

TABLE X
STATION 72, ROUTE 91
South line of Hudson, Ohio

Date	Ac	B ₁	B ₂	B ₃	C ₁	C ₂	C ₃	D ₁	D ₂	D ₃
1925										
Feb 23	7 390	6 646	6 730	6 830	6 631	6 701	6 798	5 761	5 887	5 961
Difference	- 039	- 006	- 018	- 033	+ 008	- 014	- 029	- 029	- 043	- 053
Mar 19	7 351	6 640	6 712	6 797	6 639	6 687	6 769	5 732	5 844	5 908
Difference	+ 002	- 007	- 011	- 010	- 011	- 010	- 011	- 006	- 008	- 007
Apr 8	7 353	6 633	6 701	6 787	6 628	6 677	6 758	5 726	5 836	5 901
Difference	000	- 003	- 000	- 006	- 007	- 003	- 004	- 006	+ 001	- 006
May 12	7 353	6 630	6 701	6 782	6 621	6 674	6 754	5 720	5 837	5 895
Difference	+ 010	+ 009	+ 009	+ 012	+ 006	+ 010	+ 011	+ 018	+ 010	+ 027
July 21	7 363	6 639	6 710	6 794	6 627	6 684	6 765	5 738	5 847	5 922
Difference	- 013	- 005	- 014	- 014	- 004	- 013	- 013	- 016	- 014	- 013
Sept 29	7 350	6 634	6 696	6 780	6 623	6 671	6 752	5 722	5 833	5 909
Difference	+ 051	+ 052	+ 047	+ 050	+ 047	+ 055	+ 050	+ 067	+ 064	+ 060
1926										
Jan 19	7 401	6 686	6 749	6 830	6 676	6 726	6 802	5 789	5 897	5 969
Difference	+ 063	+ 055	+ 050	+ 052	+ 051	+ 049	+ 053	+ 060	+ 067	+ 076
Mar 11	7 464	6 741	6 799	6 882	6 727	6 775	6 855	5 849	5 964	6 045
Difference	- 108	- 106	- 101	- 098	- 102	- 100	- 100	- 119	- 123	- 215
Apr 9	7 356	6 635	6 698	6 784	6 625	6 675	6 755	5 730	5 841	5 830
Difference	- 004	- 003	- 003	- 004	- 003	- 005	- 005	- 007	- 009	
May 19	7 352	6 632	6 695	6 780	6 622	6 670	6 750	5 723	5 832	*5 940
Max diff 1925	040	016	034	050	010	030	046	041	054	066
Max diff 1926	112	109	104	102	105	105	105	126	132	
Difference Apr to Apr	+ 003	+ 002	- 003	- 003	- 003	- 002	- 003	+ 004	+ 005	- 071

* Broken up

SUB-BASE TESTS ON ROUTE 26, WASHINGTON COUNTY, OHIO

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In October and November, 1924, a series of sub-base experimental sections was constructed upon the Marietta-Athens road known as State A1d Route 26. These sections varied from 100 to 200 feet in length. The sub-base construction was 2, 4 or 6 inches in thickness, and was constructed of sand, gravel, slag or an admixture of 5 per cent Portland cement, by volume, mixed with the top 2, 4 or 6 inches of the natural sub-base. Adjoining sections of the natural soil base were left at either end of the three divisions of this test work for comparison. The sand and gravel were dredged out of

TABLE I
TOTAL CRACKS ON OCTOBER 12, 1926, UPON SUB-BASE TEST SECTIONS, ROUTE 26, WASHINGTON COUNTY, OHIO

Station to station	Base	Transverse, left side	Transverse, right side	Through transverse	Corner cracks		Longitudinal and center line	Section length	Total feet of cracks	Foot of crack per foot of road	Number of cracks
					Left	Right					
129-00 0 to 129-65 0	Natural soil	2 cracks, 24	Feet 2 cracks, 36	Feet 2 cracks, 36	1 crack, 4	Feet 4 cracks, 14	Crack continued from non-experimental road, 65 feet	Feet 65 0	Feet 2 00	6	
129-65 0 to 130-68 5	6 ins gravel		4 cracks, 72	4 cracks, 72	2 cracks, 4	4 cracks, 14		103 5	0 90	11	
130-68 5 to 131-66 0	6 ins sand	2 cracks, 21	4 cracks, 72	4 cracks, 72	1 crack, 3	2 cracks, 5	End of above, 3 feet	97 5	1 00	8	
131-66 0 to 132-66 5	6 ins cem-clay		4 cracks, 72	4 cracks, 72	1 crack, 3	2 cracks, 5		100 5	0 84	7	
132-66 5 to 133-66 0	6 ins slag		2 cracks, 36	2 cracks, 36				99 5	0 36	2	
133-66 0 to 134-65 7	2 ins sand	1 crack, 4	3 cracks, 54	3 cracks, 54	3 cracks, 12	3 cracks, 9	1 joint	99 7	0 79	10	
134-65 7 to 135-64 5	4 ins sand		4 1/2 cracks, 87	4 1/2 cracks, 87	2 cracks, 5	2 cracks, 9		98 8	0 69	7	
135-64 5 to 137-00 0	Natural soil		2 cracks, 36	2 cracks, 36	2 cracks, 7	1 crack, 2		135 5	0 74	9	
137-00 0 to 138-59 2	Natural soil	1 joint	6 cracks, 111	6 cracks, 111	3 cracks, 10	2 cracks, 3	1 thaw (a blowup)	59 2	0 64	3	
138-59 2 to 139-62 5	2 ins sand	1 crack, 9	5 cracks, 90	5 cracks, 90	1 crack, 4	2 cracks, 3	Many cracks at culvert	201 0	0 52	7	
139-62 5 to 139-63 5	4 ins slag	1 crack, 11	7 cracks, 128	7 cracks, 128	4 cracks, 11	4 cracks, 13	3 cracks, 7 feet, 1 blowup	201 5	0 78	18	
139-63 5 to 140-65 0	4 ins gravel	1 joint	6 cracks, 108	6 cracks, 108	2 cracks, 8	1 crack, 2	1 crack, 4 feet	177	0 90	23	
140-65 0 to 142-61 3	4 ins sand	7 cracks, 46	6 cracks, 108	6 cracks, 108	2 cracks, 8	1 crack, 2	1 crack, 131 feet (1 joint)	201 7	1 58	21	
142-61 3 to 144-63 0	4 ins cem-clay	1 crack, 11	5 cracks, 90	5 cracks, 90	2 cracks, 5 5	2 cracks, 5 5		190 5	0 56	8	
144-63 0 to 146-53 5	6 ins sand	1 crack, 9	4 cracks, 72	4 cracks, 72	1 crack, 1	1 crack, 3	1 L, 74 feet and continued	146 5	1 08	8	
146-53 5 to 148-00 0	Natural soil		5 cracks, 90	5 cracks, 90			1 joint	51 0	0 00	0	
148-00 0 to 149-51 0	Natural soil		4 cracks, 72	4 cracks, 72	1 crack, 1	1 crack, 2		200 5	0 46	6	
149-51 0 to 149-51 9	2 ins gravel	1 crack, 6	8 cracks, 144	8 cracks, 144	1 crack, 2			193 5	0 41	6	
149-51 9 to 149-45 0	2 ins slag		3 cracks, 54	3 cracks, 54			1 crack, 12 feet	200 0	0 58	11	
149-45 0 to 201-45 0	2 ins cem-clay	1 crack, 12	3 cracks, 54	3 cracks, 54			1 joint	150 5	0 44	4	
201-45 0 to 202-95 5	2 ins sand		3 cracks, 54	3 cracks, 54			1 joint	51 0	1 06	3	
202-95 5 to 203-46 5	2 ins to 4 ins sand	1 crack, 4	2 cracks, 14	2 cracks, 14			1 joint	79 0	0 54	5	
203-46 5 to 204-25 5	4 ins sand	2 cracks, 16	4 cracks, 30	4 cracks, 30	2 cracks, 4	2 cracks, 5		118 5	0 68	9	
204-25 5 to 205-44 0	6 ins sand	4 cracks, 19	7 cracks, 56	7 cracks, 56	2 cracks, 4		2 cracks, L, 69 feet	156 0	1 24	16	
205-44 0 to 207-00 0	Natural soil	5 cracks, 40	36 cracks, 648	36 cracks, 648	Not counted		2 cracks, L, 70 and 444 feet	900 0	1 48	54	
207-00 0 to 216-00 0	Natural soil		16 5 feet, all broken up								

TABLE II
 ADDITIONAL CRACKS ON SUB-BASE TEST SECTIONS, ROUTE 26, WASHINGTON COUNTY, OHIO
 NOVEMBER 10, 1925, TO OCTOBER 12, 1926

Sub-base material	Transverse cracks		Clear across	Corner cracks		Center, longitudinal
	Left side	Right side		Left	Right	
65 ft natural soil	2 = 15 ft		1 = 18 ft	1 = 4 ft		
136 ft natural soil			1 and extension = 22 ft			
59 ft natural soil	No extra		1 = 18 ft			
50 ft natural soil	No extra					
51 ft natural soil		1 extension to left side = 13 ft		1 = 2 5 ft		
56 ft natural soil	8 = 55 ft	4 = 22 ft	5 = 90 ft	2 = 5 ft		L extended 3 113 ft 3 113 ft
1000 ft natural soil adjoining	10 = 70 ft 1 = 2 ft	5 = 35 ft 1 = 2 ft	8 = 148 ft 1 extension = 5 ft 1 = 18 ft	4 = 11 5 ft		Right long, 3 ft.
Total, 1,417 ft natural soil	1 = 11 ft 2 = 17 ft	1 extension = 9 ft	1 = 18 ft		1 = 2 ft 2 = 5 ft	
103 ft 6 in gravel	No extra					
202 ft 4 in gravel	No extra					
200 ft 2 in gravel	No extra					
98 ft 6 in sand						
190 ft 6 in sand						
119 ft 6 in sand						
196 ft 4 in sand						
100 ft 4 in sand						
79 ft 4 in sand						
99 ft 2 in sand						
203 ft 2 in sand						
202 ft 2 in sand						
100 ft 6 in cem -clay	No extra					
202 ft 4 in cem -clay	4 = 27 ft	2 = 12 ft	2 short extensions = 7 ft			Longitudinal, 3 ft
200 ft 2 in cem -clay						
100 ft 6 in slag	No extra					
201 ft 4 in slag	1 = 6 ft		2 = 36 ft			Longitudinal, 3 ft
194 ft 2 in slag						

the Ohio River a short distance below Marietta The granulated slag was shipped in from the Steubenville District

The road is an 18-foot concrete road with thickened edges, 7 inches thick at the center and 9 inches at each edge, reinforced with one 3/4-inch bar along either edge and with no center joint. Transverse joints were placed only at the end of the day's work.

The experimental work was constructed in three sections of 800, 1,000 and 1,200 feet in length, made up of the smaller 100 or 200 feet sections of the individual test bases

The soil in each division was of dark red color, fairly fat in clay and in appearance to the eye seemed to be *all* of the same type There was perfectly dry weather throughout the construction of the experimental sections No difficulty was experienced in getting a good admixture of the cement and soil

A survey of the cracks was made on November 10, 1925, and another survey made on October 12, 1926

Table I gives a record of the total number of cracks showing on October 12, 1926, with their total number of feet in length

Table II shows the additional cracks that have appeared from November 10, 1925, to October 12, 1926.

The results for the total number of cracks from the time of construction is summed up in Table III

TABLE III
SUMMARY OF TOTAL CRACKS

Pavement in feet	Type of base	Total feet of cracks	Ratio
1,513	Natural soil	1,950	1 29
502	Cement-clay	561	1 12
2,015 4	Combined natural soil and cement and clay	2,511	1 25
1,285	Sand	946 5	0 74
505 5	Gravel	342	0 68
494	Slag	220	0 45
2,284 5	Combined porous base	1,508 5	0 66

Slag appears to have a slight advantage over any other treatment The porous bases show approximately one-half as many cracks as appear in the natural soil base The additional cracks showing from November, 1925 to October, 1926, are summed up in Table IV

TABLE IV
SUMMARY OF ADDITIONAL CRACKS

Pavement in feet	Type of base	Total feet of cracks	Ratio
1,417	On natural base	377 5	0 266
502	Cement-clay	49 0	0 098
1,285	Sand	177 0	0 133
494	Slag	45 0	0 091
505	Gravel	32 0	0 063

The natural base compared with the treated base consists of the adjoining sections of natural base at either end of each main division of the experimental work, these lengths ranging in length from 50 to 139 feet, together, with a section 1,000 feet long adjoining the westernmost division of the sub-base tests

Considering the fact that the additional cracks appearing in the second year show the same good effects caused by the treated bases that the total cracks show for two years service, it would seem safe to assume that the treated bases really have meant improved road construction

It will not be safe to draw any conclusions as to the sufficiency or insufficiency of 2, 4 or 6 inch treatment. At present some of the two inch treatments show less cracks than the 4 or 6 inch

Table V gives the soil analyses for a number of soils along Route 26 where these sub-base tests are being tried

TABLE V
SOIL ANALYSIS OF THE SOILS ALONG ROUTE 26

Soil	Road sta	Coarse material	Sand	Silt	Susp clay	Total clay	Volu change	Moist equiv
168	71+50	14 1	28 2	23 5	2 9	48 3	18 5	16 8
119	129+50	1 1	9 6	29 5	6 3	60 9	22 8	21 6
103	133+85	2 6	9 3	27 1	10 1	63 6	17 3	24 3
104	132+50	6 6	11 3	29 9	8 2	58 8	17 7	23 1
120	167+50	0 0	7 7	22 9	6 7	69 4	24 6	24 3
122	260+30	3 4	0 6	16 0	6 7	83 4	21 4	20 0
95	201+00	4 4	8 0	23 0	3 4	69 0	19 7	20 0
42	467+50	0 0	0 2	8 8	17 7	91 0	30 2	43 1

CONCLUSIONS

- 1 The cement-clay admixture appeared during construction, and shows in results since to be little if any different than the natural soil base
- 2 The porous bases show thus far much less cracking than do the natural soil and admixture of cement and soil bases
- 3 The increase in cracks during the second year show similarly favorable results for the porous bases
- 4 It is unsafe at this time to draw conclusions upon the sufficiency of 2, 4 or 6 inch porous bases to save the road maintenance an equivalent of their first cost

IMPACT FORCES EXERTED BY THE MOTOR TRUCK
ON THE HIGHWAY

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THE COOPERATIVE MOTOR TRUCK IMPACT PROJECT

Two years ago, a progress report on the Motor Truck Impact Project was submitted to the Highway Research Board. This project is cooperatively conducted by the Bureau of Public Roads, the Rubber Association of America, and the Society of Automotive Engineers. All of the tests scheduled at that time have been completed and additional tests have also been made¹

The investigation has so far been confined principally to the measurement of the vertical reaction between the road and the wheel and determination of the influences of tire equipment, load, speed, and road surface roughness. The procedure and apparatus are substantially as outlined in the earlier report, and may be found in detail in the June, 1926, issue of *Public Roads*.

The results of the tests reported below are illustrative of the effects of the variables and are believed to be generally accurate within 10 per cent. They were obtained with equipment specified by a joint committee representing the three agencies cooperating in the Motor Truck Impact Tests, and the results apply specifically to the tire equipments used, which were standard at the time of the tests.

The term "cushioning effect" as used refers only to the vertical reaction between the road and the wheel, and, although exerting an influence thereon, is not to be confused with the popular term

¹ More than 150 truck and tire combinations have been tested to date