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Dip Design

New Engineering Orientation Program

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ENGINEERING FIELD NOTES

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DIP DESIGN

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Author's Comments

Completion of this article was sparked by the question raised by Royal M. Ryser in the November 1971 Field Notes. *It is hoped that publication of this article will answer the questions posed and will catalyze acquisition of design information needed for rational dip design.*

Field measurements can be conveniently recorded and processed on field notebook size forms of the type shown in Figure 7. Interested readers may obtain a limited number of copies from the author.

INTRODUCTION

Draining water from the surface of unpaved roads before it destroys the riding surface or accumulates sufficient energy to damage the adjacent watershed is a familiar problem to designers of mountain roads. Often, when a dip is doing a good hydraulic job, it becomes so arrogant that it bounces the vehicle hard enough to rap the head of anyone driving over it. This paper presents a dip design technique which simultaneously satisfies these conflicting hydraulic and traffic requirements.

A theoretical treatment is presented to develop a thorough understanding of the problem and to provide a basis for making the field measurements which are badly needed if this more rational design technique is to be used. So far, the technique has been used by basing the design on arbitrarily selected constants and has yielded results which are not too discouraging. It is hoped that this article will encourage readers to make the needed measurements and share their findings through the forum of FIELD NOTES. A wide cross section of opinion is needed, due to the somewhat subjective nature of the measurements.

The problem on unpaved roads is to remove water from the road surface. This is difficult to do because traffic on muddy roads creates ruts which the water follows. Insloping or outsloping the road surface has been used with varying degrees of success, depending primarily on the rutting tendency of the road surface. Outsloping on soils which become slippery when wet has resulted in disfavor among road users who have slipped off the road. Various structures, such as open top culverts, do an excellent job when conditions are right, but siltation and high maintenance costs are common.

Dips in the road profile provide an obvious solution, but, unfortunately, good hydraulic characteristics don't necessarily coincide with good driveability. Most dip designs sacrifice driveability by being too abrupt and are often too shallow to effectively divert water for very long. Dips, when first constructed, divert water from the road easily, but as traffic uses the wet road, ruts are formed which cut through the top of the dip. Effectiveness is further reduced by the mud ridges formed by mud squeezing out of the rut as wheels pass through. These mud ridges in the bottom of the dip act as lateral dikes to prevent water from leaving the ruts. A 3-inch-deep rut with 3-inch-high ridges is enough to cause failure of a typical 6-inch-deep dip. Gravel surfacing through the dip may be the answer to rutting, but often requires expensive maintenance and does not prevent failure caused by reduction of freeboard as sediment accumulates in the bottom of the dip.

The solution is to build the dip with enough freeboard so that the rutting action can't cut through and so that there is sufficient sediment storage space to last between maintenance periods. Recalling the head bumping that occurs even on some of the shallow dips makes it obvious that new criteria are needed if dips are to be further deepened.

DESIGN RELATIONSHIPS

Head bumping results from unacceptably large vertical accelerations imposed on the vehicle by the dip. Speed plays an important part in determining the magnitude of the vertical accelerations, and some designers apparently expect the driver to slow down and proceed cautiously through the dips. Other geometric elements of the road are coordinated, in part, by a design speed, so it seems that consistency would be fostered if dips also conformed to these criteria.

The basis for design from the standpoint of traffic driveability is developed from the relationship of speed to vertical acceleration. This relationship can be approximated from the dynamics of centrifugal acceleration:

$$a = \frac{v^2}{R} \qquad (1)$$

where,

a = centrifugal acceleration in f.p.s.^{2}
v = tangential velocity in f.p.s.
R = radius in ft

If the circle is tipped up to a vertical plane, then the centrifugal accelerations become vertical accelerations along the upper and lower segments of the circle.

In highway design, the vertical curves are parabolas, rather than circular arcs, and the radius, therefore, changes throughout the curve. In spite of this, the radius of curvature can be approximated with sufficient accuracy by assuming that the vertical curves are circular (Ref 4). The relationship developed is

$$R = 100K \tag{2}$$

where K expresses the curvature of a parabolic arc in units of feet per %,

$$K = \frac{L}{A} \tag{3}$$

where,

L = length of vertical curve in ft
A = algebraic difference in grades in %

Solving equations (1) and (2)

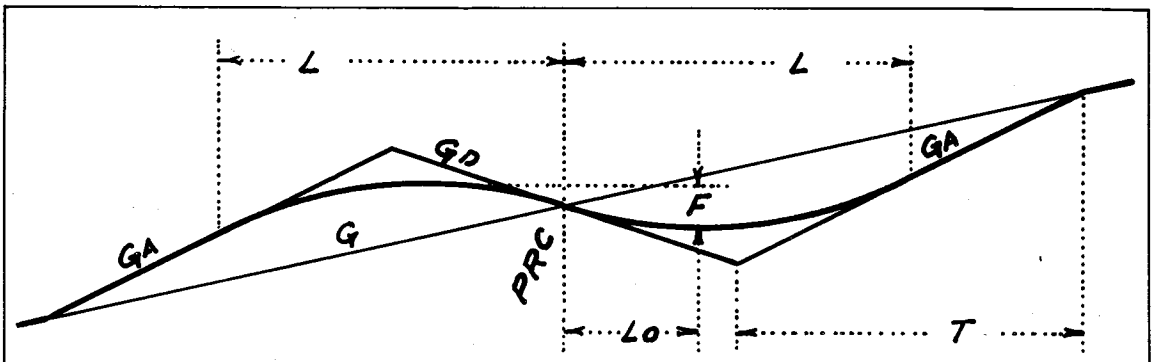
$$R = \frac{v^2}{a} = 100K$$

Solving for K and expressing speed V in miles/hr yields

$$K = \frac{V^2}{46.5a} \tag{4}$$

Equation (4) shows that K also measures the driveability of a vertical curve, being dependent upon speed V and the acceptable vertical acceleration a. The acceptable vertical acceleration is not precisely defined and will be discussed later in the section entitled "Design Criteria."

As mentioned earlier, hydraulic effectiveness demands depth for sediment storage and for control of rutting. This depth, or freeboard, is defined in the Figure 1 along with other important dimensions.



G – Original road grade (often changes within the dip)
GA – Approach grades (symmetry between crest and sag is convenient, but not necessary)
GD – Adverse dip grade
F – Freeboard
Lo – Distance from center of dip, PRC, to hydraulic bottom
L – Length of vertical curves (crest and sag lengths will be different if approach grades are not equal)
T – Length of approach grade

Figure 1. – Dip Dimensions.

Throughout this paper, distances will be expressed in feet, and grades will be expressed as percents. The relationships are developed using absolute values, $|g|$, of the grades, so it is imperative that the designer relate the calculations to the crest or the sag curve situation with which he is dealing.

The freeboard F can be found by noting that the grade = 0 at the bottom of the sag and at the top of the crest. Then the difference in elevation between the low point of the sag and the point of reverse curvature PRC is equal to the average grade between PRC and F, multiplied by the distance Lo between them(Ref 4).

Then for equal K's on the crest and sag curves, the freeboard is

$$F = \frac{(GD)\ (Lo)}{100}$$

From L = KA and grade = 0 at the high and low points on the vertical curves,

$$Lo = (K)\ (GD) \qquad (5)$$

then,

$$F = \frac{GD^2 K}{100}$$

or,

$$GD = \sqrt{\frac{100F}{K}} \qquad (6)$$

Notice from equation (6) that the adverse dip grade GD is a function of both hydraulic and driveability characteristics – freeboard F and vertical curvature L, respectively. Other relationships are:

$$L = AK = (|GD| + |GA|) K \qquad (7)$$

$$T = \frac{L (|GD| + |G|)}{2 (|GA| - |G|)} \qquad (8)$$

DESIGN CRITERIA

The preceding paragraphs have developed the necessary design relationships based on driveability at various speeds and on hydraulic effectiveness for diverting water. Design values for the dip vertical curves can now be obtained through knowledge of vehicle speed, allowable vertical acceleration, and freeboard requirements. However, before plugging these parameters in and grinding out a family of design values, it would be helpful to investigate the constraints imposed by vehicle underclearance and by the maximum dip spacing allowable for erosion control. Also, as mentioned earlier, an acceptable vertical acceleration is not yet defined.

Vehicle Underclearance limits the maximum sharpness of curvature. Minimum clearances of front and rear overhangs and at vehicle center are tabulated in the *Traffic Engineering Handbook* (Ref 2) for various dynamic conditions, such as front dive, rear jounce, and full jounce. Both composite long vehicle and composite short vehicle dimensions are given, which have been compiled to illustrate the worst possible dimensions likely to appear on future cars. They are, therefore, considered conservative for the typical vehicle using Forest roads, with the possible exception of camper trailers pulled by passenger cars.

In order to obtain limiting design values, the dimensions given by Baerwald are converted to equivalent radii K, as shown in Figure 2, by the technique outlined in the section entitled "Field Measurements." The resulting minimum allowable K values are shown in Table 1.

The minimum K for dip design appears to be about 0.9, since the full jounce condition on a crest vertical curve is extremely improbable.

TABLE 1. – Maximum Sharpness of Curvature as Limited by Vehicle Underclearance.

Vertical Curve	Vehicle	Dynamic Condition	K
Sag	Longest Front	Normal	.23
		Front Dive	.44
		Rear Jounce	.26
		Full Jounce	.38
	Rear	Normal	.49
		Front Dive	.43
		Rear Jounce	.83
		Full Jounce	.68
	Shortest Front	Normal	.16
		Front Dive	.28
		Rear Jounce	.15
		Full Jounce	.25
	Rear	Normal	.33
		Front Dive	.28
		Rear Jounce	.88
		Full Jounce	.60
Crest	Longest	Normal	.46
		Front Dive	.74
		Rear Jounce	.74
		Full Jounce	1.85
	Shortest	Normal	.14
		Front Dive	.17
		Rear Jounce	.17
		Full Jounce	.23

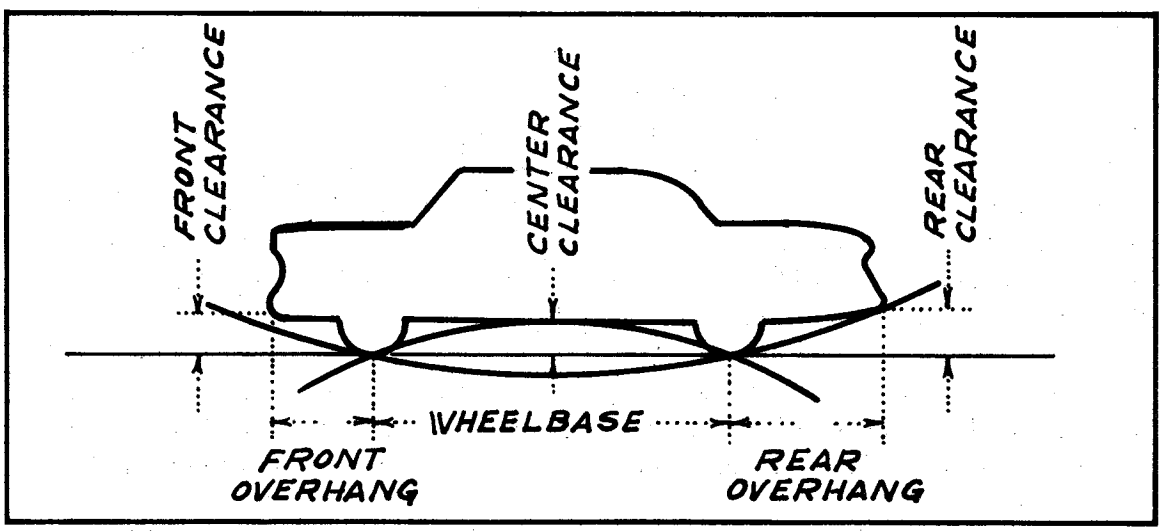


Figure 2. – Vehicle Underclearance Limits Curve Sharpness.

Erosion Control considerations lead to the generalization that dips must be deep and must be spaced at closer intervals as road grades increase. Spacing criteria have been developed for a variety of soil types and road grades in the Northern Region by Packer and Christensen (Ref 6). These criteria, developed from a study of 720 sites, indicate that the most important parameters influencing road surface erosion are soil type and road grade. Packer (Ref 5). Their criteria for cross drain spacing is to limit 83 percent of erosion rills to depths less than 1 inch. In addition to the soil type and road grade, they include modifying factors to account for the road position on the slope, the exposure direction of the slopes, and the steepness of the slope. A plot of their spacing requirements for various soil types and road grades is shown in Figure 3. Since the plot ignores their modifying factors, all of which call for closer spacings, the plot gives their maximum allowable spacing. The plotted data has been modified to account for the adverse dip grade shown in Figure 4. Their data represents the distance 2T. Therefore, the curves are plotted by adding L to their erosion distance. The soil type categories are defined in Table 2.

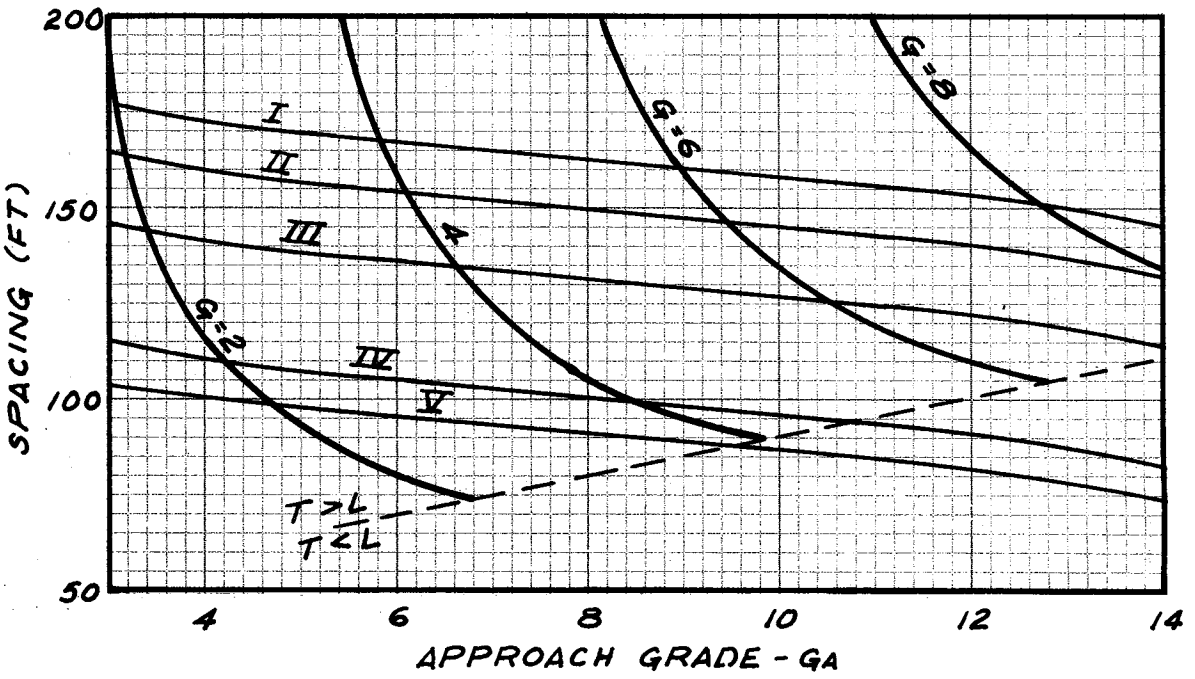


Figure 3. — Dip Spacing as Defined by Road Grade and Soil Type. (For V = 20 m.p.h., F = 1.0, a = 5 f.p.s.², and road located on upper third of north-facing 80 percent slope.)

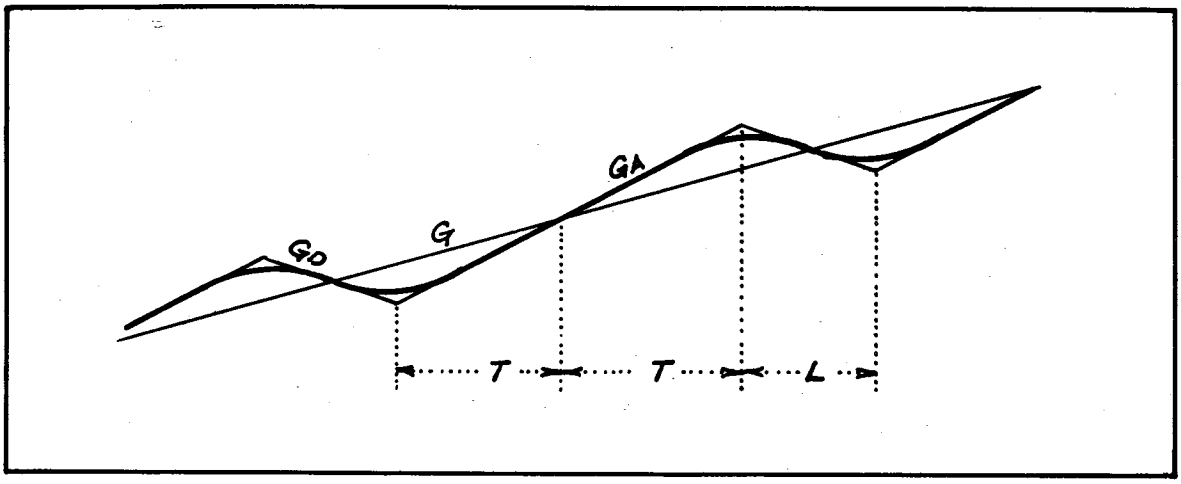


Figure 4. – Dip Spacing.

TABLE 2. – Erosion Potential of Soil Groups (Ref 6).

Decreasing Coarseness ↓ Increasing Detachability	Group	Description of Parent Material
	I	Hard sediments, shale, slate, limestone, rhyolite
	II	Basalt, quartzite, conglomerate
	III	Granite, sandstone, gneiss, schist, glacial silt, soft shale
	IV	Andesite, soft limestone
	V	Loess

Superimposed on the plot are lines showing road grades, G, which indicate spacing required from driveability considerations. These lines show the sustained grades achieved if the dips were not built in, and are derived from the fact that the dips can be spaced more closely by merely steepening their common approach grade GA. The limit is reached when the points of tangency coincide at a point of reverse curvature. This limit is shown on the graph as the dashed line T = L. Figure 4 shows the dimensions needed for the derivation.

The spacing is shown by $S = 2T + L$ and since, (9)

$$T = \frac{L\,(GD + G)}{2\,(GA - G)} \tag{8}$$

and,

$$L = K\,(GD + GA) \tag{7}$$

then,

$$S = K\,(GD + GA)\,\frac{(GD + G)}{(GA - G)} = 1 \tag{10}$$

Substituting in values for 20 m.p.h., 1.0 foot freeboard, and vertical acceleration of 5 f.p.s.^{2} gives the values plotted.

For instance, a sustained grade of 6 percent in soil type III requires dips to be spaced at 125 feet and connected by a 10.5 percent grade. This brings out the importance of additional research to verify an acceptable erosion standard and to determine the maximum allowable vertical acceleration consistent with safety of operation. The basic assumption of a 1-inch rill depth is subject to question. Ideally, the tolerable erosion criteria should be related to traffic impairment, watershed damage, and maintenance costs. Practically, however, the above criteria may be the best there are. The door is open. . . .

Design of the *Hydraulic Bottom* of the dip requires additional study. In order to remove water from the road, the hydraulic bottom must slope to one side. If the dip crosses the road at 90 degrees, then outsloping (or insloping) is required if sedimentation is to be minimized and if creation of a soft spot and the ensuing chuckhole is to be avoided. On the other hand, a dip crossing at a skew will acquire some grade automatically, but may also require outsloping when grades are low. From a driveability standpoint, skewing a dip greatly increases the comfort of passenger car and pickup truck occupants, but tends to twist the frame of longer trucks, so that they favor square dips. This twisting effect has been troublesome on the typically abrupt dips used to date. The dips designed by the criteria in this paper will be considerably longer and the twisting problem may not be as severe.

Vertical Acceleration is briefly mentioned by AASHO Policy (Ref 1). A value of 1 f.p.s.^{2} is given as the upper limit for a comfortable ride through a sag vertical curve. However, for both sag and crest curves, other criteria, such as headlight sight distance, govern; and this value is, therefore, seldom attained. Since the length of the drainage dip is inversely related to the vertical acceleration, minimizing the length of the dip requires that the allowable value of acceleration be as high as possible consistent with safe vehicle operation. A trade-off is required wherein comfort (but not safety) is sacrificed to gain hydraulic effectiveness.

A maximum allowable vertical acceleration of 5 f.p.s.^{2} was selected on a trial basis for designing dips into timber roads on the Uinta and Manti-LaSal National Forests. Results are very sketchy so far, but indicate that this is a workable value.

The example design shown in Figure 5 will illustrate the practical aspects of the foregoing theory. The problem illustrated requires the design of a dip with 1.5 ft freeboard for a 6 percent road which can be driven through at 20 m.p.h., with a vertical acceleration of 5 f.p.s.^{2}

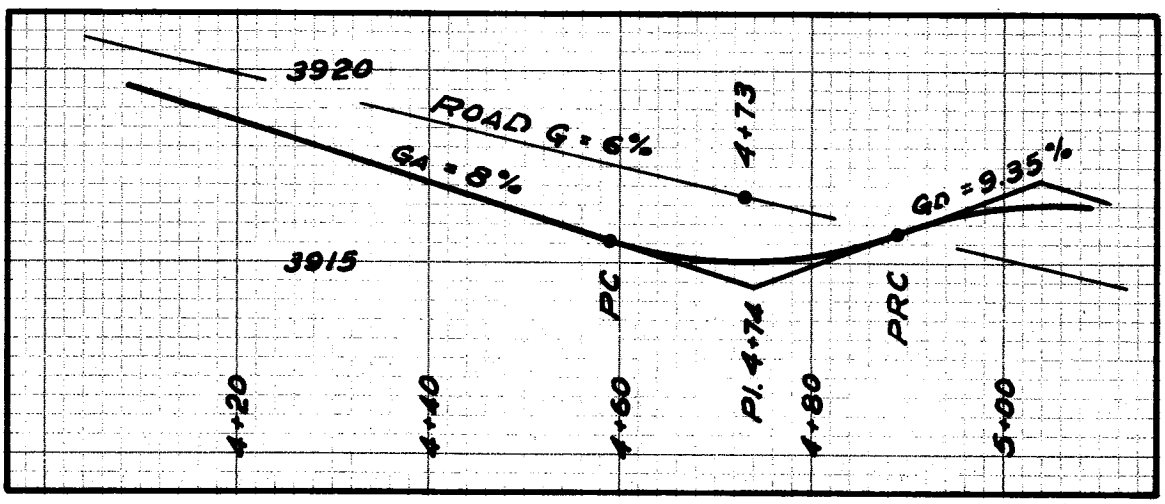


Figure 5. – Example Design.

It is desired to build a right angle dip with the hydraulic bottom at station 4+73. This station is selected because it is a daylight section and the water will, therefore, flow onto undisturbed ground.

$$K = \frac{V^2}{46.5a} = \frac{(20)^2}{46.5\ (5)} = 1.72 \text{ ft /\%} \qquad (4)$$

$$GD = \sqrt{\frac{100F}{K}} = \sqrt{\frac{100\ (1.5)}{1.72}} = 9.35\% \qquad (6)$$

$$Lo = (K)\ (GD) = 1.72\ (9.35) = 16.1 \text{ ft} \qquad (5)$$

$$PT = PRS = 4{+}73 + 16.1 = 4{+}89.1, \text{ use } 4{+}89$$

The approach grade will be arbitrarily selected as 8 percent, thereby making the grade change:

$$A = GD + GA = 9.35 + 8.00 = 17.35\%$$

$$L = AK = (17.35)\ (1.72) = 29.8, \text{ use } 30 \text{ ft} \qquad (7)$$

$$T = \frac{L}{2}\frac{(GD+G)}{(GA-G)} = \frac{30}{2}\frac{(9.35+6.0)}{(8.0-6.0)} = 115 \text{ ft} \qquad (8)$$

If the erosion distance of 2(115) = 230 feet is satisfactory, then the arbitrarily selected 8 percent approach grade is also satisfactory. The approach grade GA could also have been selected from Figure 3 if the soil type were known.

$$PC = 4{+}89 - 30 = 4{+}59$$

$$PI = 4{+}74$$

Elevations can be calculated as follows, but are normally scaled from the profile.

Station			Elevations
	4+73		3916.7
		-(6%) (16)	
PRC	4+89		3915.74
		-(9.35%) (15)	
PI	4+74		3914.34
		+(8%) (15)	
PC	4+59		3915.54

Elevations of several points on the curve are calculated in Table 3 below for future reference. In practice, sufficient accuracy is normally obtained by scaling from the profile.

$$\frac{1}{K}=\frac{A}{L}=\frac{17.35}{30}=0.578\%/\text{ft} \tag{3}$$

TABLE 3. – Example Vertical Curve Calculations.

Station		Chord Gradient		Elevation
			-8.0%	
PC	4+59			3915.54
		(1/2)(.578)10 = +2.89%	(-5.11%)(10)	-0.51
	4+69			3915.03
		.578(10) = +5.78%	(+0.67%)(10)	+0.07
	4+79			3915.10
		.578(10) = +5.78%	(+6.44%)(10)	+0.64
PT	4+89	(1/2)(.578)10 = +2.89%		3915.74
			+9.36%	

These are the calculations for the sag portion of the dip. Similar calculations are made for the crest vertical curve. The usual (though not mandatory) practice is to make the two portions symmetrical about the PRC. The tabulated data given in Table 4 makes the design much simpler. Fifteen miles per hour is the minimum tabulated speed, since

$$K=\frac{V^2}{46.5a}=\frac{(15)^2}{46.5\,(5)}=0.97 \tag{4}$$

if the maximum acceptable vertical acceleration is assumed to be 5 f.p.s.^{2} A value of K = 0.9 was shown earlier to be the minimum allowable due to vehicle underclearance. Instructions for use of the table are as follows:

- When designing dips on a uniform grade, enter the table with the uniform grade G. Establish the middle of the dip PRC at a distance Lo downgrade from the desired drainage point. Locate the VPI's, using GD and L. Lay out the taper T. Note that the tabulated GA is 2 percent greater than G.

- If entrance and exit grades are different, or if GA is not 2 percent greater than G, enter the table using the desired approach grade GA and use the adverse grade GD to connect the otherwise independently laid out curves. Length L is different for each curve and can be found by interpolation for each approach grade GA.

TABLE 4. – Dip Design Values for a = 5 f.p.s.[2]

Speed	Grade		Freeboard					
			0.5		1.0		1.5	
	G	GA	L	T	L	T	L	T
15			GD = 7.2 Lo = 7		GD = 10.2 Lo = 10		GD = 12.4 Lo = 12	
	2	4	11	25	14	42	16	58
	4	6	13	36	16	55	18	73
	6	8	15	48	18	71	20	91
	8	10	17	63	20	89	22	111
	10	12	19	80	22	108	24	133
	12	14	20	98	23	130	26	156
	14	16	22	119	25	153	28	182
20			GD = 5.4 Lo = 9		GD = 7.6 Lo = 13		GD = 9.3 Lo = 16	
	2	4	16	30	20	48	23	65
	4	6	20	46	23	68	26	88
	6	8	23	66	27	92	30	114
	8	10	26	89	30	118	33	144
	10	12	30	115	34	149	37	178
	12	14	33	145	37	182	40	214
25			GD = 4.3 Lo = 12		GD = 6.1 Lo = 16		GD = 7.5 Lo = 20	
	2	4	22	35	27	55	31	73
	4	6	28	58	32	82	36	104
	6	8	33	85	38	115	42	140
	8	10	38	118	43	153	47	182
	10	12	44	157	49	196	52	229
	12	14	49	201	54	244	58	281
30			GD = 3.6 Lo = 14		GD = 5.1 Lo = 20		GD = 6.2 Lo = 24	
	2	4	29	41	35	62	40	81
	4	6	37	70	43	97	47	121
	6	8	45	108	51	140	55	168
	8	10	53	153	58	191	63	223
	10	12	60	205	66	249	71	286

The procedures are equally suited for hand or computer computations of earthwork quantities. Automatic earthwork adjustment programs should not be used, however, since the computer will disturb the necessary relationships of the dip. Therefore, earthwork should be essentially balanced before the dips are introduced in the profile or, preferably, earthwork adjustments should be made by hand using unit mass factors.

Dip Location is an important design function. The purpose of the dip is to divert water from the road surface before it can do an unacceptable amount of damage. Therefore, the most effective locations are at the *top* of steep grades and at locations where the fill height is minimum. Correlation with horizontal alinement is needed to avoid hazardous situations, such as dipping the middle of a sharp curve.

When a dip is to be constructed in an existing road, the crest curve should be built from undisturbed material, since traffic will soon displace the loose fill material.

FIELD MEASUREMENTS

As previously mentioned, this rational approach to dip design is predicated upon knowledge of the maximum safe vertical acceleration. This section develops a technique for estimating this value and also adapts the technique to construction inspection.

Allowable maximum vertical accelerations can be determined by driving through a dip at various speeds and recording the speed which seems to be the upper limit for safe operation. Determining this acceptable acceleration value requires a highly subjective judgment which will be influenced by a variety of factors, such as type of vehicle, loaded weight, suspension stiffness, road alinement, dip skew, and driver experience. Because of the subjective nature of the measurements, it is important to develop a composite viewpoint representing a wide range of the factors mentioned above. Future issues of these FIELD NOTES should provide an excellent forum for disseminating experience obtained by engineers Service-wide.

The equivalent radius K is determined by profiling the dip as outlined in the following paragraphs. Once the vehicle speed and dip curvature K are known, the acceleration is easily calculated.

The following derivation leads to a simple means of calculating the vertical acceleration, once the elevations of three equally spaced points on the curve and the vehicle speed have been determined.

In general form, the equation of a parabola is $y = px^2 + qx + r$. The second derivative $Y = 2p$ expresses the sharpness of curvature or rate of change of grade (Meyer, Ref 4). This constant rate of change of grade is

$$2p = \frac{A}{L} = \frac{1}{K}$$

The vertical acceleration determined from Equation 4 is

$$a = \frac{1}{K} \times \frac{V^2}{46.5} \qquad (4a)$$

Acceleration is thus determined if the vertical curve sharpness, K, and velocity are known. The sharpness of curvature is found by measuring the elevations of three points equally spaced at distance h, as shown in Figure 6.

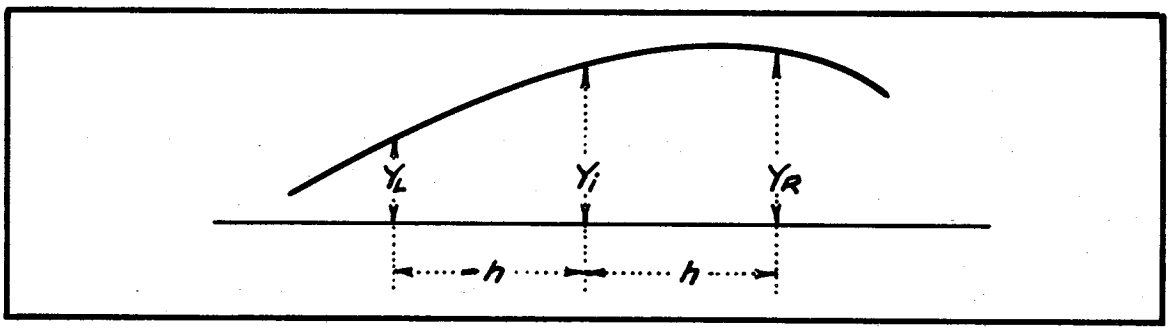


Figure 6. – Sharpness of Curvature.

Taking the origin at the point Y_i, the general parabola

$Y = px^2 + qx + r$ is evaluated at all three points:

$$Y_L = Y(-h) = ph^2 - qh + r$$

$$Y_i = Y(o) = r$$

$$Y_R = Y(h) = ph^2 + qh + r$$

Combining these equations gives

$$Y_L - 2Y_i + Y_R = 2ph^2$$

Finally, solve for 2p and multiply by 100 to express 2p in units of percent per foot.

$$2p = \frac{100}{h^2}(Y_L - 2Y_i + Y_R) = \frac{1}{K} \qquad (11)$$

This equation can be used in this form by plugging in the elevations (or rod readings) of the three points.

To illustrate the procedure, assume that the dip previously designed in Table 3 is constructed and that 20 m.p.h. is judged to be the maximum safe speed, by driving through it several times. The next step is to profile the dip. Three points spaced 10 feet apart have the following rod readings: 3.16, 2.65, 2.72.

Then,

$$\frac{1}{K} = \frac{100}{10^2}(3.16 - 2\,[\,2.65\,] + 2.72) = 0.58 \qquad (11a)$$

and

$$a = \frac{1}{K}\frac{V^2}{46.5} = (0.58)\frac{20^2}{46.5} = 5.0 \qquad (4a)$$

The mathematical agreement implies a precision which will not be obtainable under field conditions, since the constructed dips will not be perfect parabolas as in this contrived example.

Several refinements needed to cope with field irregularities are shown in the following example taken from actual measurements.

The rod readings are plotted with an exaggerated vertical scale and smoothed by eye as shown in Figure 7. Equally spaced measurements are not necessary – the object is to obtain an accurate profile and then scale equally spaced rod readings from the smoothed curve. Averaging two or three sets as shown will yield improved accuracy. The smoothing process will give better accuracy, because minor undulations are absorbed by the wheels and suspension and do not significantly affect the overall vehicle motion.

It is important to note that the value determined by this technique is not the true vertical acceleration experienced by the occupants of the vehicle due to the damping provided by the vehicle suspension, to effects of the dip skew, and to the fact that both upward and downward accelerations are experienced sequentially. Implicit in the foregoing description is the necessity of treating the crest and sag portions separately in the measurements and calculations. Perhaps the experience gained through measurement will indicate that the critical factor is the rate of *change* of acceleration, rather than the acceleration itself. Substantial modification of the technique presented here would undoubtedly result. Nevertheless, this paper will, hopefully, provide a rational basis for further investigations of dip design.

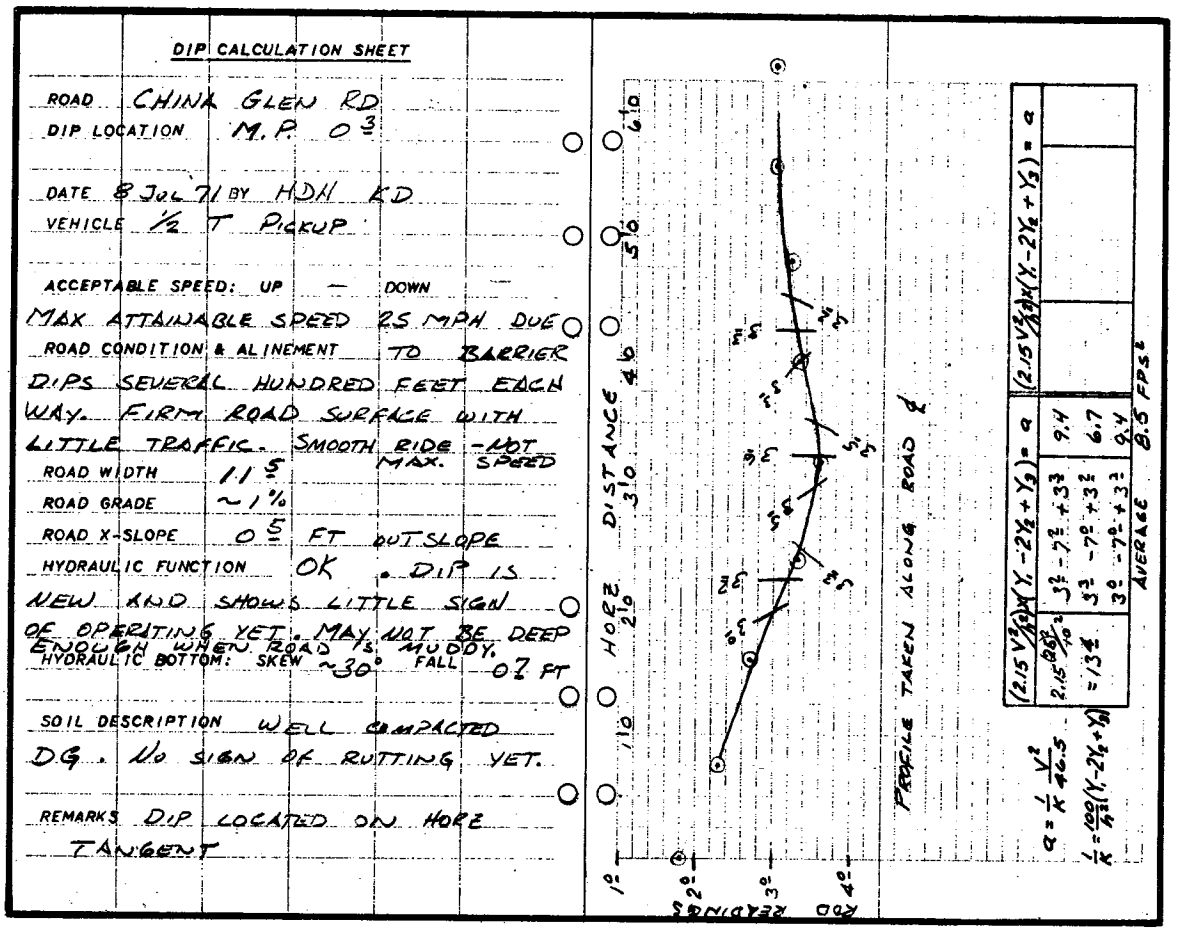


Figure 7. — Field Measurement and Calculation.

For *Construction Inspection*, it is merely necessary to profile the dip and check $\frac{1}{K}$ from Equation 11 against the value used in the design.

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NEW ENGINEERING ORIENTATION PROGRAM

By Richard G. Deleissegues,
Civil Engineer, Washington Office

The new Forest Service Orientation Program for Engineers was sent to the Regional Offices in January 1973. The new orientation program is a slide-tape presentation accompanied by a self-evaluation booklet (mini-exam). The Mini-Exam will indicate the student's level of comprehension. These slide-tape programs are in living color, short (from 11-15 minutes), informative, and interesting to both new and "regular" Forest Service employees. This program replaces the earlier engineering orientation system developed in 1969.

The 1969 programmed learning system had many strong points, such as:

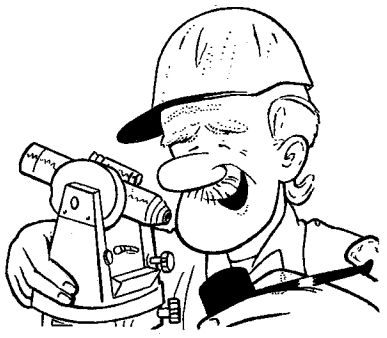
- It was accepted by management and well-received by both trainees and supervisors.
- It was effective in reducing attrition and effective as an operating and live program.
- It provided trainees with large amounts of orientation and background material and denoted specific engineering skills which are utilized by the Forest Service.
- It developed a professional interest and knowledge of available career alternatives and showed the trainee his role as a representative of the engineering profession on the Forest Service teams.

In the same context, some deficiencies in the 1969 programmed-learning subsystem series (SS) were noted. Some of these deficiencies were:

- The failure to complete SS-1 and SS-2 "at home" material due to its volume.
- It did not involve the first-line supervisor.
- The material was not well-designed for the trainees.
- The use of too much programmed instruction material which could not be used later as a reference tool.
- It lacked up-to-date audiovisual techniques.

Due to the deficiencies noted above, the program has been reanalyzed and the format changed to strengthen the shortcomings and to give new engineering employees the feeling of communicating with their supervisors. Past feedback from field evaluations of the program pinpointed the need to revise the first part of the system (the "at home" or office portion) and to include an interface and communication between the two people involved – the new employee and his supervisor.

The revised version of old SS-1, -2, and -3 is now called Phase I and consists of SS-1 through SS-5. These are available through Regional Offices for your immediate use.



The Old Timer

Revised SS-1 through SS-5 are characterized by eliminating the programmed learning which was not applicable in this situation and by using a brief, easy, and informal style, which is enhanced by the use of a colorful character called "O.T." (Old Timer).

The new orientation is well worth reviewing. Even if you are a seasoned employee, we encourage you to take the time to see it.

All Forest Service employees will benefit from the history, organization concept, current programs and challenges described in the orientation program. You may want to present this program to all Forest personnel – they are sure to learn something they didn't know about the Forest Service.

The new system consists of the following:

- TT 10 (7000) Supervisors' Guide
- TT 11 (7000) Part I - "The Greatest Good"
- TT 12 (7000) Part II - "The Great Tradition"
- TT 13 (7000) Part III - "Men to Match our Mountains"
- TT 14 (7000) Part IV - "Where the Action Is"
- TT 15 (7000) Part V - "Impact"
- TT 16 (7000) "Self-Evaluation, Mini-Exam"
- TT 17 (7000) "Orientation Booklet" – includes an introduction, suggested reading list and a glossary of often-used words, abbreviations, and acronyms.

The trainee will need only booklets TT 16, "Self-Evaluation, Mini-Exam," and TT 17, "Orientation Booklet." Sufficient quantities of these two training booklets were sent to Regional Offices for distribution to new employees. The remaining booklets are kept with

the slide-tape programs. The binder should stay with the program set (slides and tapes) when the program is sent to Forests and when it is returned to the Regional Offices.

Additional copies of all training booklets for this program are available, in limited numbers, through Central Supply, Washington Office.

Previous orientation subsystems, TT 10 through TT 17, are no longer available through the WO Central Supply – the new training texts for the slide-tape programs have replaced them. A limited supply of the old, programmed learning orientation system texts is available until July 1974 from the Division of Engineering, Washington Office. SS-1 contains the history, mission and organization of engineering in the Forest Service and a Program and Appropriation Section. All other subsystems are still available for use.

After you have seen the five slide-tape programs in the new Engineering Orientation System, we would appreciate hearing your comments, both good and bad, on the package, including any ideas you have for improving it.

Let the "Old Timer" tell you all about the Forest Service – it's interesting, informative, and it's a subject about which we should be well informed.

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Region 5.
Slide-Tape Wins Award

V. M. Dekalb, Project Leader of the Transportation Planning Project; Ann Corneille, Past President of the Oakland Board of Education and sponsor of the film strip award; and James Halverson of the Lawrence Berkeley Laboratory, who produced the slide tape show receive the award.

The Forest Service's Transportation Planning Project located in Berkeley, and assigned to the Division of Engineering, R-5, has received the 1973 National Educational Film Festival Ann Corneille Award for a recently produced slide presentation. The show is entitled "The What-if Analysis" and was developed for explaining transportation analysis tools to Forest Officers in management and staff positions.

The presentation won the "Best of Slide-Tape Trophy in the Film Festival," which was held in Oakland in April. It was one of over 200 film and slide entries entered internationally.

The Transporation System Planning Project is completing the development of various computerized analysis techniques for use in planning and managing road systems on National Forests. These techniques, ranging from network analysis to data collection, are being developed in cooperation with the University of California, Berkeley; Stanford University; and San Jose State University. Implementation has begun on the Project in the field, and widespread Forest Service use should occur within a few years. "The What-if Analysis" show is available upon request from the Division of Engineering, R-5 RO.

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Editor's Note: We will be happy to publish news items from all Regions. What's the news in Regions 1, 2, 3, 4, 6, 8, 9 and 10? Please submit your news item to reach the Washington Office on the first day of the month preceding the next month's publication.

CONSULTATION AND STANDARDS

C. R. Weller
Assistant Director

Chippewa Flowage. Chippewa Flowage is a 17,000-acre expanse of near-pristine water, shoreline, and land. Ninety-two percent of the 205 miles of shoreline is undeveloped. The area has National significance due to its wild atmosphere and reputation as the best muskellunge fishing in the world. There are approximately 27,000 acres within the project boundary: Northern States Power Company owns approximately 25,000 acres; LacCourte Oreilles Indian tribe owns approximately 1,800 acres; and 110 acres are National Forest. All power is generated downstream of the dam with releases from the dam. The project is now before the Federal Power Commission for relicensing and is the focal point of a major natural resource controversy. This is the first project recommended for recapture by the Forest Service.

Because of the resource values, the U. S. Department of Agriculture, in 1968, recommended recapture of the project lands by the Federal Government and that the lands be integrated into the contiguous Chequamegon National Forest. In March 1972, U. S. Department of the Interior also recommended recapture and return of Indian lands to the LacCourte tribe – the remainder to be a part of the National Forest.

Conservation groups have alleged that present management threatens the ecological and environmental values. Petitions to intervene have been filed by both supporters and opponents to the relicensing. Several State agencies have also been involved. On-the-ground public involvement appears to favor recapture.

Hearings on the relicensing have already been held in Sawyer County, Wisconsin; they started in Washington, D.C. September 13.

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TECHNOLOGICAL IMPROVEMENTS

Heyward T. Taylor
Assistant Director

Evaluation of Trade Name Products Used in Highway Construction or Maintenance. An evaluation of highway trade name products has been distributed to all Regional Materials Engineers by memorandum dated August 24, 1973. Nearly 1,000 different products in 23 categories were evaluated. The 80-page list of products was compiled by the AASHO Subcommittee on Materials from information supplied by various State highway departments. The list was made available to the Forest Service through its membership and participation in the AASHO Subcommittee on Materials. Each product is listed by name along with the manufacturer's name and address, a description and use, status with respect to acceptance or rejection, and a brief explanation of the evaluation. The categories in which the products were evaluated are:

1. Aggregates
2. Bituminous materials and additives
3. Portland cement concrete curing materials
4. Portland cement concrete admixtures
5. Waterproofing membranes and materials
6. Concrete finishing products
7. Concrete patching materials
8. Barriers and roadside structures
9. Culverts and drainage structures
10. Deicing chemicals
11. Skid control systems
12. Testing and construction equipment
13. Structural materials and components
14. Structural paints
15. Bituminous rejuvenators and preservatives
16. Reflective crack control
17. Soil stabilizers
18. Traffic marking materials
19. Mulch and erosion controls
20. Miscellaneous
21. Rust passivators
22. Joint fillers, seals and materials
23. Adhesives

Regional Materials Engineers are in the best position to decide on the usefulness of the various trade name products with respect to their use in a forest environment. They should be consulted for further information in this area.

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Harold L. Strickland
Assistant Director

Engineering Management. The Washington Office Engineering Management Section functions as staff support to the Assistant Director for Engineering, Operations and Management; the Director of Engineering; and the Deputy Chief's Office for National Forest Systems.

The Section's principal functions are handling Congressional mail and liaison with Congress on matters dealing with Forest Development Roads and Trails and Pollution Abatement Programs. The section is staffed with four people: Messrs. Frank Hammond and Dale O. Frost, Management Engineers (working titles); Mrs. Aileene McVay, Management Assistant; and Mrs. Phyllis Aiken, secretary. Engineering Management personnel prepare and/or coordinate all material concerning the budget requests for the above programs, participate in NFS budget analyses, and prepare and coordinate backup materials for hearings on appropriation bills and other legislation affecting engineering activities and services of the Forest Service. The sources for this information are the reports you in the field submit. Projections and/or adjustments are made based on historical data from your reports and from multilevel projections of needs sent in by you.

The complete budget cycle takes two years from the time requests go out from Washington for information until you receive an allocation; things change in that time; new pressures develop. As examples, and of specific interest to you at this time, are:

- The Federal Aid Highway Act of 1973 and its supporting reports which direct the use of authorizations provided for in the Act, and provide for $140 million each year for roads and trails, 1974-1976 (see Field Notes, Vol. 2, Number 6, June 1970, on how authorization affects program levels).

- The Appropriations Act for FY 1974 now before Congress and its supporting reports which prohibit the use of funds for preparing sales specifying purchase location, survey, and design.

- Pending legislation which will set drinking water standards and provide for state monitoring and regulation of our water systems and their use.

Copies of these actions are available and can be secured by your Operations section for your review. The impacts of these actions will be analyzed and reflected to you as fully as possible in the FY 1974 final allotments, FY 1975 tentative allotments, and FY 1976 Chief's Program and Work Planning Advice.

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