

## TESTS on RUTTING of SHOULDERS

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## SYNOPSIS

This paper presents data on the degree of rutting of various shoulders, including turfed shoulders, stabilized with granular material, under a 9,000-lb. wheel load on dual tires. Data are given on the materials and design of the several sections, the compaction, the moisture content, and the depth of root growth of the grass.

While turf shoulders are pleasing in appearance, and may be economical to maintain where traffic is not excessive, particularly where the need for ditch cleaning is reduced, they are often soft when wet, and drivers may prefer to risk stopping on the pavement rather than to take a chance on having the vehicle mired down.

For the sake of safety, shoulders should be of such character that the vehicles can operate on them readily.

Shoulders of a number of designs were constructed, and later were tested for resistance to rutting. Rather full data were obtained on the grading and physical characteristics of the several designs.

The rutting tests were made on March 24 and 25, 1953, when the supporting power of the shoulders was probably at about its lowest value. In the early morning of March 24 there were 1.37 in. of rain, and during the testing on March 25 another 1.44 in. of rain fell.

Rutting tests were conducted on a turfed shoulder constructed several years ago, on the road between Washington, D. C., and the town of Indian Head, Prince Georges County, Maryland, and also on a series of experimental shoulder plots on the Henry G. Shirley Memorial Highway in Arlington County, Virginia.

Shirley Highway Tests

The test plots on the Shirley Highway were constructed in the fall of 1951. The several designs are shown in Fig. 1. Sections A through G were specially constructed under controlled conditions to afford several variations in design. Section H, representative of the shoulders generally on the northerly portion of the Shirley Highway, is shown by the test data in Table 1 to have been generally comparable in quality to the specially prepared test plots, though less closely controlled when constructed. The plots were seeded in the fall of 1951, and again in 1952, but each time weather conditions following were unfavorable for securing a stand of grass. In addition, the plots were used by trucks for rest stops before entering Washington. At the time the rutting tests were run, there was a sparse stand of grass on portions of the plots, but considerable areas were bare. After completion of the rutting tests, the surface was smoothed and seeded and a good stand of grass was secured.

The rutting tests were made by use of a truck having a 9,000-lb. load on one wheel with dual tires. The truck was operated at slow uniform speed, with the loaded wheel about 3 ft. outside the edge of pavement. Successive runs followed the same path. Only six runs were made, since at that time the ruts did not seem to become appreciably deeper.

Table 1 shows the test results of investigations of the surface layer of the shoulder material at the time of the rutting tests, and the depth of rutting. The large scale cross sections show the rutting and extrusion caused by the tests.

TABLE 1

## TEST DATA - SURFACE LAYERS, 3- to 6-in. THICK

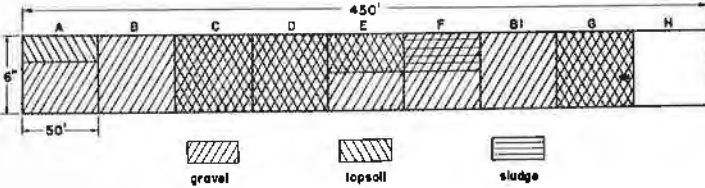
Plot	SHIRLEY						INDIAN HEAD			
	A	B	C	D	E	F	B-1	G	H	
<u>Sieve Analysis</u>										
Passing 2-in.	100	100	100	100	100	100	100	100	100	100
1½-in.	100	91	100	100	99	100	100	97	100	99
1-in.	98	85	96	98	94	97	95	92	98	92
¾-in.	95	75	90	91	87	88	86	83	97	85
⅜-in.	90	58	76	77	70	67	63	67	93	72
No. 4	85	46	65	68	58	52	49	56	90	64
No. 10	82	38	58	62	50	43	40	49	88	60
No. 40	71	23	42	45	35	26	21	35	71	49
No. 200	45	11	26	27	19	14	10	20	45	36
<u>Hydrometer Analysis-Passing No. 10 Sieve</u>										
Coarse Sand	17	39	29	27	31	40	46	29	18	18
Fine Sand	32	32	28	30	31	30	30	32	31	23
Silt	29	13	23	23	20	15	10	20	30	38
Clay	23	16	20	20	18	16	14	19	21	22
<u>Physical Constants</u>										
Liquid Limit	27	23	30	27	28	31	24	26	27	26
Plasticity Index	8	9	12	10	10	11	10	9	9	7
% Nat'l Moisture	16	5	10	11	11	10	8	9	12	10
Dry Density	109	130	118	121	121	124	129	124	110	122
<u>Depths of Ruts - inch</u>										
1 Pass	0.4	0.2	0.8	0.5	0.4	0.5	0.2	0.1	0.5	Slight
6 Passes	0.9	0.7	1.1	0.9	1.1	0.5	0.5	0.5	0.8	Slight
30 Passes	-	-	-	-	-	-	-	-	-	1.8
<u>Root Depth - inches</u>										
	5	4	4	3	3	3	-	4	4	5

Indian Head Road Tests

The shoulder on the Indian Head Road consisted of a layer of gravel about 8 in. thick, with an inch of topsoil blended into the upper 3-in. portion of gravel. It had been seeded and had a good stand of grass. This shoulder demonstrates the ability of grass to prosper on a gravel-topsoil layer which lies above open graded gravel, in the Washington area. This shoulder had not been subjected to any great amount of vehicular use.

ROAD SHOULDER TEST SECTIONS  
HENRY G. SHIRLEY MEMORIAL HIGHWAY

Scale: Hor. 1" = 50', Vert. 1" = 6"



- A 4 inches of gravel under 2 inches of topsoil.
- B and BI 6 inches of gravel.
- C Mixture of 2/3 gravel and 1/3 topsoil.
- D Mixture of 4/5 gravel and 1/5 topsoil.
- E 3 inches of gravel under 3 inch mixture of 2/3 gravel and 1/3 topsoil.
- F 3 inches of gravel under 3 inch mixture of 2/3 gravel and 1/3 sludge.
- G Mixture of 3/4 gravel and 1/4 topsoil predetermined to bring P.I. to 9.
- H Existing shoulder.

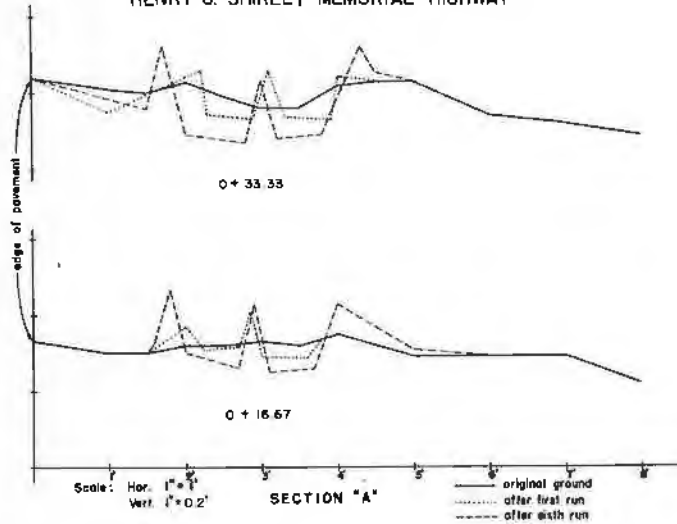
The rutting tests on the Indian Head Road were made in the same fashion as on the Shirley Highway, using the same truck, except that 30 passes were made. Very little rutting occurred under the initial passes. After about the tenth run, the wheel began to break through the turf, and rutting occurred. It appeared that the break-through was caused in part because of the rain then falling, and might not have occurred in fair weather.

Figure 1.

Test data, and depth of rut, are included in Table 1.

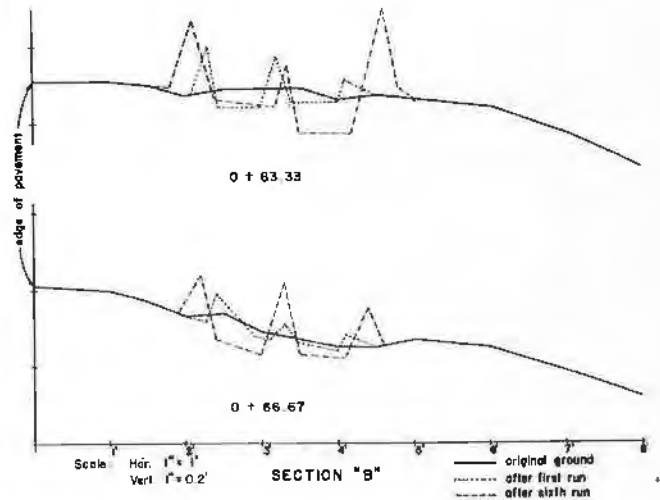
The large scale cross sections show the rutting and extrusion caused by the tests.

RUTTING TESTS ON STABILIZED SHOULDER PLOTS  
HENRY G. SHIRLEY MEMORIAL HIGHWAY



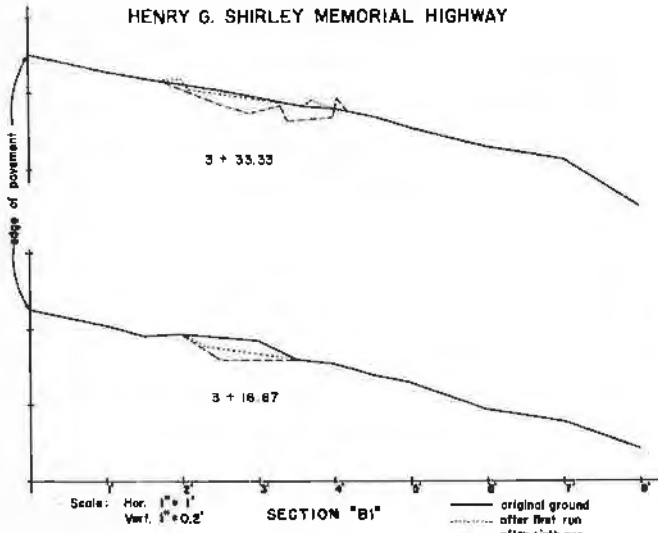
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RUTTING TESTS ON STABILIZED SHOULDER PLOTS  
HENRY G. SHIRLEY MEMORIAL HIGHWAY



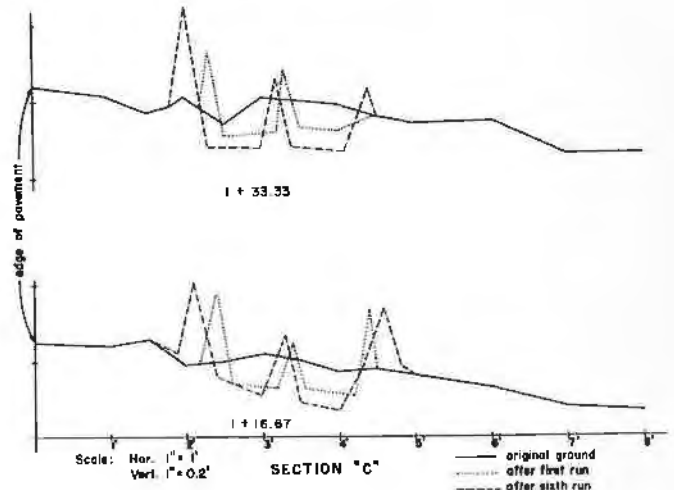
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RUTTING TESTS ON STABILIZED SHOULDER PLOTS  
HENRY G. SHIRLEY MEMORIAL HIGHWAY



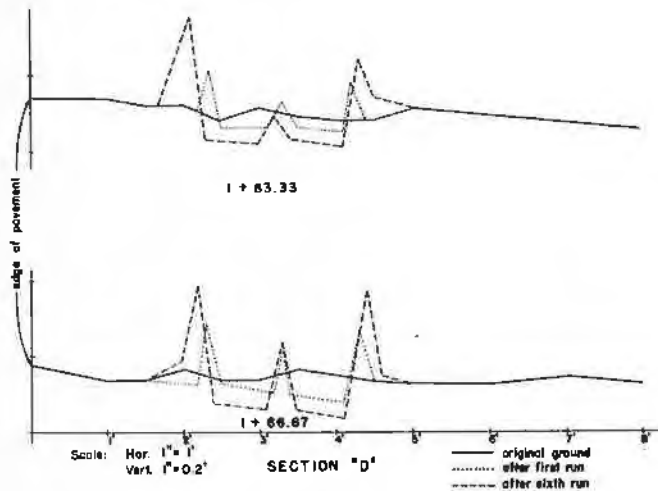
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RUTTING TESTS ON STABILIZED SHOULDER PLOTS  
HENRY G. SHIRLEY MEMORIAL HIGHWAY



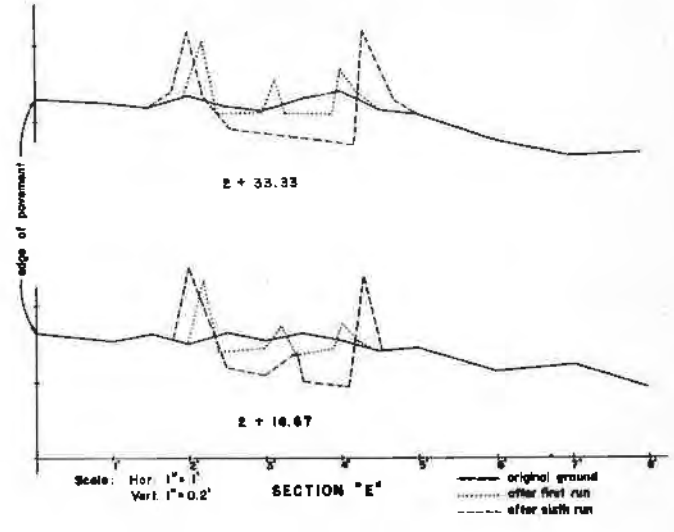
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RUTTING TESTS ON STABILIZED SHOULDER PLOTS  
HENRY G. SHIRLEY MEMORIAL HIGHWAY



Section "D"

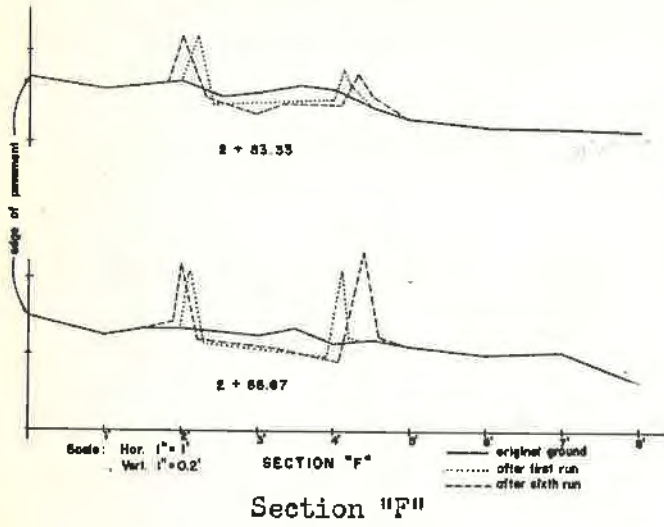
RUTTING TESTS ON STABILIZED SHOULDER PLOTS  
HENRY G. SHIRLEY MEMORIAL HIGHWAY



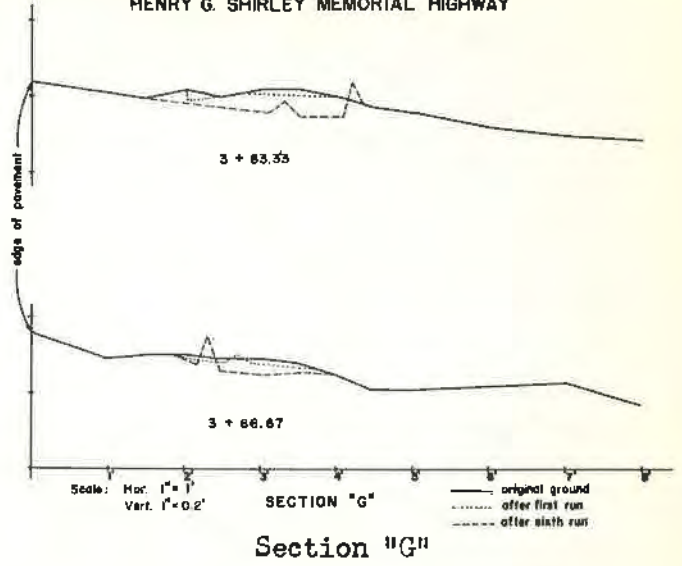
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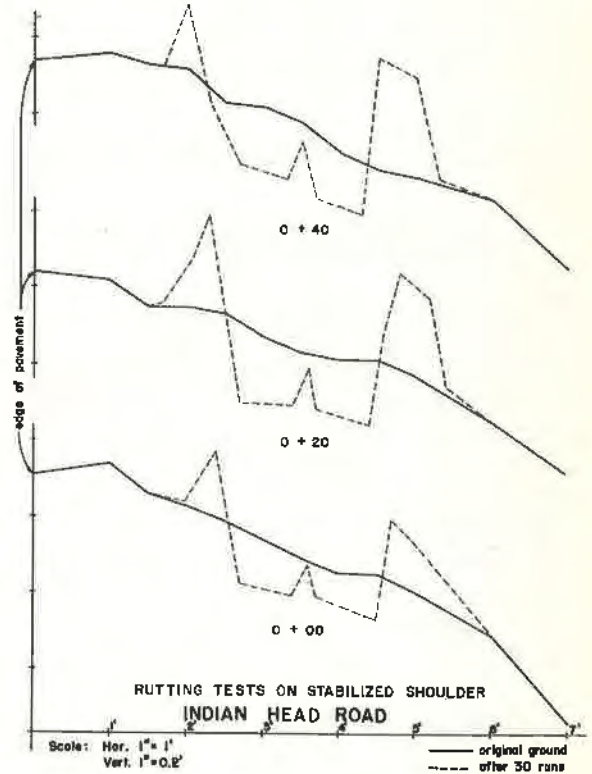
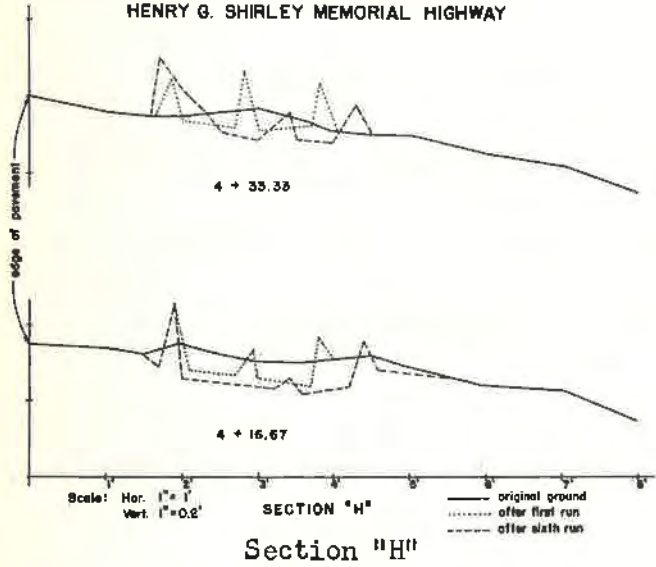
RUTTING TESTS ON STABILIZED SHOULDER PLOTS  
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Henry G. Shirley Memorial Highway

Plot	Kind (Top Layer)	Root Pene. inches	Before Test Runs		During Testing		After Test Runs		Rutting				
			Moisture %	L.L. P.I. # / cu.ft.	Moisture %	L.L. P.I. # / cu.ft.	Moisture %	L.L. P.I. # / cu.ft.	Initial	Final			
A	topsoil	5.5	17.0	29	9	104	25.9	19.1	29	9	112	0.035	0.075
B	gravel	-	4.9	23	8	120	19.9	5.9	23	9	134	0.02	0.06
C	2/3 gravel and 1/3 topsoil	5.5	11.2	28	9	112	18.1	8.5	31	14	123	0.07	0.09
D	4/5 gravel and 1/5 topsoil	3.5	11.1	27	9	118	22.4	11.2	26	9	126	0.035	0.08
E	2/3 gravel and 1/3 topsoil	5.0	11.1	28	10	119	-	10.3	27	10	124	0.03	0.09
F	2/3 gravel and 1/3 sludge	3.5	13.5	34	10	115	-	6.1	28	12	133	0.04	0.04
B-1	gravel	-	6.4	24	9	130	-	9.8	24	9	128	0.015	0.04
G	3/4 gravel and 1/4 topsoil	4.0	10.5	28	9	120	-	7.6	24	8	129	0.01	0.04
H	Existing Shoulder	4.0	11.7	27	8	106	-	13.3	27	9	133	0.04	0.07

L - Material below wheel track.

### Conclusions

The well-established turf cover on the Indian Head Road was of appreciable value in resistance to rutting.

On the Shirley Highway, where all but two of the several designs had at least 38 percent of the material retained on a No. 10 sieve, no particularly significant difference in resistance to rutting was found between the designs. In most cases, the rutting under the first application of the wheel load was  $\frac{1}{2}$  in. or less. In no case, after repeated runs, was there any indication that a breakthrough of the shoulder structure was incipient.

The considerable variation in design of the shoulders tested indicates that stable shoulders of adequate bearing capacity, and able to support turf, can be constructed with considerable latitude in the materials used, permitting economical construction with available materials. The tests indicate that for the climatic conditions of Washington, D. C., materials should prove stable if conforming to the requirements of Grading F of A.A.S.H.O. Designation M 147-49, with a maximum liquid limit of 35 and a plasticity index range of 4 to 9, assuming adequate compaction. They also show that it should be possible to secure a satisfactory stand of turf where use by traffic is not excessive.

#### Indian Head Road

Kind - 1-in. topsoil mixed with 2-inch gravel  
 Root penetration - 4 to 7 inches  
 Natural moisture, top portion - 8 to 11 percent  
 Moisture at time of test, top portion  
     Bottom of rut - 15.7 percent)  
     Side of rut - 42.6 percent) average of 3 stations  
 After test runs, top portion  
     L.L. - 25  
     P.I. - 7  
     Dry Density - 122.

Rutting - after 30 runs - 0.16 ft.

LOUISIANA DEPARTMENT OF HIGHWAYS  
 HAMMOND MAINTENANCE DISTRICT  
 HAMMOND, LOUISIANA

#### TRAFFIC TEST ON TURF SHOULDER

Baptist, Louisiana

This is a report on traffic tests on a turf shoulder conducted May 5, 1953, by the Louisiana Department of Highways in accordance with suggestions from the Committee on Stabilized Turf Shoulders of the Highway Research Board. The shoulder is located on US 190 at Baptist, La.

The shoulder selected for the experiment has given excellent service and is