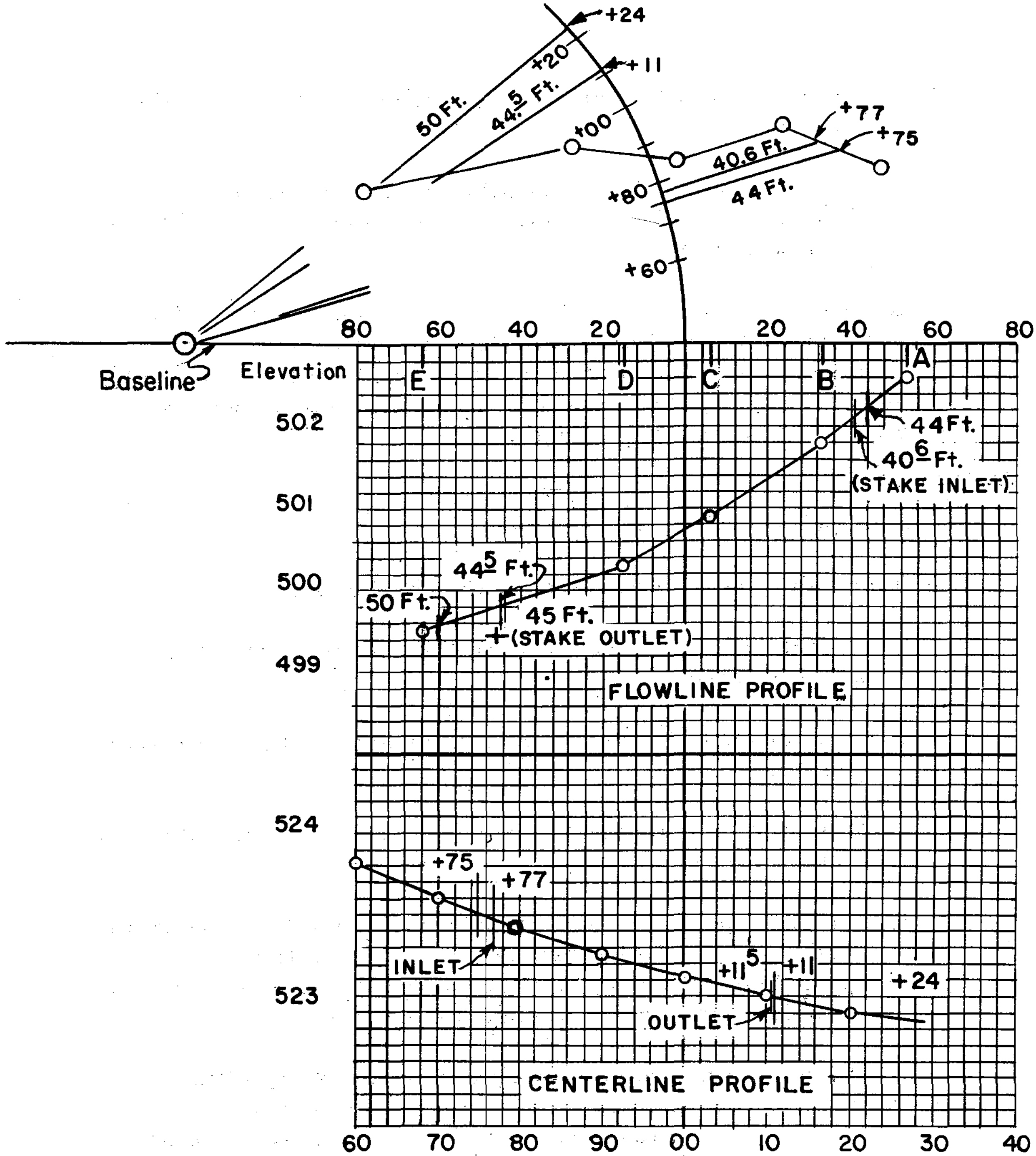


FIGURE 3



Estimate Inlet & Outlet Stations	Inlet		Outlet	
Station 18+	+75	+77	19+24	19+11
Crown -SE	+.40	+.40	-.40	-.40
C/L Elev	523.5	523.47	522.88	522.98
Shld Elev	523.90	523.87	522.48	522.58
Flow Line Elev	502.2	502.10	499.50	499.80
Fill Height	21.7	21.77	23.0	22.78
Fill Ht. x Sl. Ratio	32.6	32.6	33.5	34.17
Subgrade Width	8.0	8.0	11.0	11.00
Catch Distance	40.6	40.6	44.5	45.2
Stake At		18+77		19+11.5

FIGURE 4

5. Compute the fill width of this station and again add the subgrade width.

6. Using the computed C/L-CP distance, repeat steps 3, 4, and 5 until the computed and measured fill widths are approximately equal.

Repeat this procedure to find the outlet catchpoint data. With data from both inlet and outlet catchpoints, scale the invert length between the natural catchpoints from the plan view. For pipe invert slopes up to 14 percent, this value will be within 1 percent of the true invert length.

C. Catchpoints on a Selected Skew

(Do Steps 1 through 4 in A., Setting Up The Graph):

1. Plot the selected skew line on the plan to intersect the stream profile.

2. Project these intercepts to the baseline and to the stream profile.

3. Draw the pipe gradient line on the stream profile through these intercepts.

4. Find the approximate fill height on the inlet side from the road profile and pipe gradients. Perform the same operations for finding the inlet and outlet catch points as in finding the natural catchpoints and skew.

In order to determine the necessary excavation along either line, a skew section will have to be obtained later in the field. In either case, the invert elevation and gradient may be adjusted. In no case, is the design restricted but the staking process will generally be faster and more accurate than by field procedures.

Of course, there will be instances in crossing a meandering flowline at which the desired skew is obvious. Even so, the method suggested here is better than working on a skewed cross-section which does not provide the designer any data on the flowline gradients beyond the line intercepts.

At first, this method may seem slow, but, with a bit of experience, the designer quickly learns the sequence of work and can soon find both catchpoints in a few minutes.

EDITOR'S NOTE: In cases where the skew is obvious, it is also practical to take a cross-section along the flowline and include this cross-section when computing earthwork by EDP. The output will show catchpoints at inlet and outlet points. The length of pipe can then be computed from catchpoint data. Earthwork volumes will be affected by the skewed section, but the effect is generally negligible up to skews of 10 degrees.

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THE CURRENT STATUS OF GUARDRAIL STANDARDIZATION

by Richard A. Richter
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Bridge Division
Office of Engineering and Operations
Bureau of Public Roads
Washington, D. C.

Standardization in industrial construction, fabrication, or manufacturing processes is a means of reducing costs through the employment of mass production, assembly line techniques, and stockpiling principles. Highway guardrail is an element of highway hardware to which standardization can be applied with an expected improvement both functionally and economically.

In an effort to establish (1) what variation existed among the States in regard to their guardrail practice, and (2) what appropriate details might be selected for "standard designs", States were asked to submit [1/] drawings and specifications on how they presently

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[1/] An AASHO-AREA project under the Subcommittee on the Development, Evaluation, and Recommendation of New Highway Materials, currently being carried out by Task Force No. 13, "Standardization of Details for Bridge and Road Hardware".

install guardrails. Due to efforts at standarization which have preceded establishment of the W-beam shape by a committee of the American Iron and Steel Institute (AISI), preparation of in-house standard drawings for posts and terminals by various steel fabricators, the issuance of the AASHO guardrails specification M-180 and the publication of National Cooperative Highway Research (NCHRP) Report 54, there is a certain degree of guardrail standardization which can presently be seen throughout the country.

Thru barrier systems, W-Beam, Box Beam, and Cable, are susceptible to improvement through standardization. The following usage is noted:

Type	States Using*
W-Beam	52
Box Beam	14
Cable	14

W-Beam Systems

The majority of the States specify the rail to be supported by structurally strong posts, rather than a weak post support as pioneered by New York State. Many States use more than one type post. A breakdown is shown below:

Type	States Using
Rectangular Timber (8"x8" or 6"x8")	41
Steel (6 B8, 5 or 6 WF15.5)	33
Concrete	13

*includes Puerto Rico and the District of Columbia

(Reprinted from Highway Focus, February 1970, Vol. 2 No. 1, by permission of U.S. Department of Transportation, Federal Highway Administration, Construction and Maintenance Div.)

Bolts used to splice adjoining rails are not always tightly controlled through specifications but the illustration below represents the most common version and is specified or permitted in 45 States.

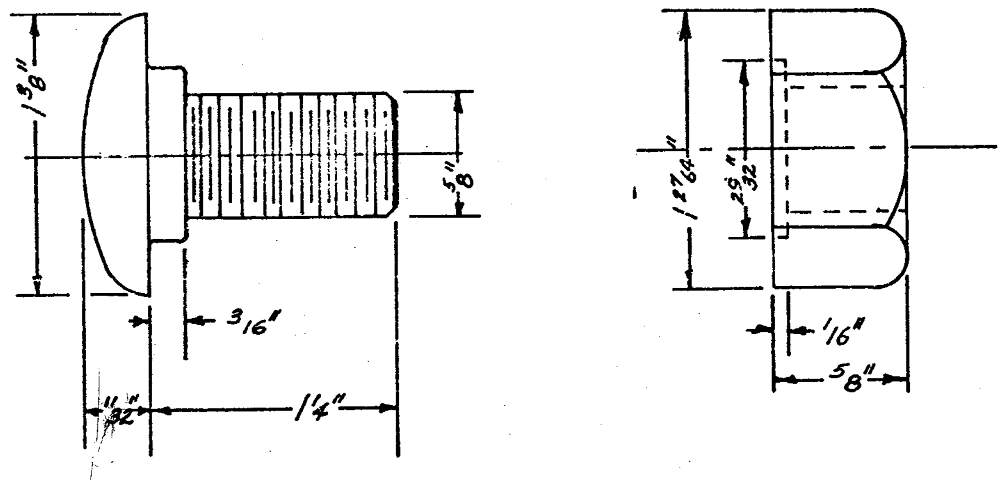
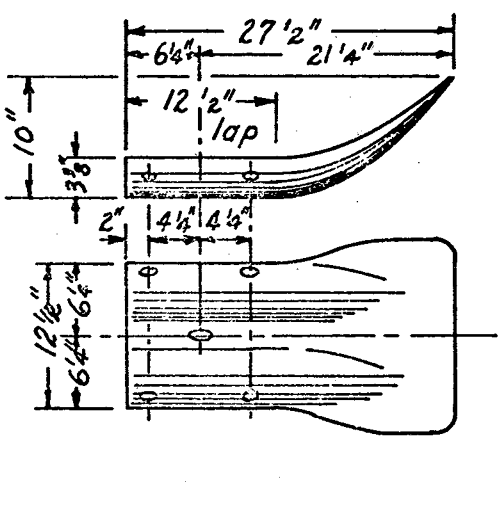


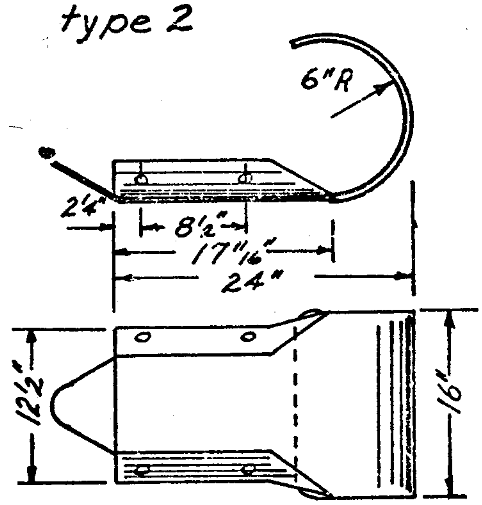
FIGURE 3

Three common terminal sections that are used at rail ends are shown below:

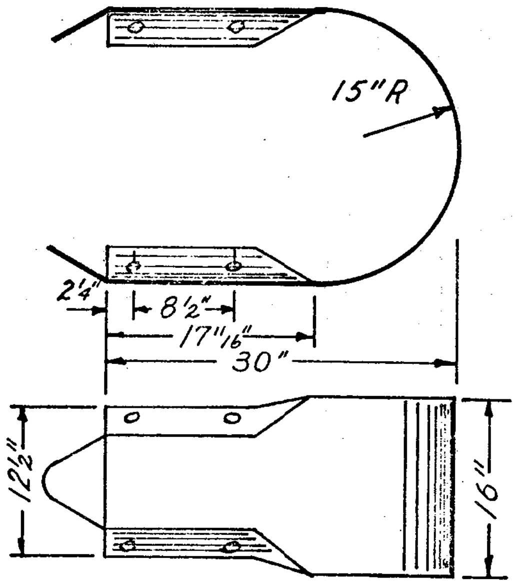
Straight Flare - type 1



Curved Terminal - type 2



Median Barrier Buffer



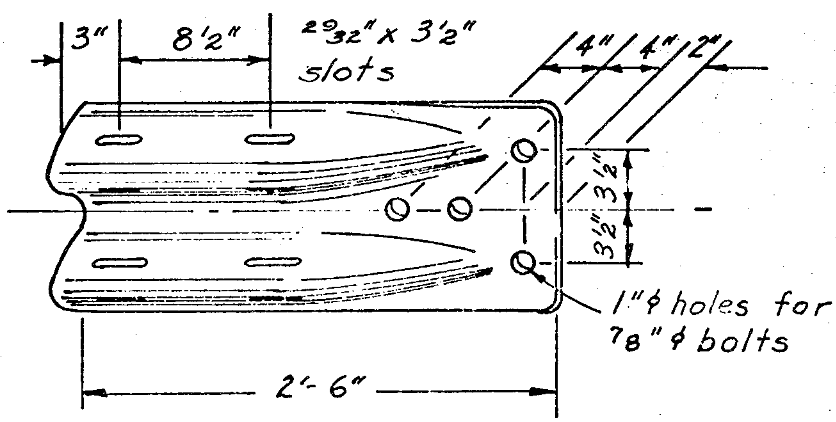
Type 3

States often use more than one type and the extent of this use is shown in the following chart:

Type	State Using
Straight Flare-Type 1	37
Curved Terminal-Type 2	21
Median Barrier Buffer-Type 3	22

A special connection for attaching the rail beam to bridge parapets or concrete walls has found wide spread application with 13 States using the following design:

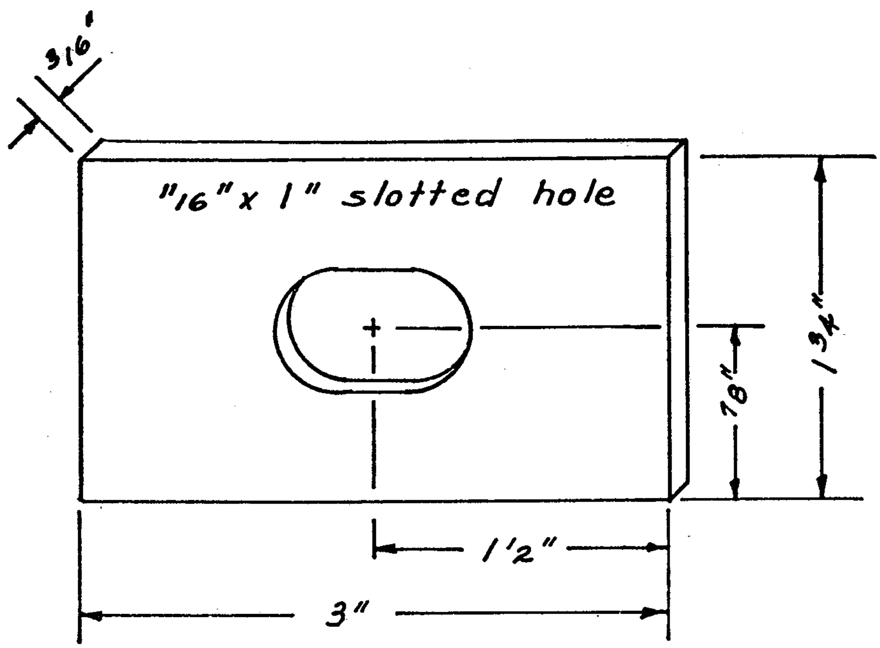
"Michigan" Connector



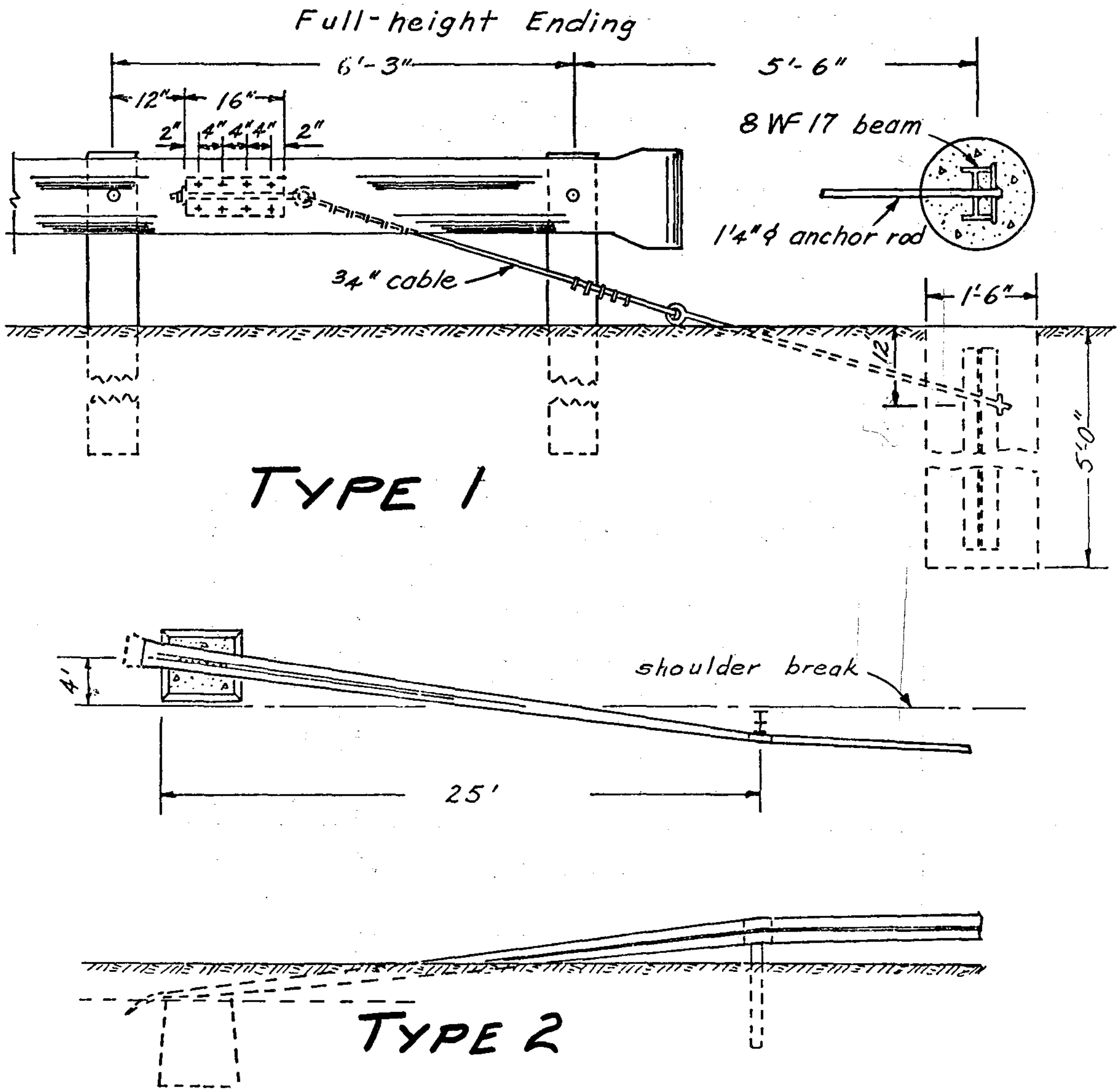
A summary of attachment methods is as follows:

Type	States Using
End Connector	13
Butt Type Connector	12
Modified Rail Section	16

Washers are used on the rail attachment bolts at each post to strengthen the mounting. A large number of variable sizes for these washers was noted, however, 28 States specify the version shown below:



To terminate the free end of guardrail an anchorage system is generally required. One of two general types is used as indicated below:



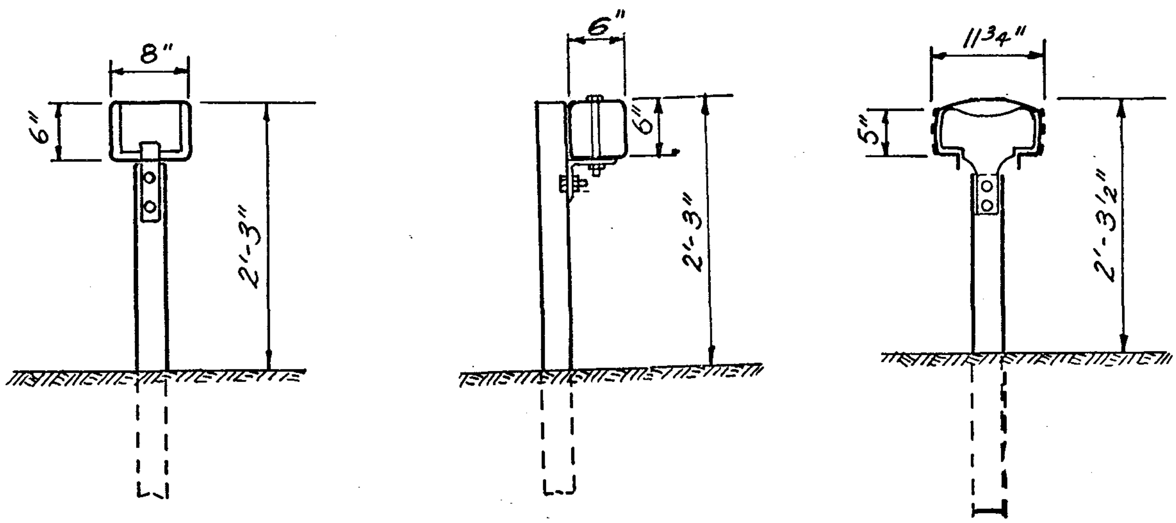
Type	State Using
Type 1 - Full-height system	17
Type 2 - Tapered down system	31

Box Beam Systems

Strong beam, weak post barriers have been widely accepted especially for median separators. The following usage is noted:

Type	State Using
Median Barrier (Steel)	13
Median Barrier (Alum.)	5
Guardrail (Steel)	3

All these states use similar designs except for differences noted in rail splices in support paddles and in terminals. The following are the common designs:



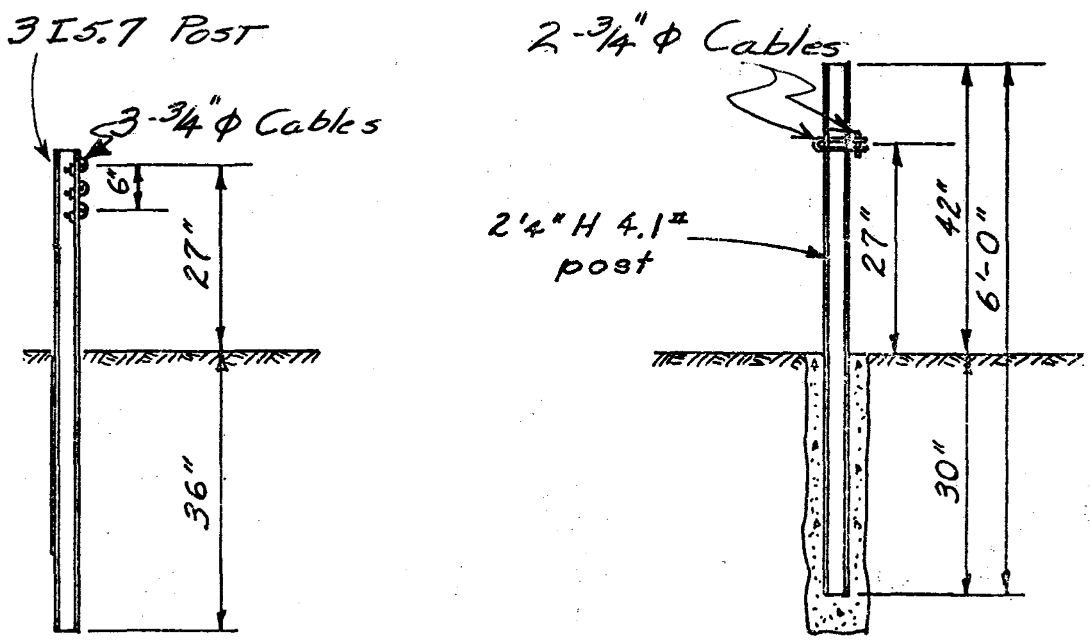
Steel Median Barrier   Steel Guardrail   Aluminum

Cable Systems

Although cable systems are sometimes considered to be undesirable because of their large deflection characteristics, many states prefer to use them because they cause a minimum effect on drifting snow. The following is a summary of the systems used.

Type	States Using
Guardrails (Weak post)	7
Guardrails (Strong post)	5
Median barrier	5

The weak post guardrail and median barrier systems are both well standardized using the following designs:



Summary

Standarization of guardrail components can serve to lower the cost of such installations as well as increase the reliability of the functional service they provide. States have, through contact with each other developed designs for various features similar to each other but with many insignificant variations in details. Through the efforts of an AASHO-AREA Joint Committee Task Force, and based upon a survey of States' designs practices, a design guide for guardrail fabrication details is being prepared in the hopes of increasing standardization and safety.

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NEWS ITEMS

HIGHWAY SAFETY STUDY

by Del Beedy, W. O.

On March 30, 1970, the National Highway Safety Bureau announced its sponsorship of a contract project: a study plan for the preparation of a highway safety program for the USDA Forest Service.

A contract has been made with the Research Triangle Institute, located near Durham, N. C., to perform the work.

The objective of the immediate study plan is to establish specific procedures for systematic development of the overall and long-range Forest Service highway safety program. The study plan will cover the road, the vehicle, and the driver aspects.

The contractor will take a firsthand look into the Forest Service road and safety situations, examine existing data, and interview Forest Service Washington Office and field personnel.

The National Highway Safety Bureau will coordinate the project. At present, no timetable or schedule has been established.

This initial project is the result of several conferences, over the past two years, with the National Highway Safety Bureau. The Bureau is interested in the project not only from the standpoint of Forest Service needs but also because the findings and developed guidelines will be useful in other similar situations common to county and local road systems with low volume and low speed characteristics.

ED&T REPORT - 7160-2 - "FIELD MAINTENANCE OF ROUTED WOOD SIGNS"

by Reg Pragnell, W. O.

This report presents a method for repairing and repainting routed wood signs without removing them from the field site. The basic maintenance unit is a pickup truck equipped with hand tools, power tools, paint spray unit, and paints.

The maintenance procedure is shown in step-by-step illustrations. Experienced sign maintenance personnel will develop additional techniques and equipment necessary to solve local problems. Use of this technique and equipment will reduce labor and material costs for sign maintenance.

ED&T Report 7160-2 will be distributed in May. Additional copies of the report are available from: Director, Equipment Development Center, Federal Building, Missoula, Mont. 59801. We are sure that the material presented in this report will be helpful to you in your sign program. Proper sign maintenance will result in longer sign life, reduced sign costs and will improve the general appearance of Forest Service signs.

ROADSIDE DITCH CLEANER

by S. J. Wilcox, EDC, San Dimas

The Paxton-Mitchell Company of Omaha, Nebr., has completed the fabrication of the prototype machine. The ditch cleaner will remove slough and debris from roadside ditches and load the material directly onto a truck. Plans are to conduct an acceptance test at the plant location, and, if successful, the unit will be shipped to the Gifford Pinchot National Forest for Field evaluation beginning in June.

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