PUBLIC ROADS

A JOURNAL OF HIGHWAY RESEARCH

FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION

VOL. 23, NO. 5 ▽ JULY-AUGUST-SEPTEMBER 1942

ENGINEERS MEASURE THE STRENGTH OF A MONOLITHIC BRICK TEST SLAB

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - - - - - - - - - - - See page 2 of cover for prices

PUBLIC ROADS ▸▸▸ *A Journal of Highway Research*

issued by the

FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION

D. M. BEACH, *Editor*

Volume 23, No. 5 July–August–September 1942

The reports of research published in this magazine are necessarily qualified by the conditions of the tests from which the data are obtained. Whenever it is deemed possible to do so, generalizations are drawn from the results of the tests; and, unless this is done, the conclusions formulated must be considered as specifically pertinent only to described conditions.

In This Issue

THE PUBLIC ROADS ADMINISTRATION - - - - - - - - - Willard Building, Washington, D. C.

REGIONAL HEADQUARTERS - 720 Phelan Building, San Francisco, Calif.

▼

DISTRICT OFFICES

DISTRICT No. 1. Oregon, Washington, and Montana.
Post Office Building, Portland, Oreg.

DISTRICT No. 2. California, Arizona, and Nevada.
720 Phelan Building, San Francisco, Calif.

DISTRICT No. 3. Colorado, New Mexico, and Wyoming.
254 New Customhouse, Denver, Colo.

DISTRICT No. 4. Minnesota, North Dakota, South Dakota, and Wisconsin.
1109 Main Post Office Building, St. Paul, Minn.

DISTRICT No. 5. Iowa, Kansas, Missouri, and Nebraska.
729 U. S. Courthouse, Kansas City, Mo.

DISTRICT No. 6. Arkansas, Louisiana, Oklahoma, and Texas.
Room 502, United States Courthouse, Fort Worth, Tex.

DISTRICT No. 7. Illinois, Indiana, Kentucky, and Michigan.
South Chicago Post Office Building, Chicago, Ill

DISTRICT No. 8. Alabama, Georgia, Florida, Mississippi, and Tennessee.
Post Office Building, Montgomery, Ala.

DISTRICT No. 9. Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.
76 State St., Albany, N. Y.

DISTRICT No. 10. Delaware, Maryland, Ohio, Pennsylvania, and District of Columbia.
Willard Building, Washington, D. C.

DISTRICT No. 11. Alaska.
Room 419, Federal and Territorial Building, Juneau, Alaska.

DISTRICT No. 12. Idaho and Utah.
Federal Building, Ogden, Utah.

DISTRICT No. 14. North Carolina, South Carolina, Virginia, and West Virginia.
Montgomery Building, Spartanburg, S. C.

ALASKA HIGHWAY DISTRICT.
303 Hoge Building, Seattle, Wash.

TESTS OF MONOLITHIC BRICK PAVEMENT SLABS

BY THE DIVISION OF TESTS, PUBLIC ROADS ADMINISTRATION

Reported by W. F. KELLERMANN, Materials Engineer

Some years ago monolithic pavements were constructed by placing the brick in the fresh concrete of the base and filling the joints with mortar. This type of pavement was discarded in favor of the conventional two-course brick pavement (1) because of trouble experienced with blow-ups which resulted from the absence of adequate expansion joints and (2) because the riding qualities were not as good as those of other high type pavements.

This report describes a recent development in the technique of constructing monolithic brick pavements and discusses the results of a series of tests made to determine the quality of pavement slabs so constructed as compared with the quality of pavement slabs constructed entirely of concrete.

The results of these tests have indicated that monolithic brick slabs, when tested with the concrete in tension, developed higher flexural strengths than comparable slabs of plain concrete. However, when the brick surface was placed in tension, the monolithic brick slabs developed much lower strengths than comparable slabs of plain concrete. In the latter case the angle at which the brick courses were placed with respect to the loading knife edge of the testing machine had an effect upon the results obtained.

In tests made with the brick surface in tension, the bond between the concrete and the brick was not affected by 100 applications of load equal to 50 percent of the ultimate load.

In the construction of brick pavements with concrete bases it has been customary during recent years to lay the brick in a bedding course of sand, or a mixture of sand and bitumen, that has been spread on the hardened concrete base, and to fill the joints between the brick with bitumen. With this type of construction, known as the two-course type, the brick wearing course could not be expected to add appreciably to the strength of the concrete base.

A number of years ago monolithic brick pavements were constructed by laying the brick in the fresh concrete of the base, rolling with a light roller, and filling the joints with cement grout. At that time the need for expansion joints was not fully appreciated and much trouble was experienced with blow-ups caused by expansion. Also the riding qualities of monolithic brick pavements did not compare favorably with the riding qualities of other high-type pavements. As a result, the monolithic type fell into disuse and the two-course type was used exclusively in brick pavement construction.

With the introduction of surface vibration as a means of compacting the concrete in pavement slabs, new possibilities were presented for the construction of monolithic brick pavements. Consequently, several monolithic brick pavements have been built in which the brick have been embedded in the concrete base by means of high-frequency surface vibrators, rather than by rollers.

The procedure is first to build the usual concrete base using a finishing machine equipped with surface vibrators. The brick are then immediately placed on the fresh concrete and vibrated with a machine designed especially for the purpose. This machine is built along the same general lines as the conventional finishing machine except that in place of the conventional screeds there is a special screed consisting of a series of steel channels. These channels are vibrated as they ride over the brick, with the result that the brick are brought to proper elevation, at the same time being forced down about ⅛ inch into the concrete. A thin sand-cement grout is then squeegeed over the brick surface, filling the joints. After the grout has taken its initial set, a second application of somewhat stiffer grout is applied. A final mortar finish over the entire surface is obtained by use of a burlap drag. It is claimed that this type of construction eliminates the objectionable features of the old-type monolithic pavement and that pavements constructed by this method are superior in many respects to the two-course type.

TWO SERIES OF TESTS MADE

In order to determine the flexural strengths of monolithic brick slabs constructed in this manner as compared with those of plain concrete compacted by surface vibration, two series of laboratory tests (series A and series B) were initiated in which the following variables were studied:

SERIES A

1. Effect of total depth of slab.
2. Effect of testing the top surface of the slab, as cast, in tension as compared with the bottom surface.
3. Effect of angle of brick courses with respect to the longitudinal axis of slab.
4. Effect of repeated loadings.

SERIES B

1. Effect of testing the top surface of the slab in tension as compared with the bottom surface.
2. Effect of angle of brick courses with respect to longitudinal axis of slab.
3. Effect of richness of concrete mix.

The brick used in these tests were the conventional 3- by 4- by 8½-inch vertical fiber lug brick normally used in pavement construction. Grout used as a filler was proportioned 1:2 by dry loose volume with sufficient water to give the desired consistency. Tables 1 and 2 give the physical properties of the aggregate while the mix data for the concrete and the grout are given in tables 3 and 4, respectively. Different cements were used in the two series. Results of strength tests on the two cements are as follows:

	Tensile strength, lb. per sq. in.
Series A:	
At 7 days	405
At 28 days	485
Series B:	
At 7 days	380
At 28 days	435

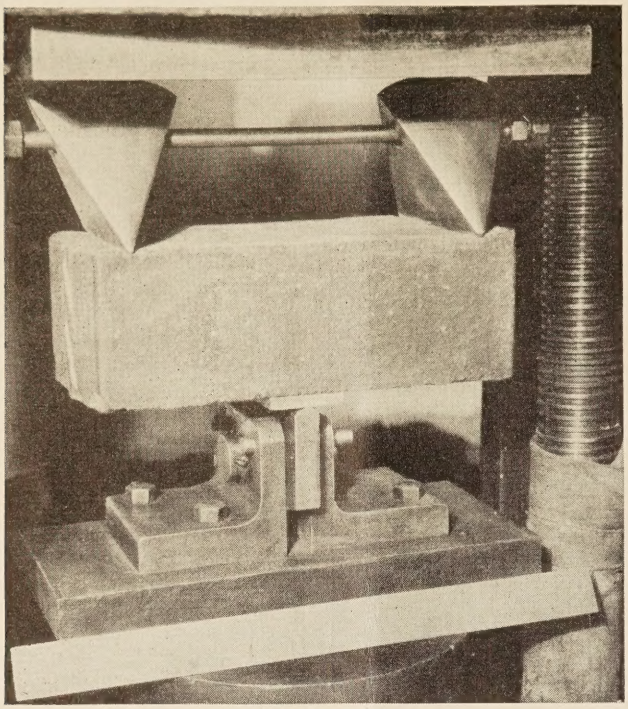


FIGURE 1.—SET-UP USED IN DETERMINING FLEXURAL STRENGTH OF PAVING BRICK.

TABLE 1.—*Physical properties of aggregates for monolithic brick pavement slabs*

Aggregates	Character of aggregate	Bulk specific gravity	Weight per cubic foot		Voids, dry rodded	Absorption	Los Angeles abrasion loss [1]
			Solid	Dry rodded			
For concrete:			*Pounds*	*Pounds*	*Percent*	*Percent*	*Percent*
Sand, series A	Quartz	2.59	162	106	35	1.00	
Sand, series B	do	2.57	160	105	34	1.50	
Gravel	do	2.58	161	107	34	.99	28.0
For grout: Sand	do	2.60	162	[2] 90	[2] 44	1.00	

[1] Grading A used. [2] Dry loose.

TABLE 2.—*Grading of aggregates for monolithic brick pavement slabs*

Sieve size	Percentage retained			
	Mortar sand	Concrete sand		Gravel
		Series A	Series B	
1½-inch	0	0	0	0
1-inch	0	0	0	38
¾-inch	0	0	0	57
⅜-inch	0	0	0	86
No. 4	0	1	1	100
No. 8	0	13	16	100
No. 16	0	25	31	100
No. 30	17	42	54	100
No. 50	65	74	83	100
No. 100	94	95	96	100
Fineness modulus	1.76	2.50	2.81	7.43

Results of tests made on the brick are given in table 5. The set-up for determining the flexural strength of the brick is shown in figure 1.

In this report the term "pavement concrete" is used to designate concrete containing 6 sacks of cement per cubic yard, which is a class commonly used in pavements. The term "base concrete" is used to designate concrete containing 4¾ sacks of cement per cubic yard, which is a class frequently used in the construction of bases.

Pavement concrete was used in series A, with sufficient water to produce a slump of approximately 1 inch.

Test specimens consisted of slabs approximately 26 inches wide by 60 inches long and 7, 8, and 10 inches in depth. Both plain concrete and monolithic brick slabs were cast for each thickness.

TABLE 3.—*Data on concrete mixes for monolithic brick pavement slabs*

Proportions by weight, pounds	W/C by volume	W_o by volume (1)	b/b_0 (2)	Mortar voids ratio	Sand in total aggregate, by weight	Cement factor	Slump
					Percent	*Sacks per cu. yd.*	*Inches*
Series A: 94 : 173 : 367	0.65	0.145	0.77	1.87	32	6.0	1.0
Series B:							
94 : 184 : 356	.65	.145	.74	2.02	34	6.0	.75
94 : 253 : 451	.84	.148	.74	2.04	36	4.75	.75

[1] Water per unit volume of concrete.
[2] Apparent volume of coarse aggregate per unit volume of concrete, dry rodded basis.

TABLE 4.—*Data on grout used in monolithic brick pavement slabs, series A and B*

Proportions		W/C by volume	
By dry loose volume	By weight	First grout	Second grout
1:2	*Pounds* 94:180	1.01	0.86

TABLE 5.—*Physical properties of paving brick used in monolithic brick pavement slabs*

Test	Average [1]	Maximum	Minimum
Absorption.....percent	4.54	5.67	3.54
Specific gravity	2.36	2.39	2.32
Standard rattler.....percent	[2] 13.6		
Modulus of rupture—pounds per square inch	2,250	2,540	1,980
Crushing strength.....do	18,380	21,690	12,830

[1] Each result is the average for 10 tests except where otherwise noted.
[2] One test.

The plain concrete slabs were constructed in the following manner: The form was filled and an excess of concrete placed on top in order to allow for subsidence. Two complete passes were then made over the entire surface with a platform vibrator operating at a frequency of 7,000 pulsations per minute. The slab was then struck off with a wooden screed. In the case of the monolithic brick slabs the form was filled to within 2½ inches of the top and the concrete vibrated in the same manner. The brick were then set in the fresh concrete and vibrated in the same manner as for the plain concrete slabs (see fig. 2). This procedure resulted in twice as much vibration of the concrete in the monolithic as in the plain concrete slabs. It was adopted because it followed actual practice for the two different types of construction in the field.

After vibrating, a 1:2 mortar grout sufficiently thin to penetrate the joints was squeegeed over the surface. As this grout stiffened it also subsided, leaving the joints low. A second and somewhat thicker grout was then applied to fill the joints. The final finish was with a burlap drag, leaving a thin mortar top over the entire surface.

All slabs were kept under wet burlap for 2 days, after which they were removed from the molds and cured in a fog room at 70° F. until tested at 29 days. In the monolithic brick slabs, three different arrangements of the brick were used. In one case the brick were laid with the courses parallel to the longitudinal axis of the slab. In the second case they were laid transversely to the longitudinal axis of the slab; while in the third case they were laid at an angle of 45°.

One group of slabs was tested with the bottom as cast in tension; the other group was tested with the top or brick surface in tension. Those slabs tested with the bottom in tension were made in groups of three, of which one was a plain concrete slab and two were monolithic brick. When testing the concrete slab and one of the monolithic slabs, each slab was loaded to failure with one application of loading. This method of loading will be referred to as instantaneous loading. The other monolithic slab was given 100 applications of a load equivalent to one-half the ultimate load obtained in the test of the first monolithic slab. The specimen was then loaded to failure. This procedure was followed in order to determine whether 100 repetitions of 50 percent of the ultimate load would produce any separation of the brick surface from the concrete base. Table 6 gives a complete outline of the procedure together with the strength results. All slabs were tested in a portable testing machine, using a pair of calibrated, heat-treated steel beams as a load-measuring device. The cover illustration shows a set-up of the testing equipment. The specimens were tested as simple beams with the load applied at the center of a 54-inch span.

TABLE 6.—*Summary of results of flexure tests on monolithic brick pavement slabs, series A* [1]

Structure	Nominal depth of slab	Surface in tension [2]	Direction of knife edge of applied load [3]	Coarse aggregate broken	Flexural strength,[4] age 29 days	Strength ratio [5]
	Inches			*Percent*	*Lb./sq. in.*	*Percent*
Concrete	7	Bottom		55	730	100
Monolithic brick	7	do	Parallel	60	868	119
Do	7	do	do.[6]	70	841	115
Concrete	8	do		60	741	100
Monolithic brick	8	do	Parallel	65	840	113
Do	8	do	do.[6]	55	788	106
Concrete	10	do		50	728	100
Monolithic brick	10	do	Parallel	65	859	118
Do	10	do	do.[6]	60	884	121
Concrete	7	Top		55	797	100
Monolithic brick	7	do	Perpendicular	65	636	80
Do	7	do	45° angle	70	535	67
Do	7	do	Parallel	45	341	43
Concrete	8	do		60	845	100
Monolithic brick	8	do	Perpendicular	50	724	86
Do	8	do	45° angle	50	508	60
Do	8	do	Parallel	40	367	43
Concrete	10	do		50	776	100
Monolithic brick	10	do	Perpendicular	60	790	102
Do	10	do	45° angle	40	588	76
Do	10	do	Parallel	55	443	57

[1] Specimens 26 inches wide by 60 inches long (approximately); tested with center loading on 54-inch span after 29 days of moist curing.
[2] In all cases where the slabs were tested with the bottom surface in tension, each result is the average of two tests. All other values are individual test results.
[3] With respect to the line of continuous brick courses.
[4] Flexural strength computed with the neutral axis assumed at the center of the slab.
[5] Plain concrete slabs in each case were taken as standard.
[6] Given 100 repetitions of a load equal to 50 percent of the ultimate load of the corresponding slab and then tested to failure.

RICHNESS OF CONCRETE MIXTURE A VARIABLE IN SERIES B

In series B the same procedure of casting, curing, and testing was employed as in series A, except that in the brick slabs that were tested with the top, as cast, in tension, the brick were placed at an angle of 45° with respect to the longitudinal axis instead of in three different ways, as was done in series A. Also, all specimens were tested by instantaneous loading. Tests were made at 28 days instead of at 29 days as in series A.

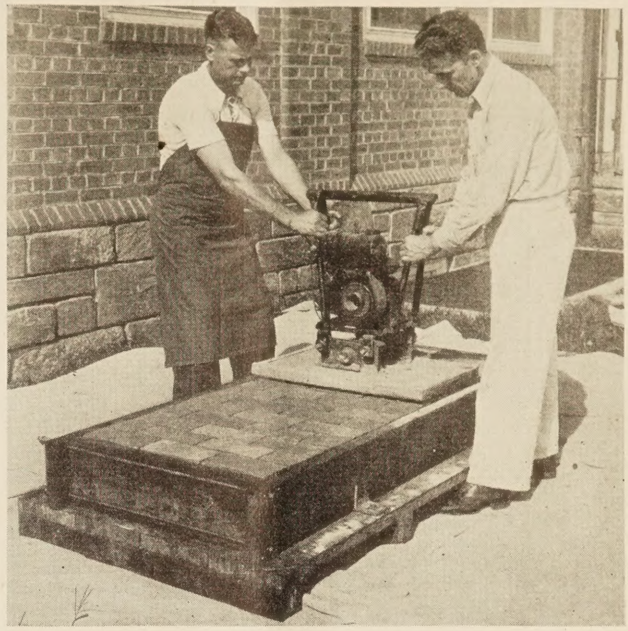


FIGURE 2.—VIBRATOR USED FOR COMPACTING PLAIN CONCRETE AND MONOLITHIC BRICK SLABS.

One variable, not included in series A but studied in series B, was the effect of the richness of the concrete mix. In series A pavement concrete was used in all slabs, while in series B both pavement concrete and base concrete were used. This was done in order to compare the strength of monolithic brick slabs of base concrete directly with the strength of vibrated pavement concrete of the same total thickness. The effect of depth of slab was not studied in series B, all specimens being 8 inches thick.

Strength results are tabulated in table 6 and shown in graphical form in figure 3. In computing the values for modulus of rupture it was assumed that the neutral axis was at the center of the slab. It is realized that this may not be a correct assumption, particularly in the case of the monolithic brick slabs. However, for purposes of determining comparative load-carrying capacity, this procedure is justified, since comparisons are made between monolithic brick and plain concrete specimens of equal thickness. The same comparisons could be made with the total breaking loads.

Considering first the results plotted in figure 3 for those specimens tested with the bottom, as cast, in tension (brick surface in compression) the monolithic brick slabs gave higher values for computed modulii of rupture than did those of plain concrete. This was true for slabs of all thicknesses tested. The modulus of rupture of the monolithic brick specimens tested instantaneously averaged 17 percent higher than that of the plain concrete, while for the monolithic slabs given 100 repetitions of 50 percent loading the modulus of rupture averaged 14 percent higher than that of the plain concrete. It will be noted that in two out of three cases the monolithic brick slabs given 100 repetitions of 50 percent of the ultimate load and then loaded to failure gave slightly lower strengths than did

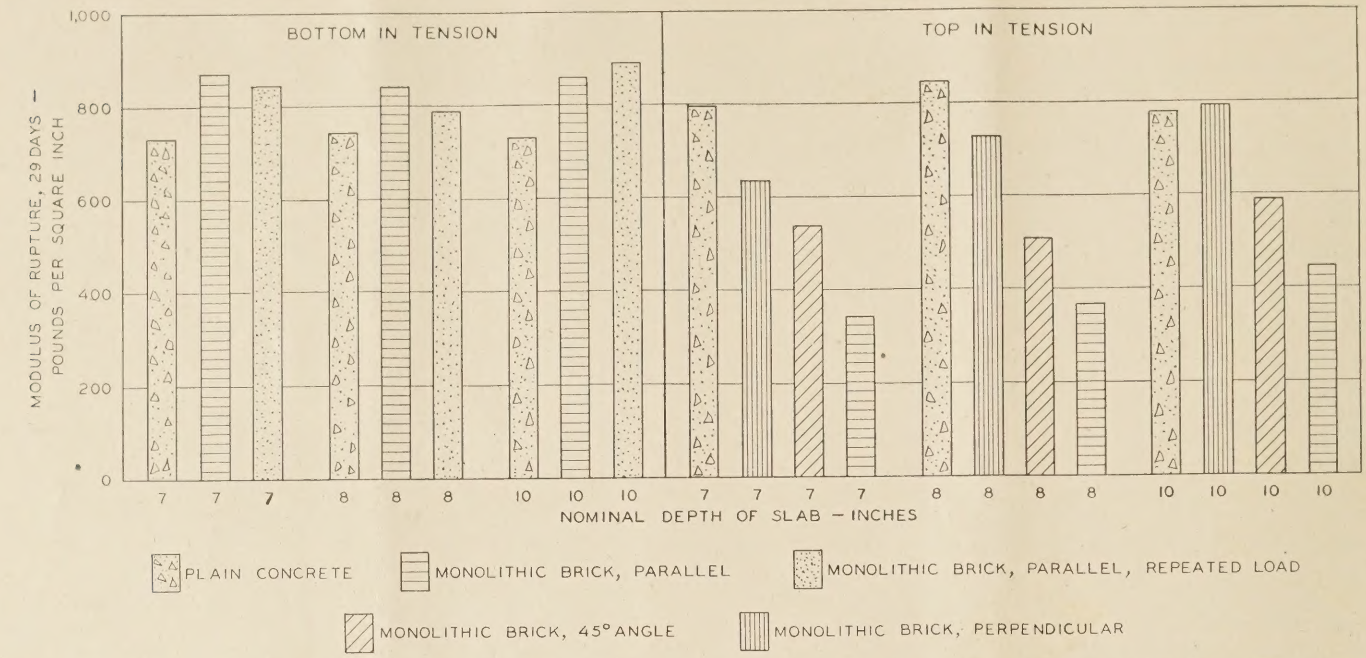


Figure 3.—Results of Flexure Tests on Monolithic Brick Pavement Slabs, Series A, at Age of 29 Days. "Parallel," "45° Angle," and "Perpendicular" Refer to the Direction of Knife Edge of Applied Load with Respect to the Line of Continuous Brick Courses. "Repeated Load" Indicates Slabs Were Given 100 Repetitions of a Load Equal to 50 Percent of the Ultimate Load of the Corresponding Slab and Then Tested to Failure.

the corresponding slabs tested with but one application of loading. It was anticipated that the repeated flexing of the slab might tend to destroy the bond between the brick surface and the concrete base but apparently this did not take place since the differences between the results obtained with the single loading and after repeated loading are within the limits of experimental error.

In all cases where the slabs were tested after repeated loadings, the percentage of brick broken at the section was less than in cases where they were tested with but one application of load. In the case of the 7-inch monolithic brick slabs tested by instantaneous loading the percentage of brick broken was 40 while for the companion slabs tested after repeated loading the percentage was 20. For the 8-inch slabs the differential was even greater whereas for the 10-inch slabs it was somewhat less.

Data for the slabs tested with the top surface, as cast, in tension are also plotted in figure 3. In this group no specimens were given repeated loadings. However, the brick were placed in three different directions so that there were four slabs in each group, one of plain concrete and three of monolithic brick. In each group the left bar represents the strength of the plain concrete while the second bar represents the strength of monolithic brick slabs in which the line of continuous courses of brick was perpendicular to the axis of the loading knife edge of the testing machine. In this case the maximum bending moment occurred at the center of the individual brick in three of the six brick courses in the cross section, while, due to the staggering of courses, the maximum bending moment occurred at the joint between brick and mortar in the other three cases. This is illustrated in figure 4–A, which shows a view of a fractured monolithic slab.

The third bar in the group gives the strength of monolithic brick slabs in which the direction of brick courses was at an angle of 45° to the axis of the loading knife edge. In this test failure occurred at the joint between the mortar and the brick (see fig. 4–B). The fourth bar in each group gives the strength of monolithic brick slabs in which the courses of brick were parallel to the axis of the loading knife edge. As was to be expected from this procedure, failure occurred at the joint between the brick and the mortar as shown in figure 4–C.

STRENGTH AFFECTED BY DIRECTION OF BRICK COURSES

The direction of the courses of brick had a marked influence upon the strength. Of the three ways of placing the brick, the highest strengths were obtained by placing the line of brick courses perpendicular to the axis of the loading knife edge, while the lowest strengths were obtained by placing the line of brick courses parallel to the axis of the loading knife edge. Brick courses placed at an angle of 45° to the loading knife edge gave intermediate results. Because of the failure in bond between the brick and grout, the monolithic brick slabs tested with the brick in tension gave much lower results than did the plain concrete slabs, the only exception being the 10-inch monolithic slabs with the brick courses perpendicular to the axis of the loading knife edge, which gave results slightly higher than those obtained with the plain concrete.

In summary, it was found that monolithic brick slabs tested with the concrete surface in tension gave results about 17 percent higher than those for plain concrete of equal thickness. On the other hand, when tested with the brick surface in tension and with the courses of brick set parallel to the axis of the loading knife edge, monolithic brick averaged only about 50 percent of the strength of plain concrete. The direction of the brick courses in the slabs had a marked effect in this test. Those slabs in which the courses of brick were set

(Continued on page 97)

VERTICAL CURVES FOR HIGHWAYS

BY THE DIVISION OF DESIGN, PUBLIC ROADS ADMINISTRATION

Reported by D. W. LOUTZENHEISER, Associate Highway Engineer

Length of vertical curve.—Any vertical curve on a highway should be as long as possible but the minimum length should be based on the sight distance requirements for the highway. The sight distances required are based on the assumed design speed for the highway. At any point on a highway the sight distance should be at least long enough that a vehicle traveling at the design speed can, upon sight of an object on the road, be brought to a stop before reaching it. Such sight distances are known as "nonpassing sight distances" and are not long enough on 2-lane roads for safe passing of vehicles in the same direction in the face of opposing traffic. Sight distances safe for passing on 2- and 3-lane roads are known as "passing sight distances." They rarely can be provided at all points, but they should be provided at frequent intervals.

The pamphlet "A Policy on Sight Distances for Highways," published by the American Association of State Highway Officials, presents a discussion of pertinent factors, calculations of and recommendations for minimum values of both nonpassing and passing sight distances for various highway design speeds. Tables 1 and 2 give the minimum lengths of vertical curve necessary for the various design speed-sight distance requirements. Reference is made to the sight distance policy for the numerical values of the various sight distances and formulas for calculation.

TABLE 1.—*Minimum length of vertical curves to provide minimum nonpassing sight distance*

A=algebraic difference of grades—percent	Length of vertical curve for assumed design speed of—				
	30 mi. per hr.	40 mi. per hr.	50 mi. per hr.	60 mi. per hr.	70 mi. per hr.
	Stations	*Stations*	*Stations*	*Stations*	*Stations*
2	0	0	0.9	2.2	4.7
3	0	.6	2.2	4.6	7.4
4	.4	1.8	3.4	6.2	9.9
5	1.1	2.5	4.2	7.7	12.4
6	1.6	3.1	5.0	9.3	14.8
7	1.9	3.6	5.9	10.8	17.3
8	2.2	4.2	6.7	12.4	19.8
9	2.5	4.7	7.6	13.9	22.2
10	2.8	5.2	8.4	15.5	24.7
11	3.0	5.7	9.2	17.0	--------
12	3.3	6.2	10.1	18.6	--------
13	3.6	6.8	10.9	20.1	--------
14	3.8	7.3	11.8	21.7	--------
15	4.1	7.8	12.6	23.2	--------
16	4.4	8.3	13.5	--------	--------
17	4.7	8.8	14.3	--------	--------
18	4.9	9.3	15.1	--------	--------
19	5.2	9.8	16.0	--------	--------
20	5.5	10.4	16.8	--------	--------

Calculations of elevations on vertical curves. Terms used are as follows (see fig. 1):

g_1 and g_2=grades, percent;
A=algebraic difference of grades, percent;
L=length of vertical curve, stations;
t=distance from end of curve, feet; and
d=vertical distance between grade line and vertical curve, feet.

The basic formulas are:

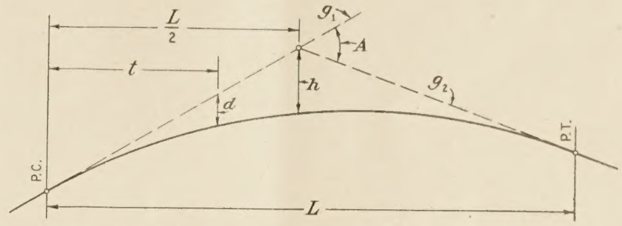


FIGURE 1.—CALCULATION OF ELEVATIONS ON VERTICAL CURVES.

TABLE 2.—*Minimum length of vertical curves to provide minimum passing sight distance*

A=algebraic difference of grades—percent	Length of vertical curve on 2-lane roads for assumed design speed of—					Length of vertical curve on 3-lane roads for assumed design speed of—		
	30 mi. per hr.	40 mi. per hr.	50 mi. per hr.	60 mi. per hr.	70 mi. per hr.	50 mi. per hr.	60 mi. per hr.	70 mi. per hr.
	Stations	*Stations*	*Stations*	*Stations*	*Stations*	*Stations*	*Stations*	*Stations*
1.00	--------	--------	--------	6.0	22.0	--------	--------	0
1.25	--------	--------	0	13.2	29.2	--------	0	7.2
1.50	--------	--------	4.0	18.0	35.0	--------	2.0	12.0
1.75	--------	--------	7.4	21.4	40.9	--------	5.4	15.4
2.00	--------	0	10.0	24.5	46.7	0	8.0	18.0
2.5	--------	3.6	13.6	30.6	--------	3.6	11.6	22.5
3.0	--------	6.0	16.3	36.8	--------	6.0	14.1	27.0
3.5	0	7.7	19.1	42.9	--------	7.7	16.4	31.5
4.0	1.0	9.0	21.8	49.0	--------	9.0	18.8	36.0
4.5	2.0	10.1	24.5	--------	--------	10.1	21.1	40.5
5.0	2.8	11.2	27.2	--------	--------	11.2	23.5	45.0
5.5	3.5	12.4	29.9	--------	--------	12.4	25.8	--------
6.0	4.0	13.5	32.7	--------	--------	13.5	28.2	--------
7	4.9	15.8	38.1	--------	--------	15.8	32.9	--------
8	5.6	18.0	43.6	--------	--------	18.0	37.6	--------
9	6.2	20.2	49.0	--------	--------	20.2	42.2	--------
10	6.9	22.5	--------	--------	--------	22.5	46.9	--------
11	7.6	24.8	--------	--------	--------	24.8	--------	--------
12	8.3	27.0	--------	--------	--------	27.0	--------	--------
13	9.0	29.2	--------	--------	--------	29.2	--------	--------
14	9.7	31.5	--------	--------	--------	31.5	--------	--------
15	10.4	33.8	--------	--------	--------	33.8	--------	--------
16	11.1	36.0	--------	--------	--------	36.0	--------	--------

$$g_1-g_2=A$$

$$h=\frac{AL}{8}$$

$$\frac{d}{h}=\frac{t^2}{2,500\ L^2}.$$

The value of d may be expressed as

$$d=\frac{A}{L}\times K,$$

where

$$K=\frac{t^2}{20,000}.$$

Table 3 gives values of $\frac{A}{L}$. Values given are for whole numbers of A and L; for intermediate values interpolate or calculate $\frac{A}{L}$ directly. Table 4 gives values of K for various values of t. Then d=value of $\frac{A}{L}$ from table 3 times value of K from table 4.

Figure 2 is a nomograph which permits a more rapid but less accurate solution for one of the above factors when the other three are known.

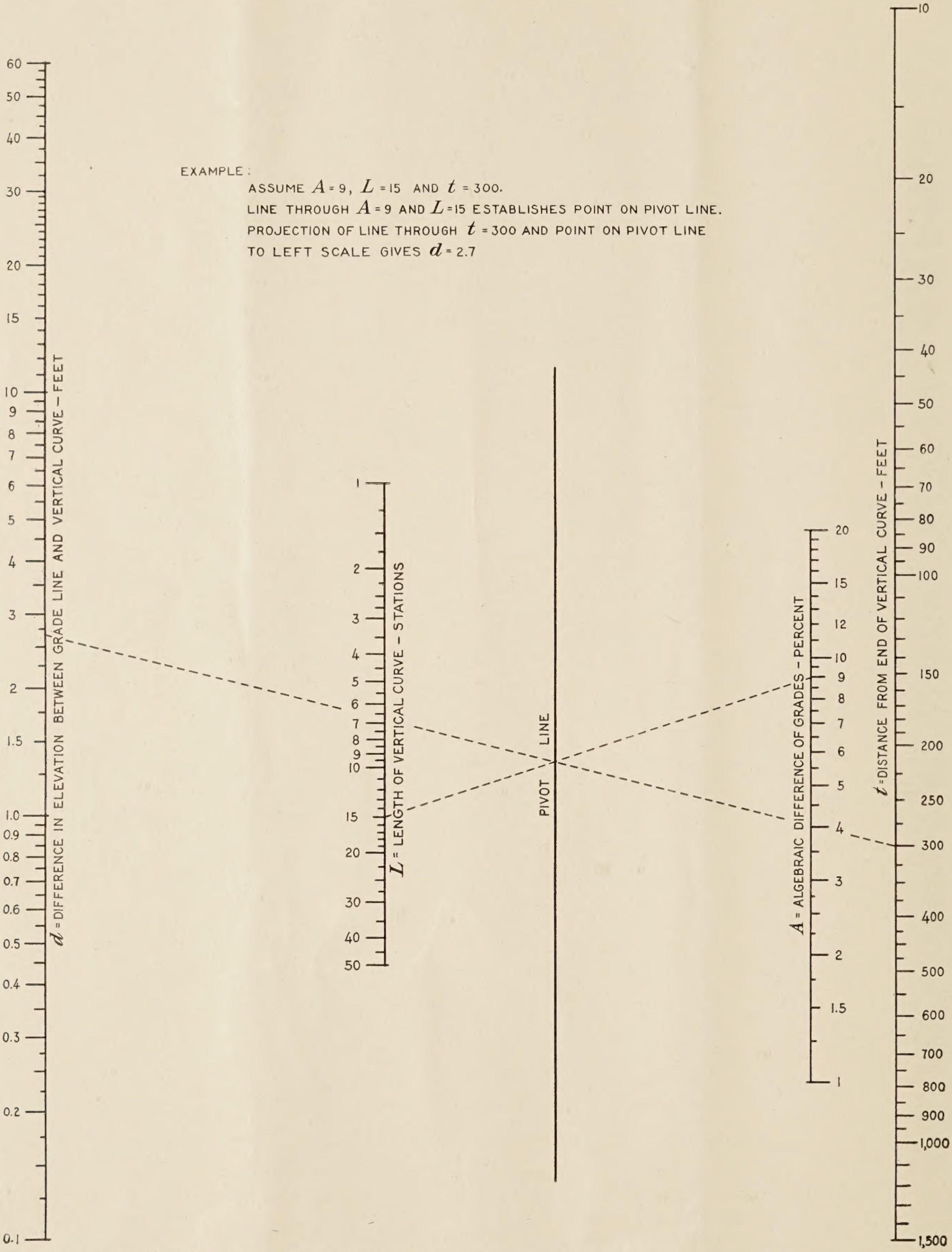


Figure 2.—Nomograph for Calculation of Elevation of a Point on a Parabolic Vertical Curve.

TABLE 3.— *Values of* $\frac{A}{L}$, *for values of A from 1 to 16 and values of L from 1 to 30*

L (stations)	A=1 percent	A=2 percent	A=3 percent	A=4 percent	A=5 percent	A=6 percent	A=7 percent	A=8 percent	A=9 percent	A=10 percent	A=11 percent	A=12 percent	A=13 percent	A=14 percent	A=15 percent	A=16 percent
1	1.0000	2.0000	3.0000	4.0000	5.0000	6.0000	7.0000	8.0000	9.0000	10.0000	11.0000	12.0000	13.0000	14.0000	15.0000	16.0000
2	.5000	1.0000	1.5000	2.0000	2.5000	3.0000	3.5000	4.0000	4.5000	5.0000	5.5000	6.0000	6.5000	7.0000	7.5000	8.0000
3	.3333	.6667	1.0000	1.3333	1.6667	2.0000	2.3333	2.6667	3.0000	3.3333	3.6667	4.0000	4.3333	4.6667	5.0000	5.3333
4	.2500	.5000	.7500	1.0000	1.2500	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
5	.2000	.4000	.6000	.8000	1.0000	1.2000	1.4000	1.6000	1.8000	2.0000	2.2000	2.4000	2.6000	2.8000	3.0000	3.2000
6	.1667	.3333	.5000	.6667	.8333	1.0000	1.1667	1.3333	1.5000	1.6667	1.8333	2.0000	2.1667	2.3333	2.5000	2.6667
7	.1428	.2857	.4286	.5714	.7143	.8571	1.0000	1.1428	1.2857	1.4286	1.5714	1.7143	1.8571	2.0000	2.1428	2.2857
8	.1250	.2500	.3750	.5000	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000
9	.1111	.2222	.3333	.4444	.5556	.6667	.7778	.8889	1.0000	1.1111	1.2222	1.3333	1.4444	1.5556	1.6667	1.7778
10	.1000	.2000	.3000	.4000	.5000	.6000	.7000	.8000	.9000	1.0000	1.1000	1.2000	1.3000	1.4000	1.5000	1.6000
11	.0909	.1818	.2727	.3636	.4545	.5454	.6364	.7273	.8182	.9091	1.0000	1.0909	1.1818	1.2727	1.3636	1.4545
12	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167	1.0000	1.0833	1.1667	1.2500	1.3333
13	.0769	.1538	.2308	.3077	.3846	.4615	.5385	.6154	.6923	.7692	.8462	.9231	1.0000	1.0769	1.1538	1.2308
14	.0714	.1428	.2143	.2857	.3571	.4286	.5000	.5714	.6428	.7143	.7857	.8571	.9286	1.0000	1.0714	1.1428
15	.0667	.1333	.2000	.2667	.3333	.4000	.4667	.5333	.6000	.6667	.7333	.8000	.8667	.9333	1.0000	1.0667
16	.0625	.1250	.1875	.2500	.3125	.3750	.4375	.5000	.5625	.6250	.6875	.7500	.8125	.8750	.9375	1.0000
17	.0588	.1176	.1765	.2353	.2941	.3529	.4118	.4706	.5294	.5882	.6470	.7059	.7647	.8235	.8823	.9412
18	.0556	.1111	.1667	.2222	.2778	.3333	.3889	.4444	.5000	.5556	.6111	.6667	.7222	.7778	.8333	.8889
19	.0526	.1053	.1579	.2105	.2632	.3158	.3684	.4210	.4737	.5263	.5789	.6316	.6842	.7368	.7894	.8421
20	.0500	.1000	.1500	.2000	.2500	.3000	.3500	.4000	.4500	.5000	.5500	.6000	.6500	.7000	.7500	.8000
21	.0476	.0952	.1428	.1905	.2381	.2857	.3333	.3809	.4286	.4762	.5238	.5714	.6190	.6667	.7143	.7619
22	.0454	.0909	.1364	.1818	.2273	.2727	.3182	.3636	.4091	.4545	.5000	.5454	.5909	.6364	.6818	.7273
23	.0434	.0870	.1304	.1739	.2174	.2609	.3043	.3478	.3913	.4348	.4783	.5217	.5652	.6087	.6522	.6956
24	.0416	.0833	.1250	.1667	.2083	.2500	.2917	.3333	.3750	.4167	.4583	.5000	.5417	.5833	.6250	.6667
25	.0400	.0800	.1200	.1600	.2000	.2400	.2800	.3200	.3600	.4000	.4400	.4800	.5200	.5600	.6000	.6400
26	.0385	.0769	.1154	.1538	.1923	.2308	.2692	.3077	.3462	.3846	.4231	.4615	.5000	.5385	.5769	.6154
27	.0370	.0740	.1111	.1481	.1852	.2222	.2593	.2963	.3333	.3704	.4074	.4444	.4815	.5185	.5555	.5926
28	.0357	.0714	.1071	.1428	.1786	.2143	.2500	.2857	.3214	.3571	.3928	.4286	.4643	.5000	.5357	.5714
29	.0345	.0690	.1034	.1379	.1724	.2069	.2414	.2759	.3103	.3448	.3793	.4138	.4483	.4828	.5172	.5517
30	.0333	.0667	.1000	.1333	.1667	.2000	.2333	.2667	.3000	.3333	.3667	.4000	.4333	.4667	.5000	.5333

TABLE 4.—*Values of K for values of t from 1 to 1,500*

t	K	t	K	t	K	t	K
1	0.000	51	0.130	101	0.510	151	1.140
2	.000	52	.135	102	.520	152	1.155
3	.000	53	.140	103	.530	153	1.170
4	.001	54	.146	104	.541	154	1.186
5	.001	55	.151	105	.551	155	1.201
6	.002	56	.157	106	.562	156	1.217
7	.002	57	.162	107	.572	157	1.232
8	.003	58	.168	108	.583	158	1.248
9	.004	59	.174	109	.594	159	1.264
10	.005	60	.180	110	.605	160	1.280
11	.006	61	.186	111	.616	161	1.296
12	.007	62	.192	112	.627	162	1.312
13	.008	63	.198	113	.638	163	1.328
14	.010	64	.205	114	.650	164	1.345
15	.011	65	.211	115	.661	165	1.361
16	.013	66	.218	116	.673	166	1.378
17	.014	67	.224	117	.684	167	1.394
18	.016	68	.231	118	.696	168	1.411
19	.018	69	.238	119	.708	169	1.428
20	.020	70	.245	120	.720	170	1.445
21	.022	71	.252	121	.732	171	1.462
22	.024	72	.259	122	.744	172	1.479
23	.026	73	.266	123	.756	173	1.496
24	.029	74	.274	124	.769	174	1.514
25	.031	75	.281	125	.781	175	1.531
26	.034	76	.289	126	.794	176	1.549
27	.036	77	.296	127	.806	177	1.566
28	.039	78	.304	128	.819	178	1.584
29	.042	79	.312	129	.832	179	1.602
30	.045	80	.320	130	.845	180	1.620
31	.048	81	.328	131	.858	181	1.638
32	.051	82	.336	132	.871	182	1.656
23	.054	83	.344	133	.884	183	1.674
34	.058	84	.353	134	.898	184	1.693
35	.061	85	.361	135	.911	185	1.711
36	.065	86	.370	136	.925	186	1.730
37	.068	87	.378	137	.938	187	1.748
38	.072	88	.387	138	.952	188	1.767
39	.076	89	.396	139	.966	189	1.786
40	.080	90	.405	140	.980	190	1.805
41	.084	91	.414	141	.994	191	1.824
42	.088	92	.423	142	1.008	192	1.843
43	.092	93	.432	143	1.022	193	1.862
44	.097	94	.442	144	1.037	194	1.882
45	.101	95	.451	145	1.051	195	1.901
46	.106	96	.461	146	1.066	196	1.921
47	.110	97	.470	147	1.080	197	1.940
48	.115	98	.480	148	1.095	198	1.960
49	.120	99	.490	149	1.110	199	1.980
50	.125	100	.500	150	1.125	200	2.000

TABLE 4.—*Values of K for values of t from 1 to 1,500*—Con.

t	K	t	K	t	K	t	K
201	2.020	251	3.150	301	4.530	351	6.160
202	2.040	252	3.175	302	4.560	352	6.195
203	2.060	253	3.200	303	4.590	353	6.230
204	2.081	254	3.226	304	4.621	354	6.266
205	2.101	255	3.251	305	4.651	355	6.301
206	2.122	256	3.277	306	4.682	356	6.337
207	2.142	257	3.302	307	4.712	357	6.372
208	2.163	258	3.328	308	4.743	358	6.408
209	2.184	259	3.354	309	4.774	359	6.444
210	2.205	260	3.380	310	4.805	360	6.480
211	2.226	261	3.406	311	4.836	361	6.516
212	2.247	262	3.432	312	4.867	362	6.552
213	2.268	263	3.458	313	4.898	363	6.588
214	2.290	264	3.485	314	4.930	364	6.625
215	2.311	265	3.511	315	4.961	365	6.661
216	2.333	266	3.538	316	4.993	366	6.698
217	2.354	267	3.564	317	5.024	367	6.734
218	2.376	268	3.591	318	5.056	368	6.771
219	2.398	269	3.618	319	5.088	369	6.808
220	2.420	270	3.645	320	5.120	370	6.845
221	2.442	271	3.672	321	5.152	371	6.882
222	2.464	272	3.699	322	5.184	372	6.919
223	2.486	273	3.726	323	5.216	373	6.956
224	2.509	274	3.754	324	5.249	374	6.994
225	2.531	275	3.781	325	5.281	375	7.031
226	2.554	276	3.809	326	5.314	376	7.069
227	2.576	277	3.836	327	5.346	377	7.106
228	2.599	278	3.864	328	5.379	378	7.144
229	2.622	279	3.892	329	5.412	379	7.182
230	2.645	280	3.920	330	5.445	380	7.220
231	2.668	281	3.948	331	5.478	381	7.258
232	2.691	282	3.976	332	5.511	382	7.296
233	2.714	283	4.004	333	5.544	383	7.334
234	2.738	284	4.033	334	5.578	384	7.373
235	2.761	285	4.061	335	5.611	385	7.411
236	2.785	286	4.090	336	5.645	386	7.450
237	2.808	287	4.118	337	5.678	387	7.488
238	2.832	288	4.147	338	5.712	388	7.527
239	2.856	289	4.176	339	5.746	389	7.566
240	2.880	290	4.205	340	5.780	390	7.605
241	2.904	291	4.234	341	5.814	391	7.644
242	2.928	292	4.263	342	5.848	392	7.683
243	2.952	293	4.292	343	5.882	393	7.722
244	2.977	294	4.322	344	5.917	394	7.762
245	3.001	295	4.351	345	5.951	395	7.801
246	3.026	296	4.381	346	5.986	396	7.841
247	3.050	297	4.410	347	6.020	397	7.880
248	3.075	298	4.440	348	6.055	398	7.920
249	3.100	299	4.470	349	6.090	399	7.960
250	3.125	300	4.500	350	6.125	400	8.000

TABLE 4.—*Values of K for values of t from 1 to 1,500*—Con.

t	K	t	K	t	K	t	K
401	8.040	501	12.550	601	18.060	701	24.570
402	8.080	502	12.600	602	18.120	702	24.640
403	8.120	503	12.650	603	18.180	703	24.710
404	8.161	504	12.701	604	18.241	704	24.781
405	8.201	505	12.751	605	18.301	705	24.851
406	8.242	506	12.802	606	18.362	706	24.922
407	8.282	507	12.852	607	18.422	707	24.992
408	8.323	508	12.903	608	18.483	708	25.063
409	8.364	509	12.954	609	18.544	709	25.134
410	8.405	510	13.005	610	18.605	710	25.205
411	8.446	511	13.056	611	18.666	711	25.276
412	8.487	512	13.107	612	18.727	712	25.347
413	8.528	513	13.158	613	18.788	713	25.418
414	8.570	514	13.210	614	18.850	714	25.490
415	8.611	515	13.261	615	18.911	715	25.561
416	8.653	516	13.313	616	18.973	716	25.633
417	8.694	517	13.364	617	19.034	717	25.704
418	8.736	518	13.416	618	19.096	718	25.776
419	8.778	519	13.468	619	19.158	719	25.848
420	8.820	520	13.520	620	19.220	720	25.920
421	8.862	521	13.572	621	19.282	721	25.992
422	8.904	522	13.624	622	19.344	722	26.064
423	8.946	523	13.676	623	19.406	723	26.136
424	8.989	524	13.729	624	19.469	724	26.209
425	9.031	525	13.781	625	19.531	725	26.281
426	9.074	526	13.834	626	19.594	726	26.354
427	9.116	527	13.886	627	19.656	727	26.426
428	9.159	528	13.939	628	19.719	728	26.499
429	9.202	529	13.992	629	19.782	729	26.572
430	9.245	530	14.045	630	19.845	730	26.645
431	9.288	531	14.098	631	19.908	731	26.718
432	9.331	532	14.151	632	19.971	732	26.791
433	9.374	533	14.204	633	20.034	733	26.864
434	9.418	534	14.258	634	20.098	734	26.938
435	9.461	535	14.311	635	20.161	735	27.011
436	9.505	536	14.365	636	20.225	736	27.085
437	9.548	537	14.418	637	20.288	737	27.158
438	9.592	538	14.472	638	20.352	738	27.232
439	9.636	539	14.526	639	20.416	739	27.306
440	9.680	540	14.580	640	20.480	740	27.380
441	9.724	541	14.634	641	20.544	741	27.454
442	9.768	542	14.688	642	20.608	742	27.528
443	9.812	543	14.742	643	20.672	743	27.602
444	9.857	544	14.797	644	20.737	744	27.677
445	9.901	545	14.851	645	20.801	745	27.751
446	9.946	546	14.906	646	20.866	746	27.826
447	9.990	547	14.960	647	20.930	747	27.900
448	10.035	548	15.015	648	20.995	748	27.975
449	10.080	549	15.070	649	21.060	749	28.050
450	10.125	550	15.125	650	21.125	750	28.125
451	10.170	551	15.180	651	21.190	751	28.200
452	10.215	552	15.235	652	21.255	752	28.275
453	10.260	553	15.290	653	21.320	753	28.350
454	10.306	554	15.346	654	21.386	754	28.426
455	10.351	555	15.401	655	21.451	755	28.501
456	10.397	556	15.457	656	21.517	756	28.577
457	10.442	557	15.512	657	21.582	757	28.652
458	10.488	558	15.568	658	21.648	758	28.728
459	10.534	559	15.624	659	21.714	759	28.804
460	10.580	560	15.680	660	21.780	760	28.880
461	10.626	561	15.736	661	21.846	761	28.956
462	10.672	562	15.792	662	21.912	762	29.032
463	10.718	563	15.848	663	21.978	763	29.108
464	10.765	564	15.905	664	22.045	764	29.185
465	10.811	565	15.961	665	22.111	765	29.261
466	10.858	566	16.018	666	22.178	766	29.338
467	10.904	567	16.074	667	22.244	767	29.414
468	10.951	568	16.131	668	22.311	768	29.491
469	10.998	569	16.188	669	22.378	769	29.568
470	11.045	570	16.245	670	22.445	770	29.645
471	11.092	571	16.302	671	22.512	771	29.722
472	11.139	572	16.359	672	22.579	772	29.799
473	11.186	573	16.416	673	22.646	773	29.876
474	11.234	574	16.474	674	22.714	774	29.954
475	11.281	575	16.531	675	22.781	775	30.031
476	11.329	576	16.589	676	22.849	776	30.109
477	11.376	577	16.646	677	22.916	777	30.186
478	11.424	578	16.704	678	22.984	778	30.264
479	11.472	579	16.762	679	23.052	779	30.342
480	11.520	580	16.820	680	23.120	780	30.420
481	11.568	581	16.878	681	23.188	781	30.498
482	11.616	582	16.936	682	23.256	782	30.576
483	11.664	583	16.994	683	23.324	783	30.654
484	11.713	584	17.053	684	23.393	784	30.733
485	11.761	585	17.111	685	23.461	785	30.811
486	11.810	586	17.170	686	23.530	786	30.890
487	11.858	587	17.228	687	23.598	787	30.968
488	11.907	588	17.287	688	23.667	788	31.047
489	11.956	589	17.346	689	23.736	789	31.126
490	12.005	590	17.405	690	23.805	790	31.205
491	12.054	591	17.464	691	23.874	791	31.284
492	12.103	592	17.523	692	23.943	792	31.363
493	12.152	593	17.582	693	24.012	793	31.442
494	12.202	594	17.642	694	24.082	794	31.522
495	12.251	595	17.701	695	24.151	795	31.601
496	12.301	596	17.761	696	24.221	796	31.681
497	12.350	597	17.820	697	24.290	797	31.760
498	12.400	598	17.880	698	24.360	798	31.840
499	12.450	599	17.940	699	24.430	799	31.920
500	12.500	600	18.000	700	24.500	800	32.000

TABLE 4.—*Values of K for values of t from 1 to 1,500*—Con.

t	K	t	K	t	K	t	K
801	32.080	901	40.590	1,001	50.100	1,101	60.610
802	32.160	902	40.680	1,002	50.200	1,102	60.720
803	32.240	903	40.770	1,003	50.300	1,103	60.830
804	32.321	904	40.861	1,004	50.401	1,104	60.941
805	32.401	905	40.951	1,005	50.501	1,105	61.051
806	32.482	906	41.042	1,006	50.602	1,106	61.162
807	32.562	907	41.132	1,007	50.702	1,107	61.272
808	32.643	908	41.223	1,008	50.803	1,108	61.383
809	32.724	909	31.314	1,009	50.904	1,109	61.494
810	32.805	910	41.405	1,010	51.005	1,110	61.605
811	32.886	911	41.496	1,011	51.106	1,111	61.716
812	32.967	912	41.587	1,012	51.207	1,112	61.827
813	33.048	913	41.678	1,013	51.308	1,113	61.938
814	33.130	914	41.770	1,014	51.409	1,114	62.050
815	33.211	915	41.861	1,015	51.511	1,115	62.161
816	33.293	916	41.953	1,016	51.613	1,116	62.273
817	33.374	917	42.044	1,017	51.714	1,117	62.384
818	33.456	918	42.136	1,018	51.816	1,118	62.496
819	33.538	919	42.228	1,019	51.918	1,119	62.608
820	33.620	920	42.320	1,020	52.020	1,120	62.720
821	33.702	921	42.412	1,021	52.122	1,121	62.832
822	33.784	922	42.504	1,022	52.224	1,122	62.944
823	33.866	923	42.596	1,023	52.326	1,123	63.056
824	33.949	924	42.689	1,024	52.428	1,124	63.169
825	34.031	925	42.781	1,025	52.531	1,125	63.281
826	34.114	926	42.874	1,026	52.634	1,126	63.394
827	34.196	927	42.966	1,027	52.736	1,127	63.506
828	34.279	928	43.059	1,028	52.839	1,128	63.619
829	34.362	929	43.152	1,029	52.942	1,129	63.732
830	34.445	930	43.245	1,030	53.045	1,130	63.845
831	34.528	931	43.338	1,031	53.148	1,131	63.958
832	34.611	932	43.431	1,032	53.251	1,132	64.071
833	34.694	933	43.524	1,033	53.354	1,133	64.184
834	34.778	934	43.618	1,034	53.458	1,134	64.298
835	34.861	935	43.711	1,035	53.561	1,135	64.411
836	34.945	936	43.805	1,036	53.665	1,136	64.525
837	35.028	937	43.898	1,037	53.768	1,137	64.638
838	35.112	938	43.992	1,038	53.872	1,138	64.752
839	35.196	939	44.086	1,039	53.976	1,139	64.866
840	35.280	940	44.180	1,040	54.080	1,140	64.980
841	35.364	941	44.274	1,041	54.184	1,141	65.094
842	35.448	942	44.368	1,042	54.288	1,142	65.208
843	35.532	943	44.462	1,043	54.392	1,143	65.322
844	35.617	944	44.557	1,044	54.497	1,144	65.437
845	35.701	945	44.651	1,045	54.601	1,145	65.551
846	35.786	946	44.746	1,046	54.706	1,146	65.666
847	35.870	947	44.840	1,047	54.810	1,147	65.780
848	35.955	948	44.935	1,048	54.915	1,148	65.895
849	36.040	949	45.030	1,049	55.020	1,149	66.010
850	36.125	950	45.125	1,050	55.125	1,150	66.125
851	36.210	951	45.220	1,051	55.230	1,151	66.240
852	36.295	952	45.315	1,052	55.335	1,152	66.355
853	36.380	953	45.410	1,053	55.440	1,153	66.470
854	36.466	954	45.506	1,054	55.546	1,154	66.586
855	36.551	955	45.601	1,055	55.651	1,155	66.701
856	36.637	956	45.697	1,056	55.757	1,156	66.817
857	36.722	957	45.742	1,057	55.862	1,157	66.932
858	36.808	958	45.888	1,058	55.968	1,158	67.048
859	36.894	959	45.984	1,059	56.074	1,159	67.164
860	36.980	960	46.080	1,060	56.180	1,160	67.280
861	37.066	961	46.176	1,061	56.286	1,161	67.396
862	37.152	962	46.272	1,062	56.392	1,162	67.512
863	37.238	963	46.368	1,063	56.498	1,163	67.628
864	37.325	964	46.465	1,064	56.605	1,164	67.745
865	37.411	965	46.561	1,065	56.711	1,165	67.861
866	37.498	966	46.657	1,066	56.818	1,166	67.978
867	37.584	967	46.754	1,067	56.924	1,167	68.094
868	37.671	968	46.851	1,068	57.031	1,168	68.211
869	37.758	969	46.948	1,069	57.138	1,169	68.328
870	37.845	970	47.045	1,070	57.245	1,170	68.445
871	37.932	971	47.142	1,071	57.352	1,171	68.562
872	38.019	972	47.239	1,072	57.459	1,172	68.679
873	38.106	973	47.336	1,073	57.566	1,173	68.796
874	38.194	974	47.434	1,074	57.674	1,174	68.914
875	38.281	975	47.531	1,075	57.781	1,175	69.031
876	38.369	976	47.629	1,076	57.889	1,176	69.149
877	38.456	977	47.726	1,077	57.996	1,177	69.266
878	38.544	978	47.824	1,078	58.104	1,178	69.384
879	38.632	979	47.922	1,079	58.212	1,179	69.502
880	38.720	980	48.020	1,080	58.320	1,180	69.620
881	38.808	981	48.118	1,081	58.428	1,181	69.738
882	38.896	982	48.216	1,082	58.536	1,182	69.856
883	38.984	983	48.314	1,083	58.644	1,183	69.974
884	39.073	984	48.413	1,084	58.753	1,184	70.093
885	39.161	985	48.511	1,085	58.861	1,185	70.211
886	39.250	986	48.610	1,086	58.970	1,186	70.330
887	39.338	987	48.708	1,087	59.078	1,187	70.448
888	39.427	988	48.807	1,088	59.187	1,188	70.567
889	39.516	989	48.906	1,089	59.296	1,189	70.686
890	39.605	990	49.005	1,090	59.405	1,190	70.805
891	39.694	991	49.104	1,091	59.514	1,191	70.924
892	39.783	992	49.203	1,092	59.623	1,192	71.043
893	39.872	993	49.302	1,093	59.732	1,193	71.162
894	39.962	994	49.402	1,094	59.842	1,194	71.282
895	40.051	995	49.501	1,095	59.951	1,195	71.401
896	40.141	996	49.601	1,096	60.061	1,196	71.521
897	40.230	997	49.700	1,097	60.170	1,197	71.640
898	40.320	998	49.800	1,098	60.280	1,198	71.760
899	40.410	999	49.900	1,099	60.390	1,199	71.880
900	40.500	1,000	50.000	1,100	60.500	1,200	72.000

TABLE 4.—*Values of K for values of t from 1 to 1,500*—Con.

t	K	t	K	t	K	t	K
1,201	72.120	1,246	77.626	1,291	83.334	1,336	89.245
1,202	72.240	1,247	77.750	1,292	83.463	1,337	89.378
1,203	72.360	1,248	77.875	1,293	83.592	1,338	89.512
1,204	72.481	1,249	78.000	1,294	83.722	1,339	89.646
1,205	72.601	1,250	78.125	1,295	83.851	1,340	89.780
1,206	72.722			1,296	83.981		
1,207	72.842	1,251	78.250	1,297	84.110	1,341	89.914
1,208	72.963	1,252	78.375	1,298	84.240	1,342	90.048
1,209	73.084	1,253	78.500	1,299	84.370	1,343	90.182
1,210	73.205	1,254	78.626	1,300	84.500	1,344	90.317
		1,255	78.751			1,345	90.451
1,211	73.326	1,256	78.877	1,301	84.630	1,346	90.586
1,212	73.447	1,257	79.002	1,302	84.760	1,347	90.720
1,213	73.568	1,258	79.128	1,303	84.890	1,348	90.855
1,214	73.690	1,259	79.254	1,304	85.021	1,349	90.990
1,215	73.811	1,260	79.380	1,305	85.151	1,350	91.125
1,216	73.933			1,306	85.282		
1,217	74.054	1,261	79.506	1,307	85.412	1,351	91.260
1,218	74.176	1,262	79.632	1,308	85.543	1,352	91.395
1,219	74.298	1,263	79.758	1,309	85.674	1,353	91.530
1,220	74.420	1,264	79.885	1,310	85.805	1,354	91.666
		1,265	80.011			1,355	91.801
1,221	74.542	1,266	80.138	1,311	85.936	1,356	91.937
1,222	74.664	1,267	80.264	1,312	86.067	1,357	92.072
1,223	74.786	1,268	80.391	1,313	86.198	1,358	92.208
1,224	74.909	1,269	80.518	1,314	86.330	1,359	92.344
1,225	75.031	1,270	80.645	1,315	86.461	1,360	92.480
1,226	75.154			1,316	86.593		
1,227	75.276	1,271	80.772	1,317	86.724	1,361	92.616
1,228	75.399	1,272	80.899	1,318	86.856	1,362	92.752
1,229	75.522	1,273	81.026	1,319	86.988	1,363	92.888
1,230	75.645	1,274	81.154	1,320	87.120	1,364	93.025
		1,275	81.281			1,365	93.161
1,231	75.768	1,276	81.409	1,321	87.252	1,366	93.298
1,232	75.891	1,277	81.536	1,322	87.384	1,367	93.434
1,233	76.014	1,278	81.664	1,323	87.516	1,368	93.571
1,234	76.138	1,279	81.792	1,324	87.649	1,369	93.708
1,235	76.261	1,280	81.920	1,325	87.781	1,370	93.845
1,236	76.385			1,326	87.914		
1,237	76.508	1,281	82.048	1,327	88.046	1,371	93.982
1,238	76.632	1,282	82.176	1,328	88.179	1,372	94.119
1,239	76.756	1,283	82.304	1,329	88.312	1,373	94.256
1,240	76.880	1,284	82.433	1,330	88.445	1,374	94.393
		1,285	82.561			1,375	94.531
1,241	77.004	1,286	82.690	1,331	88.578	1,376	94.669
1,242	77.128	1,287	82.818	1,332	88.711	1,377	94.806
1,243	77.252	1,288	82.947	1,333	88.844	1,378	94.944
1,244	77.377	1,289	83.076	1,334	88.978	1,379	95.082
1,245	77.501	1,290	83.205	1,335	89.111	1,380	95.220

TABLE 4.—*Values of K for values of t from 1 to 1,500*—Con.

t	K	t	K	t	K	t	K
1,381	95.358	1,411	99.546	1,441	103.824	1,471	108.192
1,382	95.496	1,412	99.687	1,442	103.968	1,472	108.339
1,383	95.634	1,413	99.828	1,443	104.112	1,473	108.486
1,384	95.773	1,414	99.970	1,444	104.257	1,474	108.634
1,385	95.911	1,415	100.111	1,445	104.401	1,475	108.781
1,386	96.050	1,416	100.253	1,446	104.546	1,476	108.929
1,387	96.188	1,417	100.394	1,447	104.690	1,477	109.076
1,388	96.327	1,418	100.536	1,448	104.835	1,478	109.224
1,389	96.466	1,419	100.678	1,449	104.980	1,479	109.372
1,390	96.605	1,420	100.820	1,450	105.125	1,480	109.520
1,391	96.744	1,421	100.962	1,451	105.270	1,481	109.668
1,392	96.883	1,422	101.104	1,452	105.415	1,482	109.816
1,393	97.022	1,423	101.246	1,453	105.560	1,483	109.964
1,394	97.162	1,424	101.389	1,454	105.706	1,484	110.113
1,395	97.301	1,425	101.531	1,455	105.851	1,485	110.261
1,396	97.440	1,426	101.674	1,456	105.997	1,486	110.410
1,397	97.580	1,427	101.816	1,457	106.142	1,487	110.558
1,398	97.720	1,428	101.959	1,458	106.288	1,488	110.707
1,399	97.860	1,429	102.102	1,459	106.434	1,489	110.856
1,400	98.000	1,430	102.245	1,460	106.580	1,490	111.005
1,401	98.140	1,431	102.388	1,461	106.726	1,491	111.154
1,402	98.280	1,432	102.531	1,462	106.872	1,492	111.303
1,403	98.420	1,433	102.674	1,463	107.018	1,493	111.452
1,404	98.561	1,434	102.818	1,464	107.165	1,494	111.602
1,405	98.701	1,435	102.961	1,465	107.311	1,495	111.751
1,406	98.842	1,436	103.105	1,466	107.458	1,496	111.901
1,407	98.982	1,437	103.248	1,467	107.604	1,497	112.050
1,408	99.123	1,438	103.392	1,468	107.751	1,498	112.200
1,409	99.264	1,439	103.536	1,469	107.898	1,499	112.350
1,410	99.405	1,440	103.680	1,470	108.045	1,500	112.500

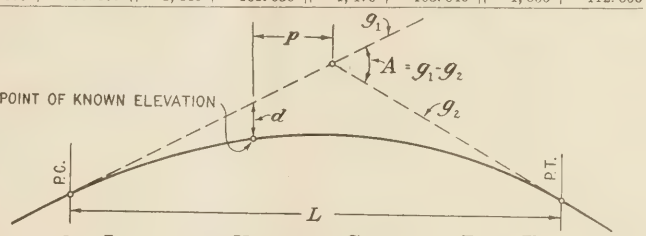


FIGURE 3.—LENGTH OF VERTICAL CURVE TO PASS THROUGH A POINT OF KNOWN ELEVATION.

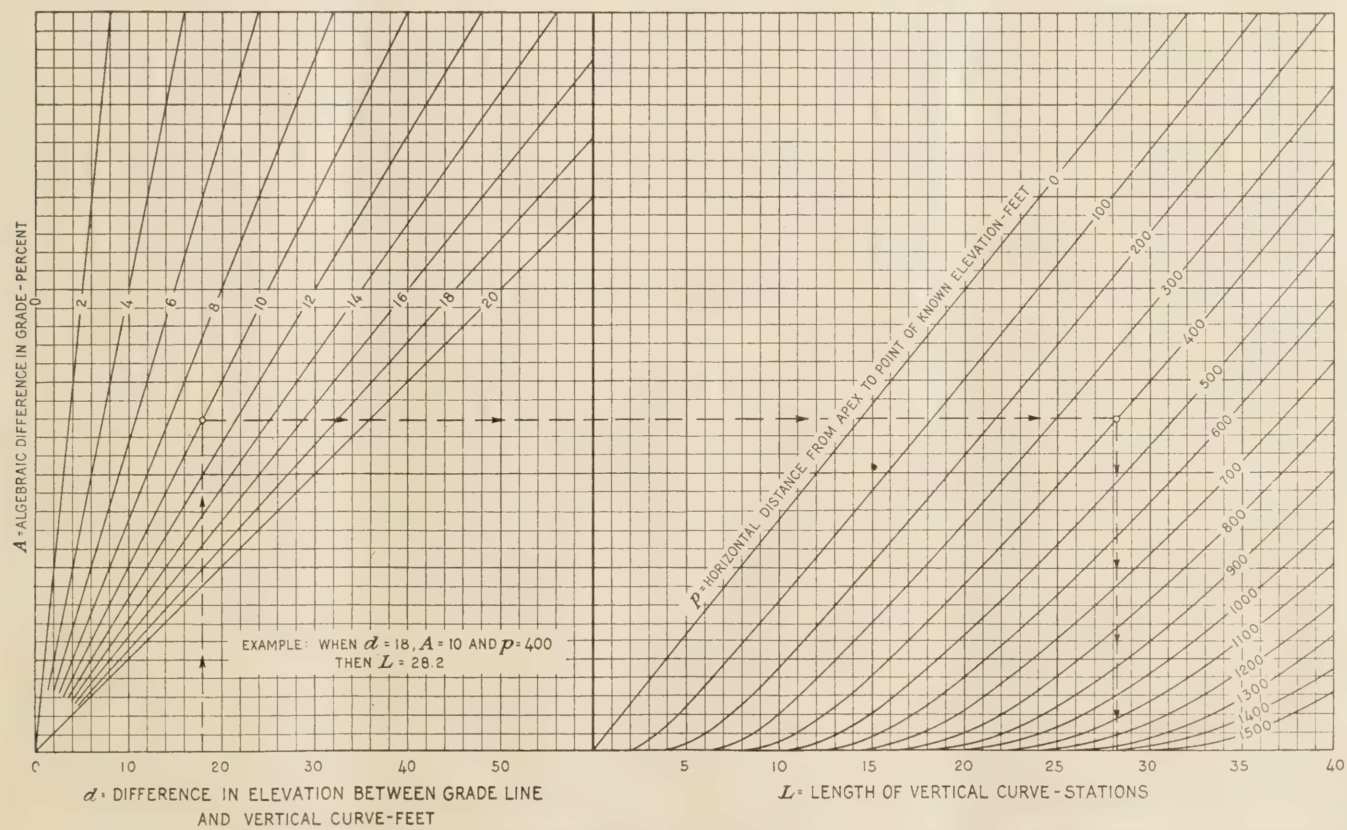


FIGURE 4.—GRAPHICAL SOLUTION FOR LENGTH OF VERTICAL CURVE TO PASS THROUGH A POINT OF KNOWN ELEVATION.

Sheet 4 of 10

PROJECT 121-C

Length V. C. = 600 Ft. h = 1.875

Station of V. P. I. = 83+50 Elevation of V. P. I. = 122.00

A = 2.50 A/L (To Nearest 0.0001) = 0.4167

Station	Grade, percent, G	Elevation on grade line	t (from table 2)	k (from table 2)	d (d=A/L·K)	Elevation		Difference in elevation between ground and grade at centerline	
						Ground	Grade	Cut	Fill
80+00	+0.50	120.25	—	—	—	120.4	120.25	0.1	–
+50	PC	120.50	0	0	0	121.0	120.50	0.5	–
81+00		120.75	50	0.125	0.05	121.4	120.70	0.7	–
+50		121.00	100	0.500	0.21	121.6	120.79	0.8	–
82+00		121.25	150	1.125	0.47	121.8	120.78	1.0	–
+50		121.50	200	2.000	0.83	121.5	120.67	0.8	—
83+00		121.75	250	3.125	1.30	120.9	120.45	0.4	–
+50	PI	122.00	300	4.500	1.88	120.5	120.12	0.4	–
84+00		121.00	250	3.125	1.30	119.6	119.70	—	0.1
+50		120.00	200	2.000	0.83	118.4	119.17	—	0.8
85+00		119.00	150	1.125	0.47	117.9	118.53	–	0.6
+50		118.00	100	0.500	0.21	117.4	117.79	—	0.4
86+00		117.00	50	0.125	0.05	116.7	116.95	–	0.3
+50	PT	116.00	0	0	0	116.2	116.00	0.2	–
87+00	-2.00	115.00	—	—	—	116.7	115.00	1.7	—

FIGURE 5.—SAMPLE SHEET FOR CALCULATION OF A VERTICAL CURVE.

Length of vertical curve to pass through a point of known elevation. Values of the following are known (see fig. 3):

A=algebraic difference of grades, percent;

p=horizontal distance from apex to point of known elevation, feet; and

d=difference in elevation between grade line and vertical curve at point of known elevation, feet.

It is desired to determine L, the length of vertical curve (in stations) to pass through point of known elevation. The following basic formula is used:

$$d=\frac{A\ (50L-p)^2}{20{,}000\ L}$$

A direct graphical solution for value of L is given in figure 4. The steps in using this figure are:

1. Enter at value of d (lower left scale) and project upward to value of A (left sloping lines).
2. Project horizontally across to value of p (right sloping lines).
3. Project down to read value of L (lower right scale).

Figure 4 may also be used to solve for value of d when values of A, L, and p are known.

Figure 5 is a sample sheet for calculation of a vertical curve using the values of tables 3 and 4.

COTTON FABRIC FOR EROSION CONTROL

REPORT OF EXPERIMENTS ON ROADSIDE SLOPES AND DITCHES IN MISSISSIPPI

BY DISTRICT 8, PUBLIC ROADS ADMINISTRATION

Reported by W. B. KING, Associate Bridge Construction Engineer

COTTON FABRIC was used experimentally for erosion control on roadside slopes and ditches on eight test sections in Mississippi during the summer and fall of 1940. The fabric was furnished by the Division of Marketing and Marketing Agreements of the United States Department of Agriculture, and was installed by the Mississippi State Highway Department.

The fabric used was of the following types: S1–54, S1–40, S2–54, and S2–40, the latter figure in each designation being the width of the fabric in inches. Approximately equal amounts of each type of fabric were used, 15,948 square yards being used in the eight test sections. Both types of cotton fabric have relatively large mesh openings, type S1 having 6 openings per inch and type S2 having 4. Table 1 shows the amount of each type of fabric and use on each test section.

The fabric was delivered in rolls. On some areas of the test sections the fabric was run horizontally; on others it was run from top to toe of the slope, or "vertically."

Descriptions of each test section and the results obtained follow:

Section A.—The soil was sand-clay, clay, and marl. The areas were first treated by spreading a mixture of bermuda grass roots and topsoil to a depth of approximately 2 inches. The grass mulch was spread uniformly with shovels and rakes. The fabric was then applied and pegged down with galvanized wire staples. After passing through one growing season there appeared to be little difference in the amount of growth on the covered and uncovered areas. The fabric-covered slope was greener and the ground somewhat more moist than was the uncovered slope. The fabric in the ditch bottom appeared definitely to have retarded erosion.

Figure 1 shows the appearance of portions of Section A soon after the fabric was placed and the appearance of the same portions after one growing season.

TABLE 1.—*Amount of each type of cotton fabric and use on each test section*

Section No.	Project No.	Amount of cotton fabric, type—		Used on—
		S1	S2	
		Sq. yd.	*Sq. yd.*	
A	PWS 72–C	1,305	750	3:1 to 6:1 slopes; ditch bottom.
B	PWS 123	1,500	2,250	2:1 backslopes.
C	PWS 82–C	749	999	2½:1 and 4:1 backslopes; ditch bottom.
D	NRH 74–G	1,361	109	2½:1 backslopes; ditch bottom.
E	PWA 254–A	1,200	1,215	3:1 backslope; ditch bottom.
F	FAP 173–A	1,100	1,105	1½:1 and 2:1 backslopes.
G	NRS 236	555	750	2:1 backslopes.
H	FAP 45	500	500	2:1 backslopes.
Total		8,270	7,678	

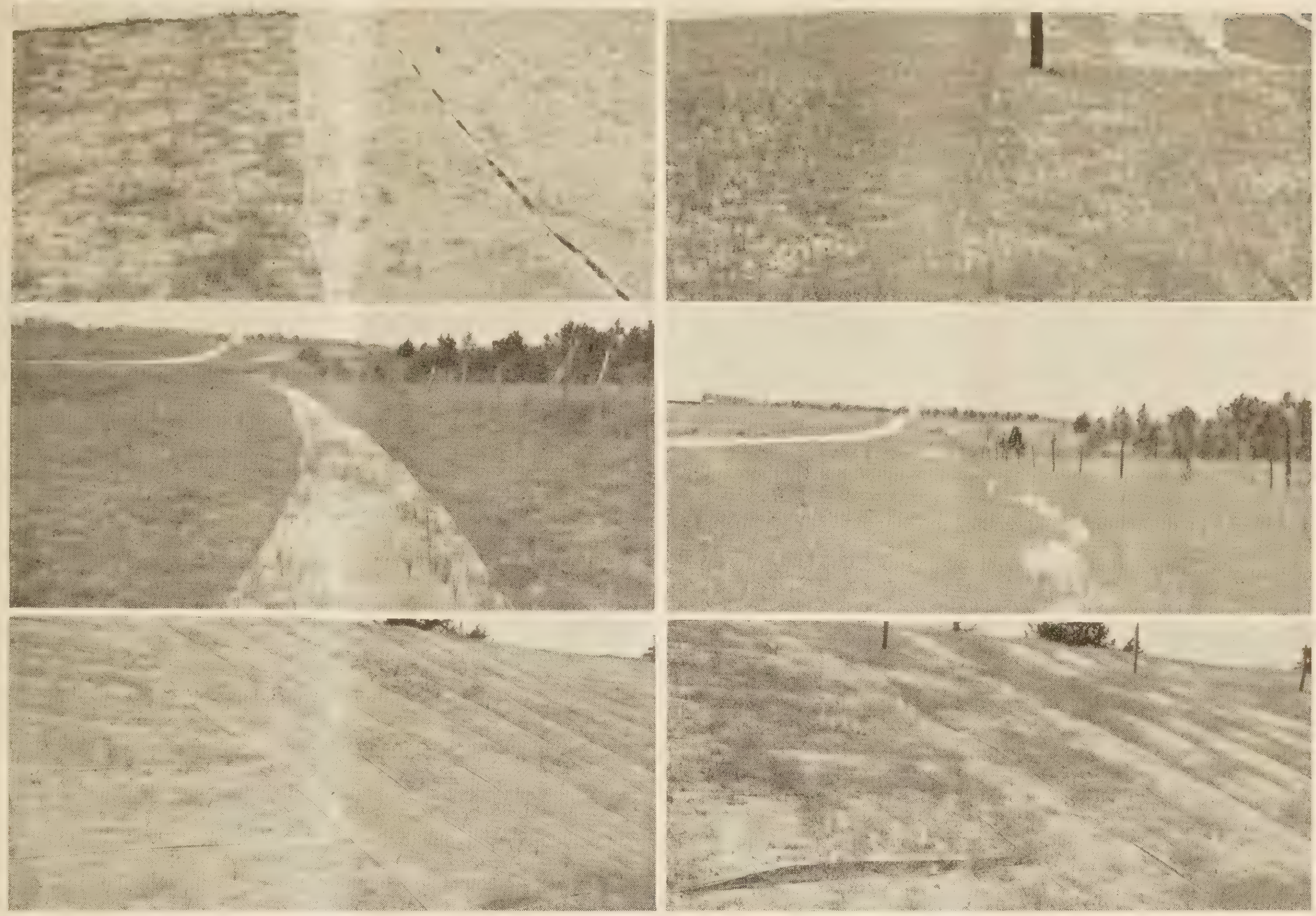


Figure 1.—Left, Appearance of Portions of Section A Soon After Fabric Was Placed; Right, Appearance of the Same Respective Portions of Section A After One Growing Season.

Section B.—The soil was sand, sand-clay, and clay. The backslopes were treated the same as the above section; and in addition commercial 4–8–4 fertilizer was mixed into the topsoil at the rate of 750 pounds per acre, and bermuda and carpet grass seed were planted. Part of the treated area was covered with cotton fabric pegged down with wooden stakes, and part was covered with straw mulch. After one growing season the fabric appeared to have helped the growth by shading and retarding erosion. However, the straw mulch appeared to have given better results more cheaply.

Section C.—The soil was topsoil, clay, sand-clay, and rock. The 2½:1 slopes and the ditch bottom were treated with topsoil and grass roots the same as on Section A. The 4:1 slope, consisting of clay and sand-clay soil, received no treatment except the cotton fabric covering. The fabric was pegged down with galvanized wire staples. After one growing season, the fabric in the ditch bottom appeared definitely to have retarded erosion and aided the growth. The fabric on the 2½:1 slopes helped by shading the growth. No difference was noted in the amount of erosion on the covered and uncovered portions. On the 4:1 slope, where no grass or topsoil was provided, the fabric appeared definitely to have retarded erosion and promoted native growth.

Section D.—The soil was a mixture of sand and clay. The areas were treated with topsoil and grass roots the same as on Section A, and the fabric similarly pegged with galvanized wire staples. At the time of inspection after one growing season, a large portion of the fabric on the slopes had disappeared. No appreciable difference could be noted in the portion of the slopes that was originally covered with fabric and the portion that was left uncovered. The fabric in the ditch bottom appeared to have helped retard erosion.

Figure 2 shows the appearance of portions of Sections B, C, and D after the fabric was placed, and the appearance of the same sections after one growing season.

Section E.—The soil was a sandy clay. A short time prior to placing the fabric the slopes were plowed, fertilized, seeded with grass, and sprigged. The grass had attained a fair growth prior to applying the fabric. A short time after the fabric was placed, two-thirds of it was destroyed by fire. No appreciable difference was noted between areas where the bank remained covered and where it was uncovered. Some erosion was noted between the grass rows beneath the fabric that remained in place. The fabric helped to retard erosion in the ditch bottom.

Section F.—The soil was limestone, hard-pan, sand-clay, and clay. The fabric was placed on backslopes that had been strip-sodded about 2 years previously. Some fabric was used on backslopes without sod. The fabric was pegged down with wooden stakes. Nine months after installation an inspection revealed that on the upper part of the north bank growth had benefited

FIGURE 2.—LEFT, APPEARANCE OF PORTIONS OF SECTIONS B (TOP), C (MIDDLE), AND D (BOTTOM) DURING OR SOON AFTER PLACING OF FABRIC; RIGHT, APPEARANCE OF THE SAME RESPECTIVE PORTIONS AFTER ONE GROWING SEASON.

by the shade afforded by the fabric. No benefit was noted on the limestone and clay soil at the bottom of the north bank. On the south bank the growth under the fabric appeared to have benefited by the shade, it being greener than the uncovered portions. No other difference between the covered and uncovered portions was noted.

Section G.—The slopes had been covered with 4 inches of good topsoil containing bermuda and other native grasses. The grass had attained a fair growth before the fabric was placed. However, the results could not be compared with those for other sections because on two of the banks the fabric had been covered with straw mulch and on the third bank the fabric had been removed and the bank covered with straw mulch.

Section H.—The soil in the slopes was sand-clay. All of the fabric was placed on sodded slopes where the grass was already well established. No results could be obtained because all of the fabric was torn loose by cattle and hogs a short time after it was placed.

The results obtained on these eight experimental sections indicate that:

1. There is no apparent advantage in using cotton fabric on 3:1 or flatter slopes that have been treated with a mixture of grass roots and topsoil.

2. Use of cotton fabric has some advantage in shading growth and retarding erosion on 2:1 and 1½:1 slopes that have been treated with a mixture of grass roots and topsoil, or sprigged, or strip sodded. However, straw mulch serves better and is more economical wherever available.

3. Cotton fabric aids natural growth and retards erosion on 4:1 slopes of sandy clay and clay soils that have received no other treatment. However, straw mulch serves better wherever available.

4. There is definite advantage in using fabric in roadside ditch bottoms in promoting growth and retarding erosion. The fabric should be pegged at short intervals across its width to hold it close to the ground.

5. The S2–54 fabric is more effective than the other types. The open mesh of the S2 fabric allows vegetation to grow through it, and the wider material is more economical to install per square yard.

6. For greatest effectiveness, the fabric should be placed up and down on slopes and parallel to the flow line in ditches.

7. Galvanized wire staples are more effective than wooden stakes in pegging the fabric.

(Continued from page 88)

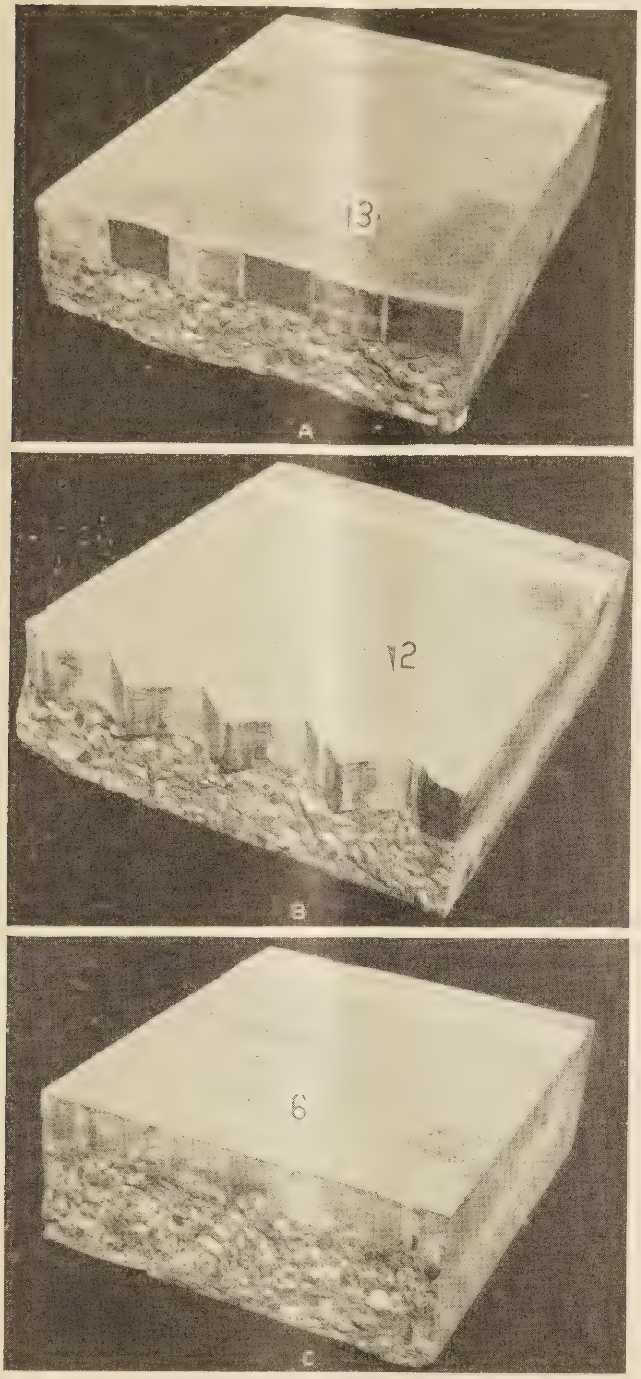


FIGURE 4.—MONOLITHIC BRICK SLABS TESTED WITH BRICK SURFACE IN TENSION. BRICK COURSES LAID (A) PERPENDICULAR, (B) AT AN ANGLE OF 45°, AND (C) PARALLEL TO THE AXIS OF THE LOADING KNIFE BLADE. NOTE FAILURE BETWEEN BRICK AND MORTAR IN (C).

perpendicular to the axis of the loading knife edge exhibited strengths equal to about 90 percent of the strength of plain concrete slabs of equal thickness, while the strength of the slabs in which the brick were set at a 45° angle averaged 67 percent of the strength of plain concrete slabs. In these tests the concrete used in the monolithic brick slabs was of the same quality (6 sacks of cement per cubic yard) as that used in the plain concrete slabs.

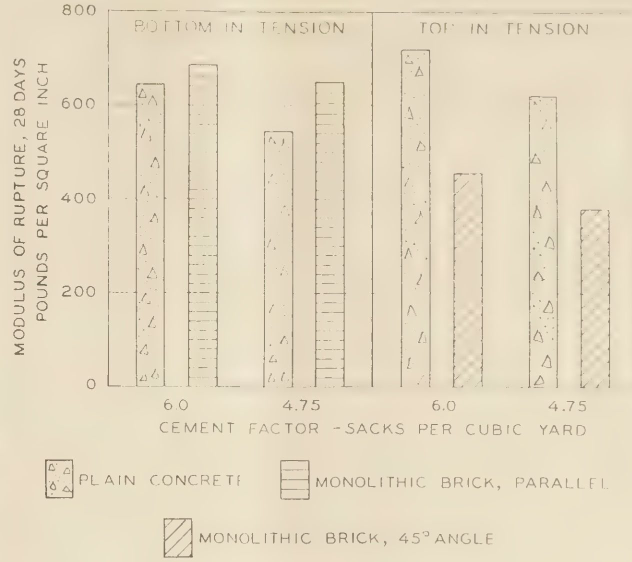


FIGURE 5.—RESULTS OF FLEXURE TESTS ON MONOLITHIC BRICK PAVEMENT SLABS, SERIES B, AT AGE OF 28 DAYS.

Strength results for series B are shown in table 7 and in figure 5. In this series all specimens were 8 inches thick. However, two different classes of concrete were used; one the pavement mix (6 sacks of cement per cubic yard), the other the base mix (4¾ sacks of cement per cubic yard). Strength results for slabs tested with the bottom, as cast, in tension are shown in the left panel of figure 5. It will be observed that, for both the pavement and base concretes, the monolithic brick slabs gave higher strengths than did the plain specimens, the average differential in strength being 13 percent. Referring to the results for series A as given in table 6, it will be observed that the differential in favor of the 8-inch monolithic brick slabs, tested with the bottom in tension was also 13 percent.

TABLE 7.—*Summary of results of flexure tests on monolithic brick pavement slabs, series B* [1]

Structure	Cement factor	Surface in tension	Direction of knife edge of applied load [2]	Flexural strength [3]	Strength ratio [4]
	Sacks per cu. yd.			*Lb. per sq. in.*	*Percent*
Concrete	6.0	Bottom		646	100
Monolithic brick	6.0	do	Parallel	686	106
Concrete	4.75	do		545	100
Monolithic brick	4.75	do	Parallel	650	119
Concrete	6.0	Top		721	100
Monolithic brick	6.0	do	45°	454	63
Concrete	4.75	do		622	100
Monolithic brick	4.75	do	45°	379	61

[1] Specimens 26 inches wide by 60 inches long by 8 inches thick (approximately); tested with center loading on a 54-inch span after 28 days of moist curing.
[2] With respect to the line of continuous brick courses.
[3] Flexural strength computed with neutral axis assumed at the center of the slab; each result the average of three tests.
[4] Plain concrete slabs were taken as standard.

The right panel in figure 5 gives results for slabs tested with the top surface, as cast, in tension, the courses of brick being placed at an angle of 45° to the axis of the loading knife edge. The effect of having the brick in tension was to lower the strength to 62 percent of that of plain concrete. This reduction in strength is also in close agreement with the results obtained in series A where the strength ratio was 60 percent for 8-inch monolithic brick slabs tested with the brick surface in tension and the brick courses at an angle of 45°.

The data plotted in figure 5 are of interest in giving a comparison of monolithic brick slabs using concrete of base mix proportions with plain concrete slabs of pavement proportions. As will be noted by comparing the first and fourth bars in the left panel of figure 5, the monolithic brick slabs using base mix proportions gave almost identical results with those obtained for the plain concrete slabs of pavement proportions. This, of course, was with the brick surface in compression. However, where the slabs were tested with the brick surface in tension, the monolithic brick slabs using base concrete were very much lower in strength.

Summarizing the data for series B, the results check very closely with those found in series A, where comparable tests were made. In addition, it was found that monolithic brick slabs made with base concrete were equal in strength to vibrated slabs of pavement concrete, when tested with the bottom in tension.

SUMMARY

The wheel load of a vehicle on a rigid pavement produces tensile stress in the bottom of the slab when the load is at the interior of the slab at some distance from an edge, or at the edge of the slab at some distance from a corner. Therefore, with respect to resistance to loads at the interior and edges of monolithic brick pavements, the most significant results of these tests were the strengths obtained with the slabs tested with the bottoms in tension.

On the other hand, a concentrated load applied at the corner of a rigid pavement produces tensile stress in the top of the slab and, if rupture occurs it will take place along a line that is roughly at an angle of 45° with the axis of the slab. Thus, if a monolithic brick pavement fails under a corner load, the slab will be ruptured along a line that is at an angle of approximately 45° with the direction of the courses of brick. The test slabs with the brick placed at an angle of 45° with the direction of the applied load were built to simulate this corner condition. When tested with the brick surface in tension they ruptured in the same direction, with respect to the brick courses, as the corner of a monolithic brick pavement would be expected to rupture. Therefore, of the results obtained with the brick slabs tested with the tops in tension, the most significant, with respect to their application in pavement design, are the strengths of the slabs with the brick placed at an angle of 45°.

With the above discussion in mind, the results of these tests may be summarized as follows, all comparisons being made on the basis of slabs of equal thickness:

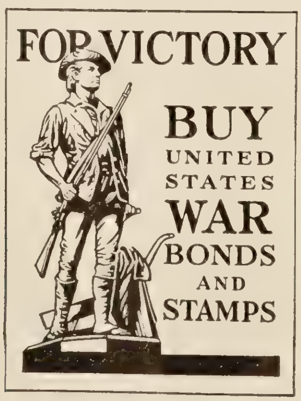
1. Monolithic brick slabs, when tested with the concrete in tension, developed flexural strengths ranging from 106 to 119 percent of the strengths of comparable slabs of plain concrete.
2. Monolithic brick slabs of base concrete and plain concrete slabs of pavement concrete, when tested with the concrete in tension, developed approximately the same strengths.
3. In monolithic brick slabs tested with the concrete in tension, the bond between the brick surface and the concrete base apparently was not affected by 100 applications of a load equal to 50 percent of the ultimate load.
4. Monolithic brick slabs with the brick at an angle of 45° with the axis of the slab and tested with the brick surface in tension developed flexural strengths ranging from 60 to 76 percent of the strengths of comparable slabs of plain concrete.
5. Monolithic brick slabs of base concrete, with the brick at an angle of 45° with the axis of the slab and tested with the brick surface in tension, developed about 53 percent of the strength of plain concrete slabs of pavement concrete.

HIGHWAY RESEARCH BOARD MEETS IN ST. LOUIS, DECEMBER 2–4, 1942

The Twenty-second Annual Meeting of the Highway Research Board will be held December 2–4, 1942, at the Hotel Statler in St. Louis, Mo.

The customary sessions of the board for the discussion of topics relating to highway finance, economics, design, materials, construction, maintenance, traffic, and soils investigation will be held.

It is expected that time and travel facilities will be greatly conserved by holding this meeting contiguous to that of the American Association of State Highway Officials which will be held in St. Louis the following week.



MOTOR-FUEL CONSUMPTION-1941

COMPILED FOR CALENDAR YEAR FROM REPORTS OF STATE AUTHORITIES 1/

TABLE G-2, 1941
ISSUED JUNE 1942

STATE	TAX RATE PER GALLON ON DECEMBER 31	GROSS AMOUNT REPORTED 2/	AMOUNT EXEMPTED FROM PAYMENT OF TAX 3/	GROSS AMOUNT ASSESSED FOR TAXATION	AMOUNT SUBJECT TO REFUND OF ENTIRE TAX	NET AMOUNT TAXED: TOTAL	NET AMOUNT TAXED: AT PREVAILING RATE	NET AMOUNT TAXED: AT OTHER RATES: RATE PER GALLON	NET AMOUNT TAXED: AT OTHER RATES: AMOUNT	AMOUNT TAXED AT PREVAILING RATE DURING 1940	INCREASE DURING 1941: AMOUNT	INCREASE DURING 1941: PERCENTAGE	STATE
	CENTS	1,000 GALLONS	1,000 GALLONS	1,000 GALLONS	1,000 GALLONS	1,000 GALLONS	1,000 GALLONS	CENTS	1,000 GALLONS	1,000 GALLONS	1,000 GALLONS		
ALABAMA	6	310,603	-	310,603	-	310,603	310,603	-	-	259,915	50,688	19.5	ALABAMA
ARIZONA	5	130,954	8,060	122,894	12,883	110,011	110,011	-	-	95,707	14,304	14.9	ARIZONA
ARKANSAS	6.5	223,634	8,872	214,762	-	214,762	190,095	(4/)	24,667	162,328	27,767	17.1	ARKANSAS
CALIFORNIA	3	2,272,732	119,055	2,153,677	175,130	1,978,547	1,978,547	-	-	1,758,326	220,221	12.5	CALIFORNIA
COLORADO	4	270,287	14,279	256,008	34,489	221,519	221,519	-	-	206,742	14,777	7.1	COLORADO
CONNECTICUT	3	422,586	14,302	408,284	9,735	398,549	398,549	-	-	364,594	33,955	9.3	CONNECTICUT
DELAWARE	4	69,122	1,837	67,285	4,197	63,088	63,088	-	-	58,397	4,691	8.0	DELAWARE
FLORIDA	7	475,905	49,446	426,459	-	426,459	426,459	-	-	388,717	37,742	9.7	FLORIDA
GEORGIA	6	449,335	22,277	427,058	-	427,058	427,058	-	-	386,847	40,211	10.4	GEORGIA
IDAHO	5.1	117,232	4,124	113,108	-	113,108	102,255	(5/)	10,853	94,565	7,690	8.1	IDAHO
ILLINOIS	3	1,670,862	-	1,670,862	135,385	1,535,477	1,535,477	-	-	1,410,967	124,510	8.8	ILLINOIS
INDIANA	4	799,091	7,484	791,607	70,074	721,533	721,533	-	-	641,164	80,369	12.5	INDIANA
IOWA	3	612,221	-	612,221	93,072	519,149	519,149	-	-	485,995	33,154	6.8	IOWA
KANSAS	3	541,494	162,862	378,632	-	378,632	378,632	-	-	346,720	31,912	9.2	KANSAS
KENTUCKY	5	352,743	15,527	337,216	-	337,216	337,216	-	-	295,205	42,011	14.2	KENTUCKY
LOUISIANA	7	343,599	29,263	314,336	6	314,330	304,900	2	6/ 9,430	264,057	40,843	15.5	LOUISIANA
MAINE	4	173,874	1,461	172,413	-	172,413	163,942	1	7/ 8,471	149,130	14,812	9.9	MAINE
MARYLAND	4	365,530	10,006	355,524	22,626	332,898	329,903	3	8/ 2,995	286,636	43,267	15.1	MARYLAND
MASSACHUSETTS	3	801,957	9,609	792,348	34,277	758,071	758,071	-	-	713,358	44,713	6.3	MASSACHUSETTS
MICHIGAN	3	1,392,274	128,012	1,264,262	64,764	1,199,498	1,198,472	1.5	9/ 1,026	1,082,006	116,466	10.8	MICHIGAN
MINNESOTA	10/ 4	625,173	33,640	591,533	71,526	520,007	11/ 520,007	-	-	497,556	22,451	4.5	MINNESOTA
MISSISSIPPI	6	254,877	14,897	239,980	-	239,980	232,458	1	12/ 7,522	197,570	34,888	17.7	MISSISSIPPI
MISSOURI	2	776,432	-	776,432	38,710	737,722	737,722	-	-	658,321	79,401	12.1	MISSOURI
MONTANA	5	148,262	6,717	141,545	28,296	113,249	113,249	-	-	104,451	8,798	8.4	MONTANA
NEBRASKA	5	259,765	11,255	248,510	21	248,489	248,339	1	13/ 150	233,438	14,901	6.4	NEBRASKA
NEVADA	4	49,018	2,909	46,109	3,108	43,001	40,807	5	14/ 2,194	35,717	5,090	14.3	NEVADA
NEW HAMPSHIRE	4	102,395	896	101,499	5,055	96,444	96,444	-	-	90,822	5,622	6.2	NEW HAMPSHIRE
NEW JERSEY	3	1,006,334	42,230	964,104	85,920	878,184	878,184	-	-	822,426	55,758	6.8	NEW JERSEY
NEW MEXICO	5	122,275	6,986	115,289	12,221	103,068	103,068	-	-	94,196	8,872	9.4	NEW MEXICO
NEW YORK	4	2,058,071	90,529	1,967,542	69,061	1,898,481	1,898,481	-	-	1,836,977	61,504	3.3	NEW YORK
NORTH CAROLINA	6	526,341	-	526,341	-	526,341	511,064	1	12/ 15,277	440,548	70,516	16.0	NORTH CAROLINA
NORTH DAKOTA	4	160,815	70,770	90,045	-	90,045	90,045	-	-	85,780	4,265	5.0	NORTH DAKOTA
OHIO 15/	4	1,638,913	90,737	1,548,176	18,675	1,529,501	1,446,626	1	7/ 82,875	1,320,885	125,741	9.5	OHIO
OKLAHOMA	16/ 5.5	473,597	78,555	395,042	-	395,042	17/ 395,042	-	-	378,275	16,767	4.4	OKLAHOMA
OREGON	5	306,484	9,348	297,136	31,167	265,969	264,132	1	18/ 1,837	228,396	35,736	15.6	OREGON
PENNSYLVANIA	4	1,704,947	11,201	1,693,746	-	1,693,746	1,693,746	-	-	1,575,078	118,668	7.5	PENNSYLVANIA
RHODE ISLAND	3	147,280	3,605	143,675	1,445	142,230	142,230	-	-	131,558	10,672	8.1	RHODE ISLAND
SOUTH CAROLINA	6	275,514	-	275,514	9,416	266,098	266,098	-	-	229,398	36,700	16.0	SOUTH CAROLINA
SOUTH DAKOTA	4	156,036	2,681	153,355	33,804	119,551	119,551	-	-	113,659	5,892	5.2	SOUTH DAKOTA
TENNESSEE	7	386,300	26,316	359,984	4,955	355,029	355,029	-	-	304,042	50,987	16.8	TENNESSEE
TEXAS	4	1,664,602	101,499	1,563,103	221,435	1,341,668	1,341,668	-	-	1,195,694	145,974	12.2	TEXAS
UTAH	4	118,062	4,356	113,706	-	113,706	113,706	-	-	102,425	11,281	11.0	UTAH
VERMONT	4	75,189	944	74,245	-	74,245	74,245	-	-	69,926	4,319	6.2	VERMONT
VIRGINIA	5	503,281	-	503,281	31,484	471,797	471,019	3	19/ 778	392,386	78,633	20.0	VIRGINIA
WASHINGTON	5	450,676	28,855	421,821	28,753	393,068	393,068	-	-	347,872	45,196	13.0	WASHINGTON
WEST VIRGINIA	5	242,167	-	242,167	8,227	233,940	233,940	-	-	214,983	18,957	8.8	WEST VIRGINIA
WISCONSIN	4	636,760	18,844	617,916	42,334	575,582	575,582	-	-	529,733	45,849	8.7	WISCONSIN
WYOMING	4	79,840	2,531	77,309	-	77,309	77,309	-	-	68,999	8,310	12.0	WYOMING
DISTRICT OF COLUMBIA	20/ 2	191,920	9,758	182,162	3,578	178,584	178,584	-	-	160,954	17,630	11.0	DISTRICT OF COLUMBIA
TOTAL	21/ 3.99	26,937,361	1,276,535	25,660,826	1,405,829	24,254,997	24,086,922	-	168,075	21,913,441	2,173,481	9.9	TOTAL

1/ AN ANALYSIS OF MOTOR-FUEL USAGE WILL BE GIVEN IN TABLE G-21, TO BE PUBLISHED LATER.

2/ EXPORT SALES AND OTHER AMOUNTS NOT REPRESENTING CONSUMPTION IN STATE HAVE BEEN ELIMINATED AS FAR AS POSSIBLE. IN CASES WHERE STATES FAILED TO REPORT AMOUNTS EXEMPTED FROM TAXATION, THE GROSS AMOUNT TAXED IS SHOWN IN THIS COLUMN.

3/ INCLUDES ALLOWANCES FOR EVAPORATION AND OTHER LOSSES, FEDERAL USE, OTHER PUBLIC USE, AND NONHIGHWAY USE, WHERE INITIAL EXEMPTIONS RATHER THAN REFUNDS ARE MADE.

4/ WITHIN 300 FEET OF BORDER, TAX IS REDUCED TO THAT OF ADJACENT STATE. GALLONS TAXED AT 2 CENTS, 6,731,000; AT 4 CENTS, 10,019,000; AT 5.5 CENTS, 7,917,000.

5/ AVIATION FUEL TAXED AT 2.5 CENTS, 607,000 GALLONS; MOTOR FUEL TAXED AT 0.1 CENT (5 CENTS REFUNDED ON NONHIGHWAY USE), 10,246,000 GALLONS.

6/ REPRESENTS EVAPORATION OR LOSS ALLOWANCE UNDER 5-CENT TAX NOT ALLOWED UNDER ADDITIONAL 2-CENT TAX, WHICH IS ADMINISTERED UNDER A SEPARATE LAW.

7/ THREE CENTS PER GALLON REFUNDED ON NONHIGHWAY USES.

8/ ONE CENT PER GALLON REFUNDED ON MOTOR FUEL USED IN VEHICLES LICENSED TO OPERATE EXCLUSIVELY IN CITIES.

9/ ONE AND ONE-HALF CENTS PER GALLON REFUNDED ON MOTOR FUEL USED IN INTERSTATE AVIATION.

10/ RATE CHANGED FROM 3 CENTS TO 4 CENTS MAY 1.

11/ TAXED AT 3 CENTS, 142,044,000 GALLONS; AT 4 CENTS, 377,963,000 GALLONS.

12/ FIVE CENTS PER GALLON REFUNDED ON NONHIGHWAY USES.

13/ FOUR CENTS PER GALLON REFUNDED ON MOTOR FUEL USED IN FLYING INSTRUCTION.

14/ DIESEL FUEL AND BUTANE.

15/ AMOUNTS GIVEN DO NOT INCLUDE 63,317,000 GALLONS OF LIQUID FUEL (KEROSENE, FUEL OIL, ETC.) TAXED AT 1 CENT PER GALLON BUT NOT SUBJECT TO THE 3-CENT TAX ON MOTOR-VEHICLE FUEL.

16/ RATE CHANGED FROM 4 CENTS TO 5.5 CENTS JUNE 1.

17/ TAXED AT 4 CENTS, 163,980,000 GALLONS; AT 5.5 CENTS, 231,062,000 GALLONS.

18/ FOUR CENTS PER GALLON REFUNDED ON MOTOR FUEL USED IN AVIATION.

19/ TWO CENTS PER GALLON REFUNDED ON MOTOR FUEL USED IN INTRASTATE AVIATION.

20/ RATE CHANGED FROM 2 CENTS TO 3 CENTS JANUARY 1, 1942.

21/ WEIGHTED AVERAGE RATE.

STATE MOTOR-FUEL TAX RECEIPTS - 1941

COMPILED FOR CALENDAR YEAR FROM REPORTS OF STATE AUTHORITIES

TABLE G-1, 1941
ISSUED JUNE 1942

STATE	TAX RATE PER GALLON ON DECEMBER 31	RECEIPTS FROM TAXATION OF MOTOR FUEL					OTHER RECEIPTS IN CONNECTION WITH MOTOR-FUEL TAX 2/					NET TOTAL RECEIPTS	LESS TAX ON AVIATION GASOLINE	ADJUSTED NET TOTAL RECEIPTS	STATE
		GROSS TAX COLLEC-TIONS	DEDUC-TIONS BY DISTRIB-UTORS FOR EXPENSES 1/	GROSS RECEIPTS BY STATE	REFUNDS PAID	NET RECEIPTS BY STATE	DISTRIB-UTORS AND DEALERS LICENSES	INSPEC-TION FEES 3/	FINES AND PENAL-TIES	MISCEL-LANEOUS RECEIPTS	TOTAL				
	CENTS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	
ALABAMA	6	18,323	-	18,323	-	18,323	-	78	-	*	78	18,401	-	18,401	ALABAMA
ARIZONA	5	6,148	-	6,148	787	5,361	*	-	1	-	1	5,362	-	5,362	ARIZONA
ARKANSAS	6.5	13,100	-	13,100	-	13,100	-	119	-	-	119	13,219	-	13,219	ARKANSAS
CALIFORNIA	3	63,330	-	63,330	5,254	58,076	17	-	-	1	18	58,094	-	58,094	CALIFORNIA
COLORADO	4	10,195	-	10,195	1,362	8,833	-	-	-	-	-	8,833	-	8,833	COLORADO
CONNECTICUT	3	12,180	122	12,058	300	11,758	45	-	1	-	46	11,804	-	11,804	CONNECTICUT
DELAWARE	4	2,665	-	2,665	164	2,501	3	-	-	-	3	2,504	-	2,504	DELAWARE
FLORIDA	7	29,832	-	29,832	-	29,832	41	524	-	-	565	30,397	-	30,397	FLORIDA
GEORGIA	6	26,311	262	26,049	-	26,049	37	-	-	-	37	26,086	-	26,086	GEORGIA
IDAHO	5.1	5,722	-	5,722	491	5,231	1	-	-	*	1	5,232	14	5,218	IDAHO
ILLINOIS	3	49,656	993	48,663	3,901	44,762	-	498	1	-	499	45,261	-	45,261	ILLINOIS
INDIANA	4	31,270	-	31,270	2,752	28,518	*	700	24	2	726	29,244	-	29,244	INDIANA
IOWA	3	18,199	-	18,199	2,861	15,338	62	-	-	-	62	15,400	-	15,400	IOWA
KANSAS	3	11,234	-	11,234	-	11,234	15	118	-	22	155	11,389	-	11,389	KANSAS
KENTUCKY	5	16,338	163	16,175	-	16,175	-	-	5	-	5	16,180	-	16,180	KENTUCKY
LOUISIANA	7	21,425	-	21,425	-	21,425	-	107	30	-	137	21,562	-	21,562	LOUISIANA
MAINE	4	6,918	-	6,918	261	6,657	-	-	*	*	*	6,657	3	6,654	MAINE
MARYLAND	4	14,000	-	14,000	930	13,070	-	-	-	-	-	13,070	-	13,070	MARYLAND
MASSACHUSETTS	3	23,576	-	23,576	1,088	22,488	48	-	*	-	48	22,536	-	22,536	MASSACHUSETTS
MICHIGAN	3	37,586	-	37,586	2,001	35,585	5	-	2	-	7	35,592	88	35,504	MICHIGAN
MINNESOTA	4/ 4	21,570	-	21,570	2,700	18,870	*	182	3	*	185	19,055	-	19,055	MINNESOTA
MISSISSIPPI 5/	6	14,126	-	14,126	373	13,753	-	-	-	-	-	13,753	-	13,753	MISSISSIPPI 5/
MISSOURI	2	15,252	-	15,252	975	14,277	-	165	9	-	174	14,451	-	14,451	MISSOURI
MONTANA	5	6,878	-	6,878	1,411	5,467	-	4	-	-	4	5,471	-	5,471	MONTANA
NEBRASKA	5	12,711	94	12,617	349	12,268	11	128	-	34	173	12,441	84	12,357	NEBRASKA
NEVADA	4	1,842	34	1,808	125	1,683	*	24	1	-	25	1,708	-	1,708	NEVADA
NEW HAMPSHIRE	4	3,913	-	3,913	198	3,715	-	-	1	-	1	3,716	-	3,716	NEW HAMPSHIRE
NEW JERSEY	3	28,814	-	28,814	2,593	26,221	69	-	2	14	85	26,306	-	26,306	NEW JERSEY
NEW MEXICO	5	5,695	-	5,695	619	5,076	26	-	-	-	26	5,102	-	5,102	NEW MEXICO
NEW YORK	4	78,041	780	77,261	2,803	74,458	62	-	-	*	62	74,520	-	74,520	NEW YORK
NORTH CAROLINA	6	31,417	-	31,417	768	30,649	-	1,271	-	11	1,282	31,931	-	31,931	NORTH CAROLINA
NORTH DAKOTA	4	3,569	54	3,515	-	3,515	1	83	-	26	110	3,625	-	3,625	NORTH DAKOTA
OHIO	4	6/ 61,274	-	61,274	3,161	58,113	-	-	-	-	-	58,113	-	58,113	OHIO
OKLAHOMA	7/ 5.5	19,141	478	18,663	2	18,661	-	315	-	-	315	18,976	-	18,976	OKLAHOMA
OREGON	5	14,702	-	14,702	1,673	13,029	-	-	*	-	*	13,029	18	13,011	OREGON
PENNSYLVANIA	4	65,627	760	64,867	-	64,867	-	-	5	-	5	64,872	-	64,872	PENNSYLVANIA
RHODE ISLAND	3	4,627	-	4,627	355	4,272	3	-	-	-	3	4,275	-	4,275	RHODE ISLAND
SOUTH CAROLINA	6	16,356	-	16,356	539	15,817	-	330	-	-	330	16,147	87	16,060	SOUTH CAROLINA
SOUTH DAKOTA	4	6,112	215	5,897	1,338	4,559	-	79	-	-	79	4,638	21	4,617	SOUTH DAKOTA
TENNESSEE	7	24,505	-	24,505	315	24,190	-	1,386	-	69	1,455	25,645	246	25,399	TENNESSEE
TEXAS	4	62,972	633	62,339	9,592	52,747	-	-	-	21	21	52,768	-	52,768	TEXAS
UTAH	4	4,500	68	4,432	-	4,432	1	-	1	*	2	4,434	64	4,370	UTAH
VERMONT	4	2,930	-	2,930	-	2,930	-	-	*	-	*	2,930	-	2,930	VERMONT
VIRGINIA	5	24,501	-	24,501	1,585	22,916	1	-	2	*	3	22,919	23	22,896	VIRGINIA
WASHINGTON	5	20,844	104	20,740	1,419	19,321	3	-	-	10	13	19,334	-	19,334	WASHINGTON
WEST VIRGINIA	5	11,956	-	11,956	403	11,553	6	-	-	-	6	11,559	-	11,559	WEST VIRGINIA
WISCONSIN	4	24,432	-	24,432	1,695	22,737	-	189	-	-	189	22,926	-	22,926	WISCONSIN
WYOMING	4	3,065	-	3,065	-	3,065	2	-	-	-	2	3,067	53	3,014	WYOMING
DISTRICT OF COLUMBIA	8/ 2	3,550	-	3,550	71	3,479	*	-	-	-	*	3,479	-	3,479	DISTRICT OF COLUMBIA
TOTAL	9/ 3.99	1,012,930	4,760	1,008,170	57,214	950,956	459	6,300	88	210	7,057	958,013	701	957,312	TOTAL

1/ THE STATES FOR WHICH AMOUNTS ARE SHOWN MAKE ALLOWANCES TO DISTRIBUTORS FOR EXPENSE OF COLLECTING THE TAX. IN KENTUCKY, SOUTH DAKOTA, UTAH, AND WASHINGTON ALLOWANCES OF 2 1/4, 4, 3, AND 1 PERCENT, RESPECTIVELY, OF THE TAX OTHERWISE DUE ARE MADE IN CONSIDERATION OF BOTH EXPENSE OF COLLECTION AND GALLONAGE LOSSES IN HANDLING. IN THESE STATES THE ALLOWANCES FOR EXPENSES ONLY HAVE BEEN ESTIMATED AS 1, 3½, 1½, AND ½ PERCENT, RESPECTIVELY.

2/ STARS INDICATE AMOUNTS LESS THAN $500.

3/ FEES FOR INSPECTION OF MOTOR-VEHICLE FUEL. WHEREVER POSSIBLE, FEES FOR INSPECTION OF KEROSENE AND OTHER NON-MOTOR-VEHICLE FUELS HAVE BEEN ELIMINATED.

4/ RATE CHANGED FROM 3 CENTS TO 4 CENTS MAY 1.

5/ SPECIAL COUNTY TAXES OF 3 CENTS PER GALLON IN HANCOCK COUNTY AND 2 CENTS PER GALLON IN HARRISON AND JACKSON COUNTIES, AMOUNTING TO $306,000 IN 1941, ARE IMPOSED FOR SEAWALL PROTECTION AND ARE NOT INCLUDED IN THIS TABLE.

6/ OHIO IMPOSES A 3-CENT TAX ON MOTOR-VEHICLE FUEL AND A 1-CENT TAX ON ALL LIQUID FUELS. THE RECEIPTS FROM THE 1-CENT TAX APPLICABLE TO NON-MOTOR-VEHICLE FUELS (KEROSENE, FUEL OIL, ETC.) WERE $627,000. THESE RECEIPTS HAVE BEEN ELIMINATED FROM THE TOTAL GIVEN, WHICH REPRESENTS A 4-CENT TAX ON MOTOR-VEHICLE FUEL.

7/ RATE CHANGED FROM 4 CENTS TO 5.5 CENTS JUNE 1.

8/ THIS RATE NO LONGER IN EFFECT; RATE CHANGED FROM 2 CENTS TO 3 CENTS JANUARY 1, 1942.

9/ WEIGHTED AVERAGE RATE.

STATE MOTOR-VEHICLE REGISTRATIONS-1941

COMPILED FOR CALENDAR YEAR FROM REPORTS OF STATE AUTHORITIES 1/

TABLE MV-1, 1941
ISSUED JUNE 1942

STATE	MOTOR VEHICLES									TRAILERS AND SEMITRAILERS				MOTORCYCLES				DEALERS REGISTRATIONS 7/		1940 TOTAL REGISTERED MOTOR VEHICLES, PRIVATE AND COMMERCIAL ONLY	YEAR'S CHANGE IN MOTOR-VEHICLE REGISTRATIONS		STATE
	TOTAL	PRIVATE AND COMMERCIAL 2/					PUBLICLY OWNED			TOTAL	PRIVATE AND COMMERCIAL 6/	PUBLICLY OWNED		TOTAL	PRIVATE AND COMMERCIAL 2/	PUBLICLY OWNED		REGULAR	EXTRA PLATES		INCREASE	PERCENTAGE INCREASE	
		TOTAL	PASSENGER VEHICLES			TRUCKS AND TRACTOR TRUCKS	TOTAL	FEDERAL 4/	STATE, COUNTY, AND MUNICIPAL 5/			FEDERAL 4/	STATE, COUNTY, AND MUNICIPAL 5/			FEDERAL 4/	STATE, COUNTY, AND MUNICIPAL 5/						
			TOTAL	AUTOMOBILES (INCLUDING TAXICABS)	BUSSES 3/																		
ALABAMA	414,451	409,706	335,000	330,727	4,273	74,706	4,745	1,780	2,965	6,526	6,478	48	-	1,400	1,400	-	-	3,185	-	339,853	69,853	20.6	ALABAMA
ARIZONA	149,440	144,401	117,712	117,377	335	26,689	5,039	2,689	2,350	5,573	5,321	97	155	574	543	1	30	334	1,574	138,403	5,998	4.3	ARIZONA
ARKANSAS	294,531	290,249	213,058	212,522	536	77,191	4,282	1,607	2,675	14,836	14,781	10	45	742	706	1	35	866	2,989	257,177	33,072	12.9	ARKANSAS
CALIFORNIA	2,996,775	2,962,222	2,618,369	2,614,106	4,263	343,853	34,553	5,767	28,786	186,258	184,104	114	2,040	19,400	18,063	4	1,333	4,918	-	2,773,659	188,563	6.8	CALIFORNIA
COLORADO	370,180	367,768	307,402	306,182	1,220	60,366	2,412	2,412	-	1,918	1,887	31	-	1,310	1,308	2	-	4,548	-	352,110	15,658	4.4	COLORADO
CONNECTICUT	555,838	551,101	471,845	470,566	1,279	79,256	4,737	488	4,249	8,095	7,857	2	236	2,607	2,312	-	295	3,045	9,893	493,667	57,434	11.6	CONNECTICUT
DELAWARE	77,730	76,842	65,014	64,662	352	11,828	888	127	761	3,339	3,274	2	63	396	342	-	54	983	-	71,763	5,079	7.1	DELAWARE
FLORIDA	553,991	545,706	460,468	458,687	1,781	85,238	8,285	1,773	6,512	24,220	23,802	25	393	2,180	2,004	1	175	2,409	-	495,210	50,496	10.2	FLORIDA
GEORGIA	566,212	558,984	463,921	460,787	3,134	95,063	7,228	2,091	5,137	16,609	16,528	22	59	1,951	1,777	6	168	571	3,127	502,603	56,381	11.2	GEORGIA
IDAHO	174,354	171,031	134,612	134,473	139	36,419	3,323	1,437	1,886	22,813	22,630	71	112	608	594	1	13	424	-	163,340	7,691	4.7	IDAHO
ILLINOIS	2,062,884	2,048,805	1,826,583	1,823,884	2,699	222,222	14,079	3,039	11,040	32,263	31,159	27	1,077	7,673	7,148	1	524	4,862	-	1,925,814	122,991	6.4	ILLINOIS
INDIANA	1,087,648	1,078,954	934,866	928,399	6,467	144,088	8,694	1,114	7,580	83,042	83,031	11	-	6,348	6,126	-	222	2,789	-	994,006	84,948	8.5	INDIANA
IOWA	834,103	825,112	715,108	714,608	500	110,004	8,991	1,184	7,807	102,495	101,944	6	545	2,843	2,843	-	-	2,047	5,177	793,969	31,143	3.9	IOWA
KANSAS	618,480	617,793	504,581	503,921	660	113,212	687	687	-	6,065	5,953	112	-	1,418	1,418	-	-	2,281	3,048	582,668	35,125	6.0	KANSAS
KENTUCKY	503,781	497,427	415,764	414,845	919	81,663	6,354	1,302	5,052	15	(8/)	15	-	1,315	1,315	-	-	919	-	463,727	33,700	7.3	KENTUCKY
LOUISIANA	437,214	430,707	348,337	344,947	3,390	82,370	6,507	1,416	5,091	16,305	16,273	31	1	1,796	1,720	1	75	242	-	365,429	65,278	17.9	LOUISIANA
MAINE	225,319	222,367	176,619	176,321	298	9/ 45,748	2,952	456	2,496	12,572	9/ 12,344	-	228	821	786	4	31	548	3,797	205,896	16,471	8.0	MAINE
MARYLAND	497,998	494,141	429,937	428,764	1,173	64,204	3,857	1,541	2,316	7,241	6,858	313	70	2,196	2,142	2	52	11,535	-	444,532	49,609	11.2	MARYLAND
MASSACHUSETTS	963,122	961,639	850,989	845,874	5,115	110,650	1,483	1,483	-	18,711	18,695	16	-	1,194	1,194	-	-	2,716	20,217	903,843	57,796	6.4	MASSACHUSETTS
MICHIGAN	1,707,458	1,705,610	1,544,245	10/ 1,543,255	990	10/ 161,365	1,848	1,848	-	169,433	169,403	30	-	5,071	5,071	-	-	2,091	2,091	1,552,561	153,049	9.9	MICHIGAN
MINNESOTA	909,903	903,042	773,332	772,708	624	129,710	6,861	1,703	5,158	118,204	117,848	36	320	2,594	2,467	-	127	3,703	-	871,351	31,691	3.6	MINNESOTA
MISSISSIPPI	299,047	293,725	222,665	220,807	1,858	71,060	5,322	1,408	3,914	8,137	8,111	26	-	482	452	-	30	2,709	-	259,013	34,712	13.4	MISSISSIPPI
MISSOURI	992,505	984,626	823,158	820,080	3,078	161,468	7,879	1,887	5,992	46,100	46,052	14	34	2,476	2,450	1	25	2,831	3,942	921,800	62,826	6.8	MISSOURI
MONTANA	204,122	198,732	147,606	147,256	350	51,126	5,390	2,469	2,921	6,630	6,544	86	-	523	523	-	-	1,053	-	191,032	7,700	4.0	MONTANA
NEBRASKA	427,509	423,058	354,598	354,276	322	68,460	4,451	1,013	3,438	48,262	47,743	26	493	1,321	1,259	-	62	2,012	2,186	412,116	10,942	2.7	NEBRASKA
NEVADA	49,868	48,160	38,636	38,480	156	9,524	1,708	902	806	1,935	1,797	49	89	178	169	-	9	86	318	44,108	4,052	9.2	NEVADA
NEW HAMPSHIRE	142,685	142,404	110,286	109,971	315	32,118	281	281	-	6,962	6,958	4	-	746	743	3	-	556	-	135,384	7,020	5.2	NEW HAMPSHIRE
NEW JERSEY	1,178,438	1,165,916	1,024,587	1,019,155	5,432	141,329	12,522	1,486	11,036	9,211	9,197	14	-	6,066	5,581	-	485	3,163	18,966	1,086,966	78,950	7.3	NEW JERSEY
NEW MEXICO	132,913	129,211	98,405	97,127	1,278	30,806	3,702	2,292	1,410	3,490	3,414	76	-	440	397	4	39	161	-	125,056	4,155	3.3	NEW MEXICO
NEW YORK	2,892,201	2,859,929	2,519,066	2,510,169	8,897	340,863	32,272	3,885	28,387	57,492	56,296	115	1,081	12,321	11,111	4	1,206	5,350	-	2,743,014	116,915	4.3	NEW YORK
NORTH CAROLINA	678,522	661,779	563,357	562,017	1,340	98,422	16,743	2,297	14,446	47,803	47,776	27	-	1,910	1,910	-	-	11,243	-	591,946	69,833	11.8	NORTH CAROLINA
NORTH DAKOTA	194,594	192,895	152,107	151,977	130	40,788	1,699	796	903	1,903	1,887	16	-	230	230	-	-	655	448	182,287	10,608	5.8	NORTH DAKOTA
OHIO	2,018,802	1,996,000	1,801,800	1,800,000	1,800	194,200	22,802	2,052	20,750	126,279	125,000	29	1,250	9,932	9,500	2	430	4,443	20,366	1,918,929	77,071	4.0	OHIO
OKLAHOMA	601,368	591,822	479,363	476,566	2,797	112,459	9,546	1,836	7,710	8,909	8,876	33	-	1,211	1,211	-	-	4,146	-	574,719	17,103	3.0	OKLAHOMA
OREGON	436,111	429,440	353,902	353,213	689	11/ 75,538	6,671	2,022	4,649	56	(11/)	56	-	1,887	1,881	6	-	711	912	393,578	35,862	9.1	OREGON
PENNSYLVANIA	2,309,068	2,285,083	2,016,420	2,010,117	6,303	268,663	23,985	2,716	21,269	37,489	36,525	306	658	14,093	13,253	6	834	36,068	-	2,145,849	139,234	6.5	PENNSYLVANIA
RHODE ISLAND	200,743	198,866	178,281	177,780	501	20,585	1,877	292	1,585	1,430	1,420	1	9	976	883	-	93	394	-	187,509	11,357	6.1	RHODE ISLAND
SOUTH CAROLINA	396,023	389,498	336,401	334,884	1,517	53,097	6,525	1,539	4,986	6,323	6,301	22	-	1,300	1,077	-	223	1,401	2,788	336,772	52,726	15.7	SOUTH CAROLINA
SOUTH DAKOTA	205,665	202,875	167,796	167,655	141	35,079	2,790	1,246	1,544	25,935	25,782	15	138	457	444	-	13	785	-	195,667	7,208	3.7	SOUTH DAKOTA
TENNESSEE	518,948	508,983	427,961	424,911	3,050	11/ 81,022	9,965	2,955	7,010	80	(11/)	80	-	1,856	1,854	2	-	406	-	447,983	61,000	13.6	TENNESSEE
TEXAS	1,833,362	1,811,101	1,441,998	1,440,996	1,002	369,103	22,261	3,646	18,615	62,259	61,397	74	788	5,069	4,741	3	325	3,872	-	1,694,113	116,988	6.9	TEXAS
UTAH	153,522	150,493	126,264	125,633	631	24,229	3,029	1,350	1,679	732	631	26	75	565	528	2	35	436	1,201	139,921	10,572	7.6	UTAH
VERMONT	97,735	97,486	87,159	12/ 87,048	111	12/ 10,327	249	249	-	2,554	2,551	3	-	444	444	-	-	627	-	93,645	3,841	4.1	VERMONT
VIRGINIA	579,119	570,567	484,588	482,838	1,750	85,979	8,552	2,106	6,446	14,206	14,024	19	163	2,946	2,773	1	172	7,057	-	498,838	71,729	14.4	VIRGINIA
WASHINGTON	627,811	617,030	522,258	520,599	1,659	94,772	10,781	2,701	8,080	27,680	27,259	88	333	2,608	2,473	1	134	-	-	562,495	54,535	9.7	WASHINGTON
WEST VIRGINIA	341,702	335,840	280,539	279,700	839	55,301	5,862	990	4,872	4,201	4,125	20	56	1,400	1,358	-	42	14,278	-	302,558	33,282	11.0	WEST VIRGINIA
WISCONSIN	980,540	968,512	808,726	807,810	916	159,786	12,028	1,837	10,191	9,224	8,921	40	263	3,885	3,590	2	293	2,269	-	900,915	67,597	7.5	WISCONSIN
WYOMING	93,646	91,459	71,157	71,017	140	20,302	2,187	1,149	1,038	11,578	11,442	31	105	296	296	-	-	390	-	85,657	5,802	6.8	WYOMING
DIST. OF COL.	177,015	174,070	160,267	158,616	1,651	13,803	2,945	1,382	13/ 1,563	956	837	10	109	796	654	67	75	168	3,659	161,914	12,156	7.5	DIST. OF COL.
TOTAL	34,764,996	34,383,167	29,507,113	29,418,313	88,800	4,876,054	381,829	84,728	297,101	1,434,349	1,421,036	2,325	10,988	140,851	133,064	128	7,659	162,286	106,699	32,025,365	2,357,802	7.4	TOTAL

1/ REGISTRATION PERIODS ENDING NOT EARLIER THAN NOVEMBER 30 AND NOT LATER THAN JANUARY 31 ARE CONSIDERED CALENDAR-YEAR PERIODS. IN THOSE STATES WHERE THE REGISTRATION PERIOD IS DEFINITELY REMOVED FROM THE CALENDAR YEAR, REGISTRATION FIGURES WERE OBTAINED FOR THE CALENDAR-YEAR PERIOD.

2/ WHEREVER POSSIBLE PUBLICLY OWNED VEHICLES AND VEHICLES NOT FOR HIGHWAY USE HAVE BEEN ELIMINATED FROM THESE COLUMNS.

3/ THE BUS FIGURES GIVEN REPRESENT COMMERCIAL BUSSES IN MOST CASES, ALTHOUGH IN SOME STATES CONTRACT SCHOOL BUSSES ARE INCLUDED. FOR STATES WHICH DID NOT SUPPLY SUCH INFORMATION, THE SEGREGATION OF BUSSES FROM OTHER MOTOR VEHICLES HAS BEEN APPROXIMATED FROM OTHER DATA AVAILABLE.

4/ DATA ON FEDERAL VEHICLES OBTAINED THROUGH AGENCY OF PROCUREMENT DIVISION, DEPARTMENT OF THE TREASURY. VEHICLES OWNED BY THE MILITARY SERVICES, INCLUDED IN PRIOR YEARS, ARE OMITTED FROM THESE COLUMNS. FEDERAL VEHICLES NOT ASSIGNED TO PARTICULAR STATES WERE LISTED AS "AT LARGE" IN PREVIOUS TABLES. IN THIS TABLE SUCH VEHICLES HAVE BEEN ASSIGNED TO STATES IN PROPORTION TO THOSE REPORTED BY STATES.

5/ STATE, COUNTY, AND MUNICIPAL VEHICLES ARE INCLUDED WITH PRIVATE AND COMMERCIAL REGISTRATIONS IN COLORADO, KANSAS, MASSACHUSETTS, MICHIGAN, NEW HAMPSHIRE, AND VERMONT. A SMALL NUMBER OF FEDERAL VEHICLES ARE INCLUDED IN THE FIGURES FOR INDIANA, KENTUCKY, LOUISIANA, MONTANA, NEW YORK, PENNSYLVANIA, AND VIRGINIA.

6/ FIGURES FOR TRAILERS AND SEMITRAILERS ARE AS REPORTED. APPARENT INCONSISTENCIES ARE DUE TO THE FACT THAT SOME STATES REQUIRE THE REGISTRATION OF TOURIST TRAILERS, LIGHT WORK TRAILERS, AND SIMILAR VEHICLES, WHEREAS OTHER STATES REGISTER ONLY FREIGHT-CARRYING TRAILERS AND SEMITRAILERS. WHEREVER POSSIBLE PUBLICLY OWNED VEHICLES AND VEHICLES NOT FOR HIGHWAY USE HAVE BEEN ELIMINATED FROM THIS COLUMN.

7/ FIGURES INCLUDE NEW-CAR, USED-CAR, AND MOTORCYCLE DEALERS REGISTRATIONS AND SOME WRECKER AND REPAIRER REGISTRATIONS. DATA ON DEALERS EXTRA PLATES ARE INCOMPLETE, ALTHOUGH THEY ARE INCLUDED WITH DEALERS REGISTRATIONS IN SOME STATES.

8/ TRAILERS OF 1,000 POUNDS CAPACITY OR MORE PROHIBITED ON HIGHWAYS, ALTHOUGH PERMITTED IN CITIES UNDER CITY LICENSES. TRACTOR-SEMITRAILERS REGISTERED AS TRUCKS. LIGHT TRAILERS PERMITTED BUT NOT REGISTERED.

9/ COMMERCIAL FULL TRAILERS INCLUDED WITH TRUCKS.

10/ TAXICABS INCLUDED WITH TRUCKS.

11/ TRAILERS INCLUDED WITH TRUCKS.

12/ TRUCKS UNDER 1,500 POUNDS CAPACITY INCLUDED WITH PASSENGER CARS.

13/ INCLUDES 547 AUTOMOBILES OF THE DIPLOMATIC CORPS.

STATE MOTOR-VEHICLE RECEIPTS - 1941

COMPILED FOR CALENDAR YEAR FROM REPORTS OF STATE AUTHORITIES 1/

TABLE MV-2, 1941
ISSUED JUNE 1942

STATE	TOTAL RECEIPTS	REGISTRATION FEES 2/ — MOTOR VEHICLES — PASSENGER VEHICLES — AUTOMOBILES (INCLUDING TAXICABS)	BUSSES 3/	TOTAL	TRUCKS AND TRACTOR-TRUCKS	TOTAL	OTHER VEHICLES — TRAILERS	MOTORCYCLES	TOTAL	MISCELLANEOUS RECEIPTS — DEALERS LICENSES	OPERATORS AND CHAUFFEURS PERMITS	CERTIFICATE OF TITLE FEES	SPECIAL TITLING TAXES 4/	FINES AND PENALTIES	TRANSFER OR REREGISTRATION FEES	ESTIMATED SERVICE CHARGES, LOCAL COLLECTORS 5/	OTHER RECEIPTS LESS UNCLASSIFIED REFUNDS	TOTAL	STATE
	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	1,000 DOLLARS	
ALABAMA	6,431	4,100	131	4,231	1,317	5,548	74	6	5,628	3	601	-	-	182	-	-	17	803	ALABAMA
ARIZONA	1,352	400	25	425	497	922	103	2	1,027	6	31	93	-	7	17	-	171	325	ARIZONA
ARKANSAS	3,935	2,130	94	2,224	1,135	3,359	199	1	3,559	101	252	-	-	4	15	-	4	376	ARKANSAS
CALIFORNIA 6/	31,927	22,166	(7/)	22,166	5,884	28,050	1,376	91	29,517	98	119	-	-	265	1,691	-	237	2,410	CALIFORNIA 6/
COLORADO	2,953	8/ 1,778	-	1,778	8/ 497	2,275	46	2	2,323	35	168	197	-	57	100	-	73	630	COLORADO
CONNECTICUT	8,249	3,417	158	3,575	1,737	5,312	27	7	5,346	115	2,096	-	-	179	178	-	335	2,903	CONNECTICUT
DELAWARE	1,456	739	(7/)	739	381	1,120	50	1	1,171	9	114	68	-	52	36	-	6	285	DELAWARE
FLORIDA	9,463	5,219	266	5,485	2,398	7,883	417	10	8,310	29	614	314	-	-	1	144	51	1,153	FLORIDA
GEORGIA	2,951	1,238	160	1,398	565	1,963	205	3	2,171	17	725	-	-	-	11	-	27	780	GEORGIA
IDAHO	1,542	673	10	683	543	1,226	76	2	1,304	25	144	57	-	-	-	-	12	238	IDAHO
ILLINOIS	26,567	16,845	(7/)	16,845	7,248	24,093	254	19	24,366	106	601	616	-	28	637	-	213	2,201	ILLINOIS
INDIANA	11,628	7,147	156	7,303	1,896	9,199	433	11	9,643	55	834	408	-	39	480	294	-125	1,985	INDIANA
IOWA	14,231	9,716	(7/)	9,716	3,378	13,094	244	10	13,348	78	675	-	-	-	252	-	-122	883	IOWA
KANSAS	4,743	2,923	(7/)	2,923	1,019	3,942	79	6	4,027	42	392	171	-	67	33	-	11	716	KANSAS
KENTUCKY	6,076	1,960	119	2,079	1,367	3,446	(9/)	3	3,449	26	621	-	1,645	16	299	-	20	2,627	KENTUCKY
LOUISIANA	3,486	10/ 1,087	118	1,205	1,236	2,441	888	5	3,334	9	159	-	-	8	-	-	-24	152	LOUISIANA
MAINE	4,434	2,288	21	2,309	11/ 1,206	3,515	12/ 31	4	3,550	81	570	-	-	35	121	-	77	884	MAINE
MARYLAND	7,830	3,599	221	3,820	743	4,563	194	5	4,762	58	413	286	1,689	498	164	-	-40	3,068	MARYLAND
MASSACHUSETTS	7,905	3,122	163	3,285	1,591	4,876	25	2	4,903	69	2,917	-	-	2	-	-	14	3,002	MASSACHUSETTS
MICHIGAN	27,163	13/ 16,017	(7/)	16,017	13/ 6,306	22,323	1,475	19	23,817	102	1,452	1,092	-	-	434	-	266	3,346	MICHIGAN
MINNESOTA 14/	19,530	14,124	222	14,346	3,851	18,197	680	13	18,890	61	182	-	-	170	-	-	227	640	MINNESOTA 14/
MISSISSIPPI	3,433	1,748	231	1,979	1,264	3,243	26	2	3,271	9	110	-	-	35	-	-	8	162	MISSISSIPPI
MISSOURI	11,713	8,201	(7/)	8,201	1,632	9,833	218	13	10,064	106	496	581	-	4	438	-	24	1,649	MISSOURI
MONTANA	1,797	964	(7/)	964	397	1,361	29	1	1,391	20	189	70	-	64	52	-	11	406	MONTANA
NEBRASKA	3,195	1,366	27	1,393	1,078	2,471	66	2	2,539	42	322	180	-	-	86	-	26	656	NEBRASKA
NEVADA	405	191	1	192	119	311	11	1	323	3	57	-	-	2	14	-	6	82	NEVADA
NEW HAMPSHIRE	3,291	-	-	-	-	2,724	-	4	2,728	23	395	-	-	87	-	-	58	563	NEW HAMPSHIRE
NEW JERSEY	24,349	11,874	316	12,190	4,528	16,718	450	11	17,179	79	4,519	584	-	262	317	-	1,409	7,170	NEW JERSEY
NEW MEXICO	2,213	1,082	68	1,150	632	1,782	70	1	1,853	12	191	40	-	5	-	-	112	360	NEW MEXICO
NEW YORK	53,978	36,207	-	36,207	12,670	48,877	845	48	49,770	210	1,564	-	-	585	1,427	-	422	4,208	NEW YORK
NORTH CAROLINA	9,777	5,462	110	5,572	3,114	8,686	587	8	9,281	42	178	235	-	64	-	-	-23	496	NORTH CAROLINA
NORTH DAKOTA	2,025	1,286	15	1,301	409	1,710	6	1	1,717	22	176	74	34	-	-	-	2	308	NORTH DAKOTA
OHIO	33,421	17,317	(7/)	17,317	9,671	26,988	1,707	48	28,743	216	926	685	-	173	507	2,117	54	4,678	OHIO
OKLAHOMA	7,086	2,820	248	3,068	1,758	4,826	764	6	5,596	55	549	368	-	-	-	400	118	1,490	OKLAHOMA
OREGON	4,416	1,766	43	1,809	15/ 1,485	3,294	(7/)	6	3,300	27	762	259	-	41	-	-	27	1,116	OREGON
PENNSYLVANIA	41,326	21,715	690	22,405	9,507	31,912	714	35	32,661	429	3,577	2,555	-	10	1,803	-	291	8,665	PENNSYLVANIA
RHODE ISLAND	3,425	2,115	52	2,167	580	2,747	6	4	2,757	17	494	-	-	-	112	-	45	668	RHODE ISLAND
SOUTH CAROLINA	2,749	1,070	49	1,119	801	1,920	198	1	2,119	34	503	-	-	39	37	-	17	630	SOUTH CAROLINA
SOUTH DAKOTA	1,879	1,482	5	1,487	277	1,764	48	1	1,813	19	-	31	-	-	-	-	16	66	SOUTH DAKOTA
TENNESSEE	7,077	-	-	-	-	6,123	-	-	6,123	(16/)	644	-	-	161	-	-	149	954	TENNESSEE
TEXAS	26,671	14,570	189	14,759	7,840	22,599	1,077	20	23,696	46	382	639	1,491	-	295	-	122	2,975	TEXAS
UTAH	1,335	601	(7/)	601	17/ 566	1,167	(7/)	1	1,168	16	35	87	-	1	26	-	2	167	UTAH
VERMONT	2,750	18/ 1,613	15	1,628	18/ 685	2,313	48	3	2,364	29	309	-	-	-	63	-	-15	386	VERMONT
VIRGINIA	8,363	5,491	-	5,491	1,738	7,229	209	8	7,446	75	123	404	-	-	255	-	60	917	VIRGINIA
WASHINGTON	5,461	1,569	78	1,647	1,363	3,010	359	7	3,376	17	1,452	181	-	88	133	195	19	2,085	WASHINGTON
WEST VIRGINIA	7,180	4,276	32	4,308	1,220	5,528	82	6	5,616	54	193	195	1,036	-	75	-	11	1,564	WEST VIRGINIA
WISCONSIN	14,862	10,365	179	10,544	3,092	13,636	517	16	14,169	36	355	8	-	-	283	-	11	693	WISCONSIN
WYOMING	652	345	-	345	238	583	55	-	638	8	-	-	-	-	4	-	2	14	WYOMING
DISTRICT OF COLUMBIA	1,985	882	20	902	464	1,366	21	3	1,390	21	326	97	-	-	34	-	117	595	DISTRICT OF COLUMBIA
PARTIAL TOTALS 19/	-	277,066	4,232	281,298	111,923	-	14,989	479	-	-	-	-	-	-	-	-	-	-	PARTIAL TOTALS 19/
FULL TOTALS	490,666	-	-	-	-	402,068	-	-	417,536	2,792	32,507	10,575	5,895	3,230	10,430	3,150	4,551	73,130	FULL TOTALS

1/ RECEIPTS FOR REGISTRATION PERIODS ENDING NOT EARLIER THAN NOVEMBER 30 AND NOT LATER THAN JANUARY 31 ARE CONSIDERED CALENDAR-YEAR RECEIPTS. IN THOSE STATES WHERE THE REGISTRATION PERIOD IS DEFINITELY REMOVED FROM THE CALENDAR YEAR, REGISTRATION RECEIPTS WERE OBTAINED FOR THE CALENDAR-YEAR PERIOD.

2/ SEGREGATION OF REGISTRATION FEES BY TYPE OF VEHICLE NOT AVAILABLE FOR NEW HAMPSHIRE AND TENNESSEE. TOTAL MOTOR-VEHICLE REGISTRATION FEES INCLUDE TRAILER FEES IN NEW HAMPSHIRE, AND TRAILER, MOTORCYCLE, AND DEALERS LICENSE FEES IN TENNESSEE.

3/ WHERE NO FEES ARE TABULATED THE FEES OF BUSSES ARE INCLUDED WITH THOSE OF AUTOMOBILES, UNLESS OTHERWISE NOTED.

4/ SPECIAL TITLE TAXES IMPOSED UNDER GENERAL SALES TAX LEVIES ARE NOT INCLUDED.

5/ IN MANY STATES COUNTY OR LOCAL OFFICERS ARE ALLOWED SERVICE CHARGES FOR ISSUING REGISTRATIONS, OPERATORS LICENSES, ETC. IN THE MAJORITY OF CASES THESE CHARGES ARE INCLUDED IN REGISTRATION AND OTHER FEES. THE AMOUNTS SHOWN IN THIS COLUMN ARE ESTIMATES OF SERVICE CHARGES COLLECTED AND RETAINED BY LOCAL OFFICIALS AND NOT REPORTED ELSEWHERE IN THE TABLE.

6/ REGISTRATION FEES INCLUDE PROCEEDS OF STATE "VEHICLE LICENSE FEES", $15,757,038, IMPOSED IN ADDITION TO THE REGULAR REGISTRATION FEES OF $13,760,350.

7/ INCLUDED WITH TRUCK FEES.

8/ FEES OF LIGHT TRUCKS INCLUDED WITH THOSE OF AUTOMOBILES.

9/ TRAILERS OF 1,000 POUNDS CAPACITY OR MORE PROHIBITED ON HIGHWAYS, ALTHOUGH PERMITTED IN CITIES UNDER CITY LICENSES. TRACTOR-SEMITRAILERS REGISTERED AS TRUCKS. LIGHT TRAILERS PERMITTED BUT NOT REGISTERED.

10/ DECREASE FROM 1940 RECEIPTS WAS DUE TO REDUCTION OF AUTOMOBILE REGISTRATION FEE TO THREE DOLLARS.

11/ INCLUDES FEES OF COMMERCIAL FULL TRAILERS.

12/ FEES OF LIGHT TRAILERS AND COMMERCIAL SEMITRAILERS ONLY. FEES OF COMMERCIAL FULL TRAILERS INCLUDED WITH THOSE OF TRUCKS.

13/ TAXICAB FEES INCLUDED WITH THOSE OF TRUCKS.

14/ LARGE INCREASE IN 1941 REGISTRATION RECEIPTS WAS DUE TO INCLUSION OF 1942 FEES COLLECTED IN LATTER PART OF 1941 BECAUSE OF CHANGE IN LAW.

15/ INCLUDES TRAILER FEES.

16/ INCLUDED WITH REGISTRATION FEES.

17/ INCLUDES FEES OF BUSSES AND TRAILERS.

18/ FEES OF TRUCKS UNDER 1,500 POUNDS CAPACITY INCLUDED WITH THOSE OF PASSENGER CARS.

19/ TOTALS OF COLUMNS FOR WHICH FULLY CLASSIFIED DATA WERE NOT AVAILABLE FOR ALL STATES.

STATUS OF FEDERAL-AID HIGHWAY PROJECTS

AS OF JULY 31, 1942

STATE	COMPLETED DURING CURRENT FISCAL YEAR			UNDER CONSTRUCTION			APPROVED FOR CONSTRUCTION			BALANCE OF FUNDS AVAILABLE FOR PROGRAMMED PROJECTS
	Estimated Total Cost	Federal Aid	Miles	Estimated Total Cost	Federal Aid	Miles	Estimated Total Cost	Federal Aid	Miles	
Alabama				$4,261,349	$2,315,384	115.2	$198,900	$99,450	0.3	$2,565,784
Arizona				665,314	552,164	28.2	487,374	301,290	4.8	1,515,952
Arkansas				1,275,742	635,815	59.9	810,614	589,082	16.9	1,172,187
California	$281,700	$165,500	11.2	4,473,982	3,124,165	42.8	2,604,776	1,858,813	75.5	2,226,638
Colorado	79,600	79,600		3,541,754	2,270,652	155.4	938,023	529,825	30.9	1,954,086
Connecticut				2,254,409	1,090,642	27.8	1,186,822	774,873	6.7	424,612
Delaware				428,810	210,460	9.0	268,040	134,020	8.4	1,513,348
Florida	65,718	45,075	.3	3,419,614	2,017,687	52.7	150,000	112,500	.9	2,909,335
Georgia	193,521	96,760	10.9	8,062,690	4,254,197	282.7	3,030,687	1,584,005	107.6	6,189,049
Idaho	307,561	218,529	17.3	1,109,663	812,177	57.3	425,377	327,494	10.6	1,529,251
Illinois	739,050	377,875	7.7	7,008,025	4,078,892	114.5	2,524,528	1,602,596	23.1	5,291,261
Indiana	805,800	402,900	15.5	6,425,689	3,129,737	89.7				2,907,857
Iowa	418,768	196,300	21.3	3,644,785	1,531,495	92.7	123,176	27,200	4.6	2,309,213
Kansas	346,856	181,060	19.0	5,964,404	3,264,041	240.2	659,063	339,177	34.9	4,550,299
Kentucky	283,274	141,637	6.2	5,089,499	2,577,107	87.0	3,263,364	1,948,234	31.5	570,843
Louisiana	15,648	11,736		1,159,867	798,961	22.4	3,755,006	2,111,722	67.6	3,423,906
Maine	155,480	77,740	2.9	1,789,292	977,337	19.2	78,610	39,305	.1	1,006,859
Maryland				2,253,781	1,102,489	12.0	810,000	573,625	4.3	780,082
Massachusetts	444,074	221,658	5.5	1,493,894	821,486	8.2	1,170,360	581,593	8.4	3,802,058
Michigan	28,000	21,000	.4	3,526,516	2,343,458	73.7	1,477,100	1,006,775	61.0	2,349,634
Minnesota	934,753	576,391	44.1	8,463,111	4,597,110	347.1	499,190	249,595	9.3	2,644,051
Mississippi				2,923,908	1,466,504	167.4	331,300	248,475	5.3	2,077,457
Missouri	699,456	349,728	14.3	9,323,372	5,599,469	158.2	2,044,687	1,057,614	21.8	3,263,308
Montana	680,704	409,067	18.3	3,076,532	2,018,054	158.3	238,580	158,250	25.7	4,088,704
Nebraska	687,804	358,622	57.6	2,260,130	1,143,999	128.5	1,167,560	874,778	76.6	3,644,730
Nevada	97,818	85,002	6.4	1,479,326	1,324,000	40.8	544,729	486,949	13.9	413,339
New Hampshire				1,682,125	1,131,880	19.4				683,756
New Jersey				85,262	42,631		758,830	551,250	2.2	2,381,851
New Mexico	55,592	38,583	11.0	726,233	566,823	26.9	818,715	671,755	58.5	1,977,719
New York	804,019	514,788	9.3	7,952,443	5,067,685	77.0	429,000	193,500	6.4	5,204,953
North Carolina	868,374	455,347	24.2	1,122,567	599,147	54.5	882,016	443,952	10.0	3,484,755
North Dakota	338,180	215,387	41.9	2,922,673	1,757,395	190.0	2,841,800	1,636,982	181.8	3,010,930
Ohio	2,757,360	1,755,944	16.2	12,047,192	7,049,032	70.2	3,527,610	1,938,966	27.7	757,003
Oklahoma				2,717,873	1,521,583	57.2	1,787,060	1,090,044	45.0	5,758,946
Oregon	112,243	51,000	10.4	3,755,534	2,128,876	75.7	397,962	318,810	26.2	930,823
Pennsylvania	365,287	182,489	4.3	8,491,988	4,527,019	61.0	3,036,620	2,235,739	18.6	2,667,949
Rhode Island	14,721	7,312		1,032,274	662,318	5.1	479,631	239,757	2.6	602,219
South Carolina				3,279,041	2,073,216	71.1	1,133,990	781,625	19.5	901,776
South Dakota	577,100	414,170	57.5	3,775,133	2,491,345	444.0	615,240	365,050	70.4	2,867,481
Tennessee	326,308	163,154	1.5	4,250,726	2,496,980	95.3				3,485,842
Texas	1,431,060	715,100	51.6	7,197,714	3,399,398	189.4	1,330,145	651,830	40.9	8,632,202
Utah	577,845	434,655	14.8	1,182,810	901,211	26.8	874,733	476,706	23.2	766,837
Vermont	237,535	107,173	2.8	955,791	608,067	18.0	36,906	18,453	.3	396,743
Virginia	305,788	153,839	8.8	2,963,766	1,625,853	42.2	35,490	17,745	.4	2,757,658
Washington	40,957	27,150	.8	2,639,710	1,473,993	30.1	211,457	124,500	3.4	1,885,522
West Virginia	423,506	208,401	4.4	2,485,653	1,502,080	24.4	884,359	488,979	8.8	1,059,368
Wisconsin	1,289,778	794,390	51.9	5,010,079	3,311,467	117.5	352,531	251,350	10.4	3,369,384
Wyoming	491,888	353,584	27.4	1,358,229	1,040,201	104.7	140,715	115,749	12.1	1,069,972
District of Columbia				353,629	206,688	.9	1,008,052	593,356	3.6	28,530
Hawaii	3,444	3,444		1,236,596	951,269	11.8	476,174	456,702	4.7	1,306,261
Puerto Rico	166,075	81,840	3.1	2,425,620	1,199,666	17.3	37,725	27,994	.2	527,567
TOTALS	18,452,645	10,693,930	600.8	177,026,119	102,393,305	4,421.4	50,935,127	31,308,034	1,227.6	121,639,890

STATUS OF FEDERAL-AID SECONDARY OR FEEDER ROAD PROJECTS

AS OF JULY 31, 1942

STATE	COMPLETED DURING CURRENT FISCAL YEAR			UNDER CONSTRUCTION			APPROVED FOR CONSTRUCTION			BALANCE OF FUNDS AVAILABLE FOR PROGRAMMED PROJECTS
	Estimated Total Cost	Federal Aid	Miles	Estimated Total Cost	Federal Aid	Miles	Estimated Total Cost	Federal Aid	Miles	
Alabama				$562,252	$300,210	10.9	$23,031	$11,050		$590,870
Arizona	$63,345	$46,046	2.9	142,693	103,688	6.7	69,383	49,650		414,777
Arkansas				662,760	329,780	32.4	135,656	67,416	8.0	180,507
California	4,995	4,995		703,607	555,721	8.8	18,050	9,500		954,372
Colorado				137,809	78,621	3.2	152,387	35,323	5.0	497,995
Connecticut				275,575	120,602	4.8				194,940
Delaware	43,350	21,675	5.0	8,040	4,020		102,873	37,618	3.9	251,159
Florida	108,248	54,124	.2	188,120	103,530	6.0				399,766
Georgia				1,326,307	775,503	82.8	604,762	302,381	36.6	938,371
Idaho				391,287	259,816	12.2	38,149	23,587	2.8	183,196
Illinois	40,000	20,000	2.2	1,263,384	631,692	63.2	219,000	109,500	3.7	771,146
Indiana	80,000	40,000	5.3	1,269,466	599,282	48.8				927,827
Iowa	109,341	51,500	20.6	543,562	242,570	79.1	32,056	15,050	8.8	585,167
Kansas	26,060	17,170		1,808,040	904,857	97.9	177,337	88,669	23.4	1,039,534
Kentucky	140,794	22,951	4.5	1,041,841	378,281	29.9	35,726	6,400	.1	319,467
Louisiana				15,460	7,730		674,013	267,134	15.3	533,140
Maine	64,770	32,385	3.8	116,796	58,398	4.1	39,383	19,614	.5	142,227
Maryland				226,410	113,205	1.8				345,564
Massachusetts	241,682	128,841	3.4	462,552	264,842	6.7				522,088
Michigan	51,800	25,900		672,898	336,449	29.4	219,670	109,835	.2	655,791
Minnesota	34,062	17,031	.1	1,031,533	521,505	98.0	298,260	148,730	19.6	560,306
Mississippi				1,504,188	714,285	59.0				388,361
Missouri	162,104	81,052	12.5	560,911	271,114	57.7	186,244	63,193	32.4	1,030,471
Montana	39,842	22,609	7.3	252,900	148,113	23.7	13,569	7,715	4.5	904,396
Nebraska	54,055	29,603	10.8	131,727	68,477	13.9				695,483
Nevada				88,578	56,842	4.6	107,839	90,444	11.9	144,428
New Hampshire				241,995	164,766	3.6				87,696
New Jersey	278,480	149,240	6.2	163,825	100,815	7.6				561,260
New Mexico				262,325	169,211	19.5				250,178
New York				1,431,250	756,263	15.9				1,076,253
North Carolina	240,526	120,230	17.3	394,121	214,458	20.8	69,820	20,000	5.0	638,786
North Dakota				7,382	7,382		808,050	793,860	42.7	755,172
Ohio				901,610	498,775	14.5	236,950	118,475	5.0	1,303,467
Oklahoma				120,588	63,680	4.0	1,215,706	641,924	71.9	860,552
Oregon	108,767	66,350	3.5	286,801	163,737	16.8	30,482	18,000	1.3	333,502
Pennsylvania				292,174	146,052	5.5	194,147	97,051	2.5	724,357
Rhode Island	2,207	1,096		78,192	42,846	.8	33,245	16,622	.2	80,038
South Carolina	202,900	65,124	.5	24,944	18,355					394,792
South Dakota				9,056	9,056		1,143,430	1,047,600	114.5	757,118
Tennessee	295,522	147,761	8.4	846,000	433,000	34.8	158,042	79,021	4.6	749,292
Texas				360,490	177,895	26.5				2,241,944
Utah	55,085	27,543	2.5	99,045	73,878	1.5				305,370
Vermont				222,515	117,328	8.9				53,580
Virginia	322,312	142,308	7.7	49,604	25,572	.7				679,170
Washington				337,818	135,362	7.8	786,758	409,402	64.8	1,029
West Virginia	175,950	87,975	5.3	115,470	57,122	1.1				511,059
Wisconsin	129,993	61,830	.3	1,157,387	528,605	42.4				581,141
Wyoming				464,690	204,982	31.7				214,778
District of Columbia							107,026	52,000	.9	111,600
Hawaii				1,279	1,279		49,687	49,687	.4	285,187
Puerto Rico				74,942	40,110	3.1				216,668
TOTALS	3,076,190	1,485,339	130.3	23,332,199	12,099,662	1,053.1	7,980,731	4,806,451	490.5	27,945,338

U. S. GOVERNMENT PRINTING OFFICE: 1942

PUBLICATIONS of the PUBLIC ROADS ADMINISTRATION

Any of the following publications may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. As his office is not connected with the Agency and as the Agency does not sell publications, please send no remittance to the Federal Works Agency.

ANNUAL REPORTS

Report of the Chief of the Bureau of Public Roads, 1931. 10 cents.

Report of the Chief of the Bureau of Public Roads, 1932. 5 cents.

Report of the Chief of the Bureau of Public Roads, 1933. 5 cents.

Report of the Chief of the Bureau of Public Roads, 1934. 10 cents.

Report of the Chief of the Bureau of Public Roads, 1935. 5 cents.

Report of the Chief of the Bureau of Public Roads, 1936. 10 cents.

Report of the Chief of the Bureau of Public Roads, 1937. 10 cents.

Report of the Chief of the Bureau of Public Roads, 1938. 10 cents.

Report of the Chief of the Bureau of Public Roads, 1939. 10 cents.

Work of the Public Roads Administration, 1940, 10 cents.

Work of the Public Roads Administration, 1941, 15 cents.

HOUSE DOCUMENT NO. 462

Part 1 . . . Nonuniformity of State Motor-Vehicle Traffic Laws. 15 cents.

Part 2 . . . Skilled Investigation at the Scene of the Accident Needed to Develop Causes. 10 cents.

Part 3 . . . Inadequacy of State Motor-Vehicle Accident Reporting. 10 cents.

Part 4 . . . Official Inspection of Vehicles. 10 cents.

Part 5 . . . Case Histories of Fatal Highway Accidents. 10 cents.

Part 6 . . . The Accident-Prone Driver. 10 cents.

MISCELLANEOUS PUBLICATIONS

No. 76MP . . The Results of Physical Tests of Road-Building Rock. 25 cents.

No. 191MP. . Roadside Improvement. 10 cents.

No. 272MP. . Construction of Private Driveways. 10 cents.

No. 279MP. . Bibliography on Highway Lighting. 5 cents.

Highway Accidents. 10 cents.

The Taxation of Motor Vehicles in 1932. 35 cents.

Guides to Traffic Safety. 10 cents.

An Economic and Statistical Analysis of Highway-Construction Expenditures. 15 cents.

Highway Bond Calculations. 10 cents.

Transition Curves for Highways. 60 cents.

Highways of History. 25 cents.

Specifications for Construction of Roads and Bridges in National Forests and National Parks. 1 dollar.

DEPARTMENT BULLETINS

No. 1279D . . Rural Highway Mileage, Income, and Expenditures, 1921 and 1922. 15 cents.

No. 1486D . . Highway Bridge Location. 15 cents.

TECHNICAL BULLETINS

No. 55T . . . Highway Bridge Surveys. 20 cents.

No. 265T. . . Electrical Equipment on Movable Bridges. 35 cents.

Single copies of the following publications may be obtained from the Public Roads Administration upon request. They cannot be purchased from the Superintendent of Documents.

MISCELLANEOUS PUBLICATIONS

No. 296MP. . Bibliography on Highway Safety.

House Document No. 272 . . . Toll Roads and Free Roads.

Indexes to PUBLIC ROADS, volumes 6–8 and 10–21, inclusive.

SEPARATE REPRINT FROM THE YEARBOOK

No. 1036Y . . Road Work on Farm Outlets Needs Skill and Right Equipment.

REPORTS IN COOPERATION WITH UNIVERSITY OF ILLINOIS

No. 303. . . Solutions for Certain Rectangular Slabs Continuous Over Flexible Support.

No. 304. . . A Distribution Procedure for the Analysis of Slabs Continuous Over Flexible Beams.

No. 313. . . Tests of Plaster-Model Slabs Subjected to Concentrated Loads.

No. 314. . . Tests of Reinforced Concrete Slabs Subjected to Concentrated Loads.

No. 315. . . Moments in Simple Span Bridge Slabs With Stiffened Edges.

UNIFORM VEHICLE CODE

Act I.—Uniform Motor Vehicle Administration, Registration, Certificate of Title, and Antitheft Act.

Act II.—Uniform Motor Vehicle Operators' and Chauffeurs' License Act.

Act III.—Uniform Motor Vehicle Civil Liability Act.

Act IV.—Uniform Motor Vehicle Safety Responsibility Act.

Act V.—Uniform Act Regulating Traffic on Highways.

Model Traffic Ordinances.

A complete list of the publications of the Public Roads Administration, classified according to subject and including the more important articles in PUBLIC ROADS, may be obtained upon request addressed to Public Roads Administration, Willard Bldg., Washington, D. C.

STATUS OF FEDERAL-AID GRADE CROSSING PROJECTS

AS OF JULY 31, 1942

STATE	COMPLETED DURING CURRENT FISCAL YEAR					UNDER CONSTRUCTION					APPROVED FOR CONSTRUCTION					BALANCE OF FUNDS AVAILABLE FOR PROGRAMMED PROJECTS
			NUMBER					NUMBER					NUMBER			
	Estimated Total Cost	Federal Aid	Grade Crossings Eliminated by Separation or Relocation	Grade Crossing Structures Reconstructed	Grade Crossings Protected by Signals or Otherwise	Estimated Total Cost	Federal Aid	Grade Crossings Eliminated by Separation or Relocation	Grade Crossing Structures Reconstructed	Grade Crossings Protected by Signals or Otherwise	Estimated Total Cost	Federal Aid	Grade Crossings Eliminated by Separation or Relocation	Grade Crossing Structures Reconstructed	Grade Crossings Protected by Signals or Otherwise	
Alabama	$19,100	$19,100			1	$504,525	$502,903	7	2	1	$52,335	$52,335	2		5	$908,129
Arizona						138,529	129,838		1	2	4,095	4,095			1	230,684
Arkansas	9,364	9,364			3	171,586	169,876	1		1	14,360	13,964			5	643,828
California						688,453	688,453	3			3,775	3,775			1	2,308,368
Colorado						612,609	612,609	5		2	11,111	11,111			5	741,933
Connecticut						8,652	8,652				231,374	222,740		1		532,031
Delaware						191,599	189,867	1	1		508,406	321,785	2			179,564
Florida						843,067	840,887	8		6	78,493	78,433			13	871,496
Georgia	160,690	160,690	2			665,593	665,593	3	5	9	785,985	785,985	2	4	9	1,504,838
Idaho						185,563	176,891	2			4,189	4,189			2	448,975
Illinois	505,480	425,230	1	1	1	957,927	954,981	6		2	384,599	384,399	1	1	29	2,549,863
Indiana						440,361	440,361	2	1	13	85,861	85,861			26	1,160,246
Iowa	142,887	137,775	1	1	9	1,401,276	1,148,026	10	1	16	79,765	78,845			21	638,171
Kansas	196,324	196,119	2		2	616,568	616,568	9		3	82,621	82,621	1		5	1,294,058
Kentucky						408,223	408,223	4			23,850	23,850	1			396,031
Louisiana	252,494	252,494	2			338,486	338,486	6			658,006	655,120	5		1	736,600
Maine						253,884	253,884	1		1						284,591
Maryland	7,150	7,150			1	884,808	884,330	4		2	30,175	30,175			6	242,604
Massachusetts	84,036	83,820	1			608,552	607,941	3	1		763,830	763,830	2	1		1,250,593
Michigan						1,623,692	1,623,692	4		1	36,245	36,245			10	129,825
Minnesota						943,112	943,112	5	4		4,739	4,739			1	1,241,354
Mississippi	244,800	244,800	4			610,828	610,828	5								641,634
Missouri	13,356	13,356				1,574,876	1,297,892	5	4		20,778	20,778	1			1,462,419
Montana	5,963	5,950				93,828	93,828	1								734,621
Nebraska	96,908	96,836	1		1	410,892	410,892	8			11,853	11,853			2	480,668
Nevada						56,484	56,484	2			22,635	22,635			7	196,853
New Hampshire						76,060	75,735	2								313,962
New Jersey						632,648	507,098	2	2		299,170	239,745	1	1		922,538
New Mexico						71,000	71,000	1			259,103	252,068	3		1	519,348
New York	568,500	566,900	2	1		1,355,198	1,315,859	1	6		502,645	464,285		1		3,726,559
North Carolina	78,355	78,355		1		99,847	99,847	1		2	26,315	26,315			6	1,411,984
North Dakota	216,790	216,790	3			192,655	192,655	1								872,117
Ohio						2,752,053	2,428,331	10		1	691,590	487,460	2		4	1,428,559
Oklahoma						888,013	886,093	6		3	392,744	354,707	3		3	1,435,846
Oregon						603,387	476,181	3			13,433	13,433			4	160,571
Pennsylvania						3,160,659	3,146,130	15			235,355	235,355	1			2,506,669
Rhode Island	1,472	1,462				2,193	2,193									273,921
South Carolina	9,420	9,420			2	47,842	47,842	1	1		235,073	119,940		3	6	975,666
South Dakota						515,821	499,871	9			41,200	41,200	2			830,897
Tennessee						1,256,182	1,256,182	6	1		430,180	430,180	1	2	3	672,789
Texas	138,448	136,041	1		1	795,830	779,154	6		2						2,388,145
Utah						42,917	42,917	1		1	63,531	63,531			23	362,966
Vermont						324,331	294,552	2								113,888
Virginia						352,754	332,794	3	1	1						965,312
Washington						1,041,232	344,558	5			2,478	2,478			1	447,340
West Virginia	172,050	172,050	3			834,123	834,123	4		2	3,330	3,330			1	324,320
Wisconsin	38,476	38,381		1	1	381,214	380,470	3		4	12,687	12,687			2	1,671,665
Wyoming						6,210	6,210			4	6,159	6,158			2	428,049
District of Columbia						285,934	285,934		1							91,161
Hawaii						211,977	211,462	2								282,756
Puerto Rico						780,618	772,706	11								363,914
TOTALS	2,962,063	2,872,083	23	5	22	31,944,671	29,964,994	200	32	79	7,114,073	6,452,235	30	14	205	45,300,919