on the cost of shoulder maintenance. In this tabulation I have given cost per mile of shoulder maintenance on two types of pavement; group number 2 being concrete and other rigid-type slabs; and group number 3 being the flexible type, including surface-treated gravel and bituminous concrete on gravel base.

1949-50

COST PER MILE FOR SHOULDER MAINTENANCE

	ZONE I	II	III	IV
GROUP II (Conc-Rigid)	65	105	117	126
GROUP III (Flexible)	16	52	56	72

(Mr. Downey showed 8 slides illustrating some of the practices mentioned in the first part of this paper.)

EXPERIMENTAL SHOULDER STABILIZATION

Report of Bureau of Materials
Division of Highways
Illinois Department of Public Works and Buildings

PURPOSE - Inasmuch as the shoulders are an essential part of the highway, it is necessary that they be firm so that vehicles may stop in an emergency out of the way of other traffic. The purpose of this experiment is to develop a method of stabilizing earth shoulders by mixing soil with granular materials and at the same time provide conditions under which desirable turf grasses would have an active growth.

While other methods of shoulder construction have been tried with some success, the main idea in connection with the stabilized turf shoulders was to build stability and retain beauty in the roadway; in other words, provide simultaneously a relatively high load-supporting value in the shoulder and a shoulder surface that would lend itself to the problem of landscaping, especially on the express highway system.

This experiment was a joint project, the participating agencies being the Cook County Department of Highways, the Bureau of Public Roads, and the Illinois Division of Highways.

LOCATION OF EXPERIMENT - The experiment is located on a section of portland-cement concrete pavement, designated as Section 100-1011, F.A.S. Route 113, F.A. Project S-188 (1), Cook County; this section is on the Lake-Cook County Line Road just west of Rand Road. The experiment extends from Station 207+00 to Station 226+75, from 1,600 to 3,600 feet west of Rand Road.

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GENERAL DESCRIPTION - Twenty test sections, in which the methods of treatment varied, were included in the experiment. Types 1 to 6, inclusive, were constructed under the specifications written by the Cook County Department of Highways and Types 7 to 16, inclusive, were constructed under the requirements of the Illinois Division of Highways. All test sections are 10 feet in width, the width of the pavement shoulders Types 1 to 6 being 200 feet in length and Types 7 to 16 100 feet long. The project was constructed by contract, the contractor being E. A. Meyer Construction Co., North Chicago, Ill. Any work subsequent to the original construction, such as filling ruts and reseeding, was done by state maintenance forces.

SHOULDER SOIL AND GRANULAR MATERIALS - The shoulder soil on the project is a heavy clay which classifies as either an A6-7 or an A7-6 soil. It has a high optimum moisture content and is very unstable in wet weather. The soil-aggregate mixtures used in the various types of shoulder treatment were as follows:

Type	Aggregate	Percentage in Mixtures: Aggregate	Soil
1	(Limestone)	33	67
2	( )	50	50
3	(Screenings)	67	33
4	(Intermediate)	33	67
5	(Grade Crushed)	50	50
6	(Stone)	67	33
7	( )	90	10
7A	(Grade 4)	95	5
8	(Crushed Stone)	90	10
8A	( )	95	5
9	( )	90	10
9A	(Grade 8)	95	5
10	(Crushed Stone)	90	10
10A	( )	95	5
11	(Pit-Run)	95	5
12	(Gravel)	95	5
13	(Grade 9)	95	5
14	(Gravel)	95	5
15	Granulated Slag	90	10
16	Grade 4 Cr. Stone	90	10

The gradations of the mixtures of soil and aggregates and the plasticity indices of the portion of the mixtures passing the No. 40 sieve are given in Table 1.

CONSTRUCTION - Construction was started on September 7, 1948, and completed on October 14, 1948.

On Types 1 to 6, inclusive, the shoulder soil was excavated to the depth below the finished grade line shown on the plans. A layer of soil was placed on the subgrade and covered with a layer of aggregate, the depth of each layer being such as to give a mixture of the specified proportions (see table above). The aggregate and soil were mixed in place with a 72-inch Seaman Pulvi-Mixer, shaped with a blade grader, and compacted by means of a three-wheel roller. Following this, fertilizer was worked into the upper 2 inch of the mixture, ½ inch of topsoil spread, and the seed sown. The surface was then lightly rolled and the areas designated in Figure 2 were mulched with straw.

In case of Types 7 to 16 the shoulders were excavated to the specified depth and the required amounts of aggregate and soil were deposited on the pavement and mixed with a motor patrol grader. The mixture was placed on the subgrade in two or three layers, depending on whether the finished depth was to be 4 or 6 inch, and all but the top layer separately compacted by means of a three-wheel roller weighing 3 tons.

After compaction of the lower courses, the upper 2-inch layer of soil and aggregate was mixed with the fertilizer and placed without compacting. One inch of topsoil was then spread and the seed sown. This was followed by a light rolling; the areas designated in Figure 4 were covered with a straw mulch.

Typical cross-sections for the different types are shown in Figures 1 and 3.

FERTILIZER AND SEED - It was first planned to spread topsoil for the seed bed to a thickness of ¼ inch on Types 1 to 6 and ½ inch on Types 7 to 16. It was found that these amounts were not sufficient due to voids in the surface of the stabilized mixtures; consequently, the thicknesses of topsoil were increased to ½ and 1 inch, respectively.

Commercial fertilizers consisting of mixtures of nitrogen, phosphoric acid and potash, in the indicated percentages, were used, the nitrogen being supplied in the form of an inorganic chemical. On Types 1 to 6 and 8-7-3 mixture was used.

On Types 7 to 16 it was planned to use a 10-10-10 mixture, but material of this composition was not available. A mixture of the percentages 8-7-3 was substituted and the plan quantities increased slightly but not in sufficient amounts to offset the difference in percentage composition. The amounts of fertilizers actually used on these types were more a matter of convenience in measuring the quantities in the field. For example, Types 7, 7A, 9 and 9A were set for 23 pounds each, but since the fertilizer was furnished in 50-pound bags it was easier to divide the contents of the bags into equal parts of 25 pounds each.

The quantities of seed, fertilizer and mulch materials used are shown in Figures 2 and 4. At the time of the original seeding, tests showed the seed used on Types 1 to 6 to have a purity of 80 percent, while the seed used on Types 7 to 16 had a purity of 90 percent. The plan quantities were therefore increased proportionately in order to provide the full amounts of pure, live seeds.

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In the spring of 1949 it was found that the seed originally planted had not properly germinated and there was poor grass coverage. Consequently, on May 5 and 6, 1949, all of the test sections were lightly harrowed, plank dragged, resown with the following mixture at the rate of 150 pounds per acre, and lightly rolled.

Kind of Seed	Percent in Mixture
Kentucky Bluegrass	25
Redtop	25
Perennial Rye Grass	25
Timothy	15
Sweet Clover	10

By mid-July, 1949, there was very good grass coverage on Types 7 to 16, particularly of sweet clover and blue grass. The coverage on Types 1 to 6 was poor.

The portion of the shoulders disturbed in the traffic tests, described later in this report, were leveled with a blade grader, $\frac{1}{2}$ to 1 inch of topsoil added and smoothed, and reseeded with alta fescue at the rate of 100 pounds per acre.

TRAFFIC TESTS - On April 5, 1950, traffic runs were made to test the stability and rutting properties of the various types. This particular time was selected for these tests since the shoulders probably approximated the most adverse moisture condition to be anticipated. The ground had been free of frost for only a few days and rain or snow had generously precipitated several days prior to the traffic tests.

A 1950 Pontiac sedan, with four passengers, was first driven over the shoulders at a speed of 5 miles per hour with the right wheels just off the pavement. Five passes were made in the same wheel track. The rutting was negligible on all types, except Types 1, 2, and 3 on which the rutting was pronounced.

Following this, three passes were made with an FWD dual-tired truck carrying a load of 18,900 pounds on the rear axle and 12,000 pounds on the front axle. The truck was driven at a speed of 5 miles per hour with the right wheels 18 inches from the pavement edge. Each pass was made in the same wheel track.

Contours of the ruts and extrusions at the one-third point of each type were made by a specially designed profilometer. This device, operated manually, projected the contours of the ruts to full scale on a cardboard by a pencil fastened to the end of a perpendicular upright which was moved horizontally across the shoulders on a fixed rod. The upright was free to move vertically and was kept in contact with the ground by a small roller. Previous to the traffic tests stakes were set to hold the profilometer in a level position. Readings were taken prior to the tests to establish the original profile of the shoulders. Since the truck displaced much of the material in the ruts caused by the passenger car, no readings of the car ruts were taken.

The depth of the ruts were determined from the profilometer charts by taking an average of two readings, which actually was an average of four ruts since the dual tires made two ruts. Figures 5 and 6 are typical charts obtained using the profilometer.

The average depth of rutting of the various types after the truck passes are given in Table 2.

MOISTURE AND CBR TESTS - While the traffic tests were being made, samples of the original shoulder soil and the soil-aggregate mixtures were taken for moisture, Proctor density, and California Bearing Ratio tests. These tests were made in the laboratory and the results are shown in Tables 2 and 3.

SOME CONCLUSIONS OBTAINED FROM EXPERIMENT - From Table 2 it is noted that Types 9, 9A, 10, and 10A offered the greatest resistance to rutting, Types 9 and 9A giving the most consistent results. These four types consisted of mixtures of Grade 8 crushed stone and soil, Types 9A and 10A containing 5 percent soil and Types 9 and 10 10 percent. Considering the results on these four types, it would appear that 4 inches of thickness of stabilized mixture, Types 10 and 10A being 4 inches and Types 9 and 9A 6 inches in thickness, would give adequate support to occasional traffic.

It may also be noted from Table 2 that Type 9, 9A, 10, and 10A showed the best bearing values in the California Bearing Ratio tests. Types 1 to 6, inclusive, and Types 11 and 12 showed the lowest CBR values and the least resistance to rutting. Types 7, 7A, 8, 8A, and 16 showed good CBR bearing values but fair to poor results in the traffic tests. Type 15, containing granulated slag, showed good CBR values but poor results under traffic.

An observation from this experiment, which may be of importance in stabilized-shoulder construction as indicated by the data in Table 3, is the fact that, regardless of the type of soil-aggregate mixture, there was very little variation in the moisture content of the subgrade soil under the different types of mixtures. The average moisture content of the subsoil, at the time of the traffic tests, was 17.8 percent which is only slightly higher than the optimum for the subsoil. On the other hand, the mixtures varied widely in moisture content, the highest being found in Types 1 to 6 and 16.

All types showed good grass growth from the various seedings, except Types 1 to 6 and 15. However, the alta fescue seed, sown in May 1950, following maintenance of the shoulders after the traffic tests, has shown good growth on Type 15. The alta fescue has shown the best results of any of the seeds and will be observed for possibilities in case of future plantings on granular shoulders.

No definite conclusions could be drawn relative to the results of the kinds of seed, fertilizer, and mulch materials originally used because of failure of the first seeding. The failure of the seed to germinate was undoubtedly due to moisture and weather conditions and not to the material and methods used. The original seeding operations were completed on October 14, 1948, and the first heavy frost occurred four days later. The total precipitation during October and November was 0.62 and 2.41 inches, respectively, and the lowest temperature in November was 23 deg. F. The weather conditions were against the proper germination of the seed. It is believed, however, that the fertilizer was very beneficial in the ultimate development of the turf and that some fertilization is necessary on granular shoulders.

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TABLE 1. GRADATIONS OF SOIL-AGGREGATE MIXTURES AND CHARACTERISTICS OF SOIL FINES

Shoulder Types	1	2	3	4	5	6	7	7A	8	8A	9	9A	10	10A	11&12	13&14	15	16
Sieve Size									Percent Passing									
2 in.															100.0		100.0	
1½ in.	100.0			100.0	100.0	100.0									92.9		98.9	
1 in.	98.5		100.0	79.4	70.8	62.0	100.0	100.0	100.0	100.0		100.0	100.0	100.0	87.3	100.0		100.0
3/4 in.	96.1	100.0	98.5	65.1	45.8	43.0	94.9	95.0	93.4	98.7	100.0	97.4	99.2	99.0	81.2	92.4		91.0
½ in.	94.2	99.3	96.8	61.2	39.1	36.3	63.7	59.4	63.4	66.4	87.2	84.8	89.3	86.3	71.3	75.4	97.7	58.8
3/8 in.	92.1	97.1	95.6	58.9	36.8	34.3	49.3	44.8	49.0	52.2	77.8	72.3	78.2	73.9	63.2	67.7	96.3	45.2
No. 4	89.3	91.4	89.2	55.8	33.9	31.0	31.4	29.2	36.1	37.9	57.8	50.4	54.9	51.2	48.2	54.4	92.1	29.3
No. 10	60.0	62.8	60.6	49.1	30.7	28.5	21.0	18.9	23.2	25.5	40.0	33.3	32.6	26.9	32.2	42.0	87.0	19.0
No. 20	51.9	53.7	52.9	47.8	29.5	27.8	16.9	14.3	14.9	20.2	35.7	29.4	27.0	21.3	19.4	35.4	82.5	16.0
No. 40	45.7	47.7	46.8	46.1	27.1	26.8	14.1	11.4	10.4	16.5	32.2	26.6	22.4	17.5	9.1	27.2	59.4	13.7
No. 50	43.3	45.7	44.5	45.0	25.7	26.2	13.1	10.4	8.9	15.3	26.5	21.6	20.8	16.2	7.0	22.8	48.5	13.2
No. 100	39.9	42.4	40.8	42.6	23.8	24.9	11.8	9.0	7.0	13.5	21.8	17.4	18.8	14.5	5.5	17.0	36.8	11.7
No. 200	39.8	41.9	40.8	41.2	22.9	24.8	10.8	8.1	5.5	12.5	19.9	15.9	18.2	13.5	5.0	14.7	30.9	11.1
							Characteristics of Material Passing No. 40 Sieve											
L.L.L.*	25.2	24.9	26.7	35.3	36.2	36.8	30.8	22.3	23.7	22.6	24.4	23.1	27.7	24.9	18.3			28.5
L.P.L.**	17.5	16.6	18.0	20.1	21.2	18.2	21.7	19.3	16.5	15.9	17.1	19.4	18.8	18.4	17.6			19.2
P.I.***	7.7	8.3	8.7	15.2	15.0	18.6	8.1	3.0	7.2	6.7	7.3	3.7	8.9	6.5	0.7	N.P.	N.P.	9.3

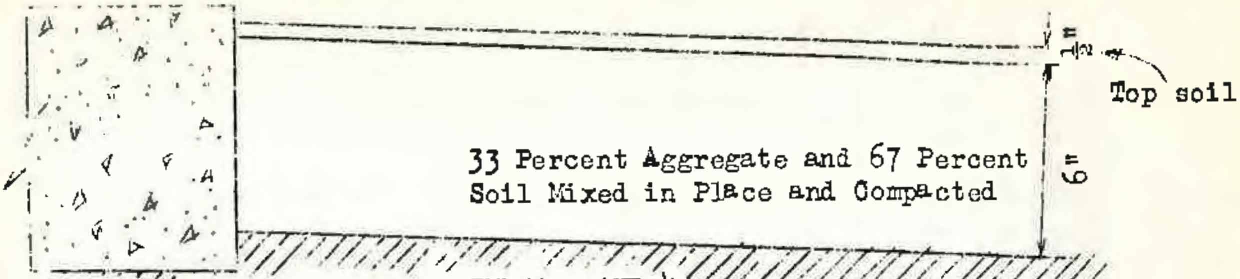
*Lower Liquid Limit
**Lower Plastic Limit
***Plasticity Index

TABLE 2. CALIFORNIA BEARING RATIO TESTS AND DEPTH OF RUTTING IN TRAFFIC TEST

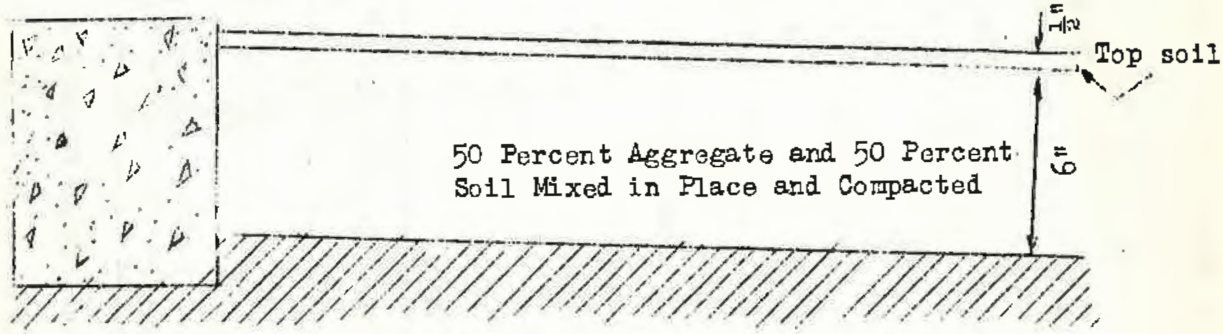
Shoulder Type	California Bearing Ratio Tests Pounds per square inch at penetration of:					Average Depth of Rutting After Three Passes of Dual-Tired Truck with 18,900-lb. Rear Axle Load. (inches)
	0.10"	0.20"	0.30"	0.40"	0.50"	
1	303	420	500	553	617	3.00
2	460	777	977	1053	1313	4.20
3	77	167	200	250	287	3.25
4	707	943	1033	1153	1323	2.70
5	703	833	850	890	907	3.00
6	620	807	863	920	990	1.75
7	880	1700	2277	2753	3027	1.80
7A	1000	1460	1767	2050	2313	1.55
8	543	1157	1653	2100	2533	2.30
8A	1123	1690	2110	2313	2630	1.55
9	1020	1473	1910	2263	2480	1.10
9A	1243	1457	2110	2433	2710	1.15
10	1173	1857	2387	2833	3180	1.55
10A	1423	2113	2500	2700	2807	1.05
11	313	287	220	237	240	1.80
12	233	253	200	213	213	1.60
13	810	1210	1313	1493	1720	1.95
14	603	1020	1183	1243	1433	2.00
15	1107	1340	1380	1103	1093	3.75
16	1113	1897	2353	2450	3173	1.90
Subsoil	177	227	263	293	320	2.35

TABLE 3. DENSITY AND MOISTURE DATA

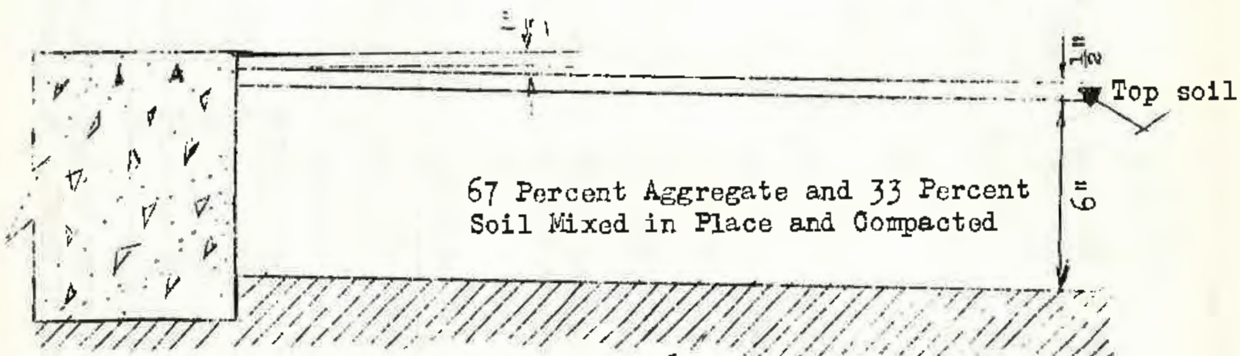
	Subgrade Soil						Soil-Aggregate Mixture								
	Proctor		During Traffic Test		Proctor		During Construction				During Traffic Test				
Shoulder Type	Density lb. per cu. ft.	Optimum Moisture %	% Moisture	% of Optimum	Density lb. per cu. ft.	Optimum Moisture %	Density lb. per cu. ft.	% of Proctor	Moisture %	% of Optimum	Density lb. per cu. ft.	% of Proctor	Moisture %	% of Optimum
1	133.0	17	18.3	107.6	139.8	12.4	106.2	76.0	10.3	83.0	116.0	83.0	17.5	141.4
2	"	"	17.1	100.6	143.8	10.8	113.9	79.2	9.3	86.1	120.8	84.0	13.9	128.7
3	"	"	20.7	121.8	140.2	12.3	108.3	77.3	8.2	66.6	124.3	88.6	13.8	112.1
4	"	"	17.4	102.4	136.7	9.7	116.0	84.8	7.9	81.4	129.5	94.7	15.8	162.8
5	"	"	19.2	112.9	136.1	7.1	116.3	85.4	10.1	142.2	136.4	100.3	17.6	247.8
6	"	"	14.8	87.1	137.5	7.8	125.1	91.0	10.6	135.8	126.2	91.8	29.3	375.6
7	"	"	19.6	115.3	141.0	11.4	136.8	97.0	5.0	43.8	129.7	92.0	8.4	73.6
7A	"	"	18.1	106.5	145.9	10.6	137.2	94.0	4.6	43.4	131.0	89.7	7.3	68.8
8	"	"	16.4	96.5	151.2	8.6	122.6	81.1	3.7	43.0	134.3	88.8	9.4	109.3
8A	"	"	19.2	112.9	149.0	9.9	130.6	87.6	3.5	35.4	121.7	81.7	9.6	96.9
9	"	"	16.9	99.4	149.0	8.9	137.6	92.3	5.1	57.3	120.3	80.7	10.3	115.7
9A	"	"	18.3	107.6	149.8	8.8	139.0	92.8	4.1	46.6	120.8	80.6	7.2	81.8
10	"	"	18.0	105.9	149.0	8.9	121.2	81.3	5.3	59.6	126.6	85.0	11.1	124.7
10A	"	"	18.8	110.6	149.8	8.8	145.6	97.2	6.0	67.7	122.8	82.0	8.2	93.1
11	"	"	17.7	104.1	144.6	10.2	127.5	88.2	3.2	31.4	124.0	85.7	6.6	64.7
12	"	"	16.7	98.2	144.6	10.2	131.1	90.7	3.8	37.2	121.4	84.0	6.0	58.8
13	"	"	17.3	101.8	154.0	7.9	139.7	90.7	4.0	50.6	125.4	81.4	8.2	103.7
14	"	"	17.0	100.0	154.0	7.9	129.3	84.0	3.7	46.8	123.7	80.5	7.5	94.9
15	"	"	17.4	102.4	116.7	22.9	84.7	72.6	10.5	45.9	92.2	79.0	20.0	87.3
16	"	"	16.7	98.2	151.2	8.6	133.8	88.4	5.3	61.6	112.6	74.4	18.2	211.6
Subsoil	"	"	19.1	112.4	133.0	17.0					121.9	91.7	18.4	108.2



TYPICAL CROSS-SECTION FOR TYPES 1 AND 4



TYPICAL CROSS-SECTION FOR TYPES 2 AND 5

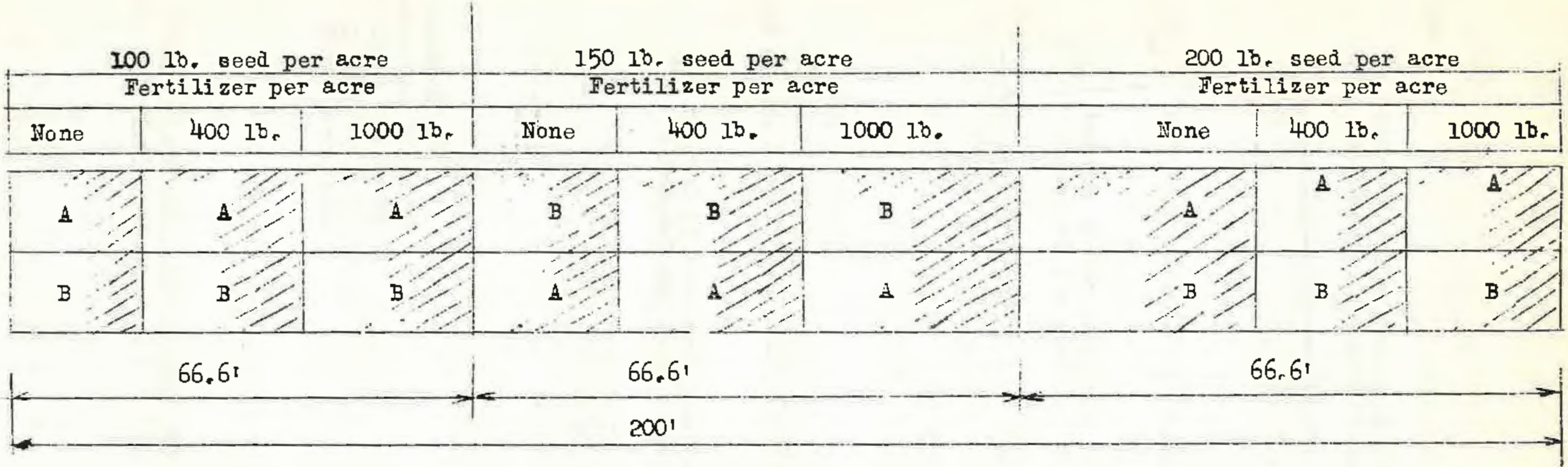


TYPICAL CROSS-SECTION FOR TYPES 3 AND 6

NOTE:
The shoulder shall begin ½" below edge of pav't and shall have a slope of 7/8" per 1'0" away from pav't.

FIGURE 1. CROSS-SECTIONS FOR EXPERIMENTAL SHOULDER STABILIZATION PLOTS CONSTRUCTED UNDER THE SPECIFICATIONS OF THE COOK COUNTY DEPARTMENT OF HIGHWAYS.

(Note: Plan of treatment which was repeated on each of Types 1 to 6, inclusive.)

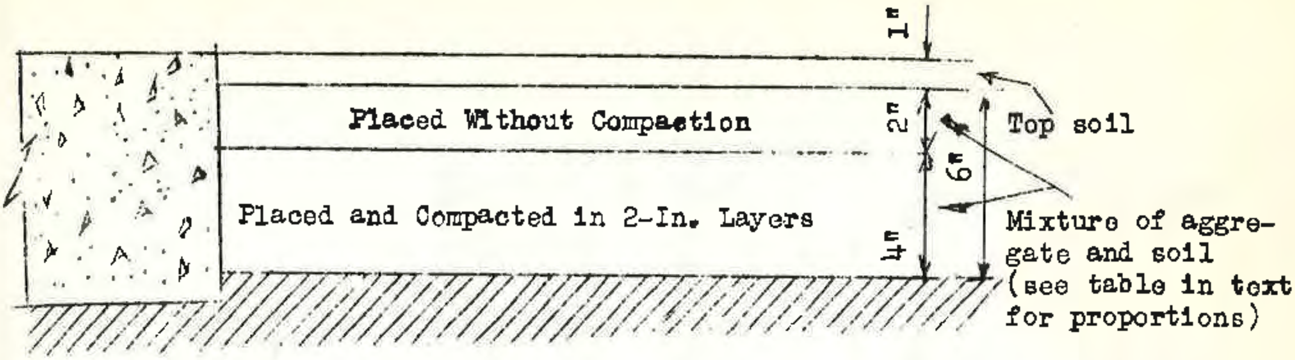


Symbols A and B indicate different grass seed mixtures.
Shaded areas mulched with straw at rate of 2 tons per acre.

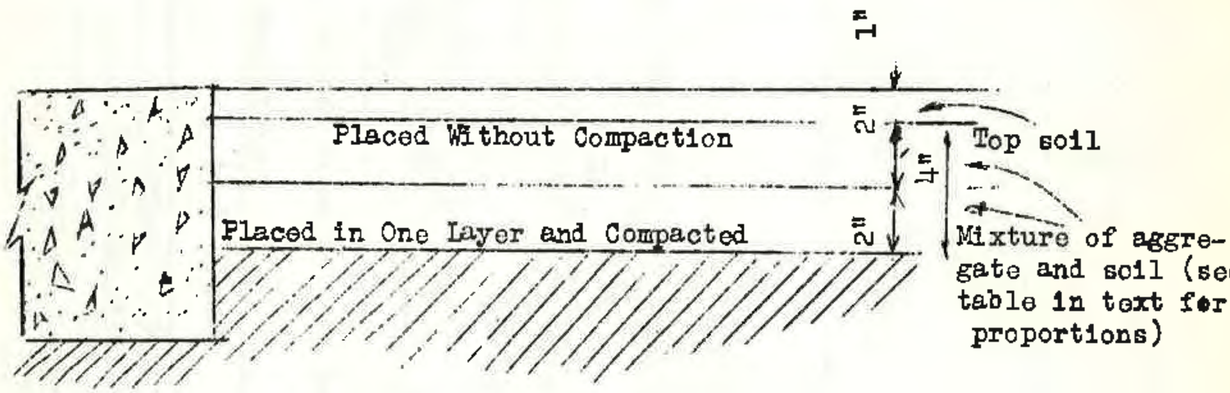
Composition of Seed Mixtures Used

Kind of Seed	200 lb. per acre		150 lb. per acre		100 lb. per acre	
	A	B	A	B	A	B
Kentucky bluegrass	100	140	75	100	50	65
Perennial rye grass	50	20	35	15	20	10
Red top	25	10	15	10	10	5
Chewings fescue	10	15	10	10	10	10
Farm rye	15	15	15	15	10	10

FIGURE 2. SKETCH SHOWING AMOUNTS OF SEED, FERTILIZER, AND MULCH MATERIALS ORIGINALLY USED ON TYPES 1 TO 6, INCLUSIVE.



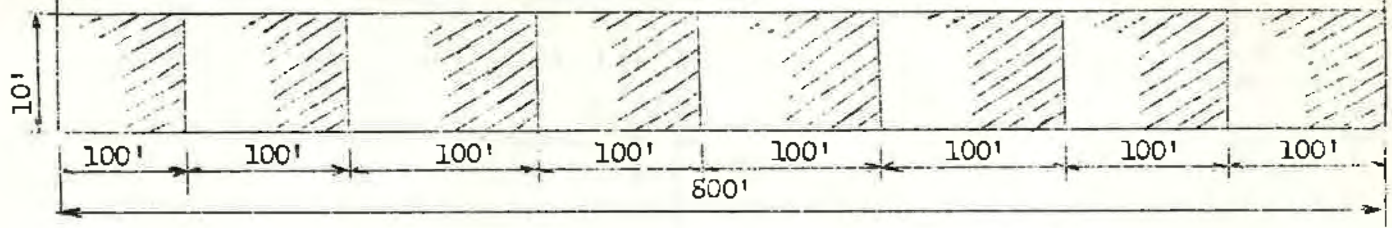
TYPICAL CROSS-SECTION FOR
TYPES 7, 7A, 9, 9A, 11, 13, 15 AND 16



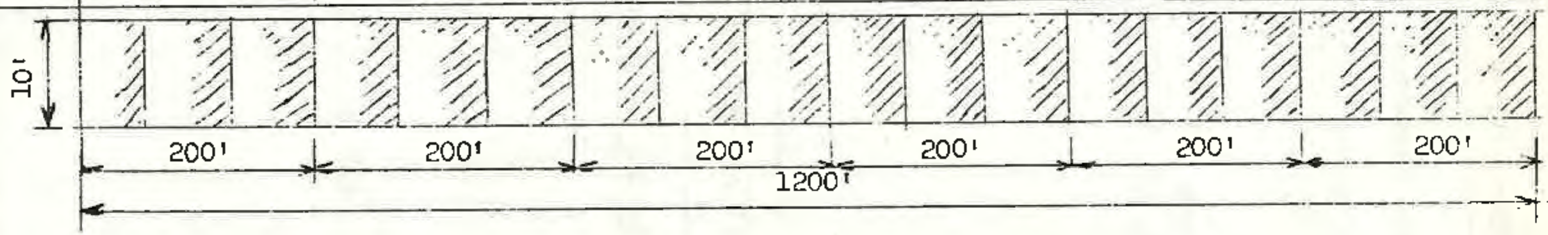
TYPICAL CROSS-SECTION FOR
TYPES 8, 8A, 10, 10A, 12 AND 14

FIGURE 3. CROSS-SECTIONS FOR EXPERIMENTAL STABILIZED SHOULDER TYPES CONSTRUCTED UNDER THE REQUIREMENTS OF THE ILLINOIS DIVISION OF HIGHWAYS.

Type No.	7	7A	8	8A	9	9A	10	10A
Seed per acre (lb.)	200	200	200	200	200	200	200	200
Fertilizer per acre (lb.)	1090	1090	740	740	1090	1090	740	740



Type No.	11			12			13			14			15			16		
Seed per acre (lb.)	50	100	200	50	100	200	50	100	200	50	100	200	50	100	200	500	100	200
Fertilizer per acre (lb.)	1090			740			1090			740			1090			1090		



Shaded areas mulched with straw at rate of 2 tons per acre

COMPOSITION OF SEED MIXTURES

Kind of Seed	Pounds per Acre		
	200	100	50
Kentucky bluegrass	140	65	32
Perennial rye grass	20	10	5
Red top	10	5	3
Chewings fescue	15	10	5
Domestic rye grass	15	10	5

FIGURE 4. SKETCH SHOWING AMOUNTS OF SEED, FERTILIZER AND MULCH MATERIALS ORIGINALLY USED ON TYPES 7 to 16, INCLUSIVE.

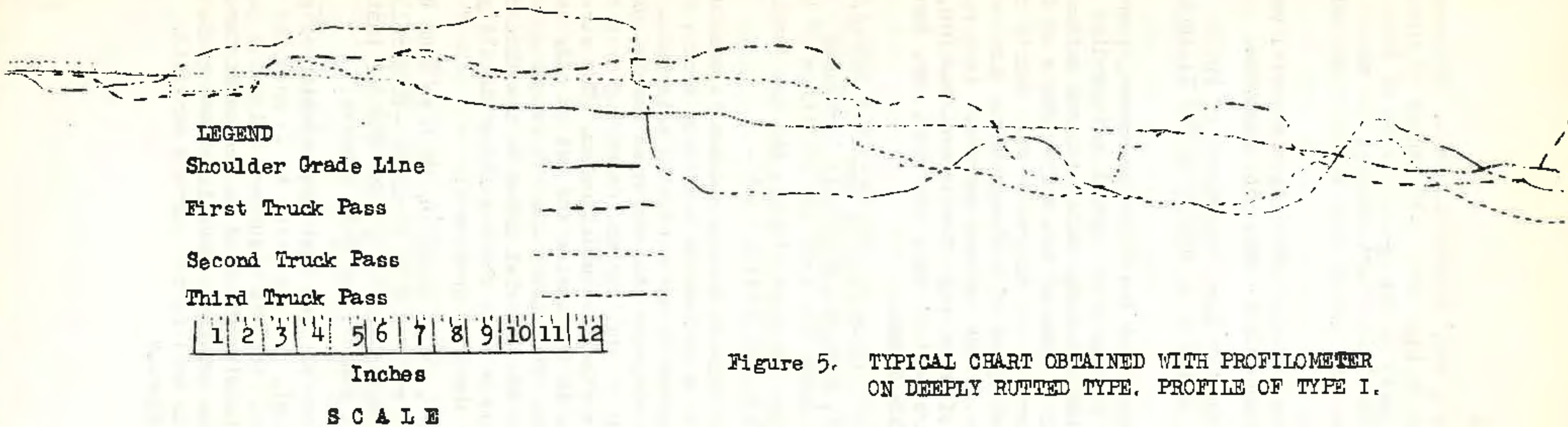


Figure 5. TYPICAL CHART OBTAINED WITH PROFILOMETER ON DEEPLY RUTTED TYPE. PROFILE OF TYPE I.

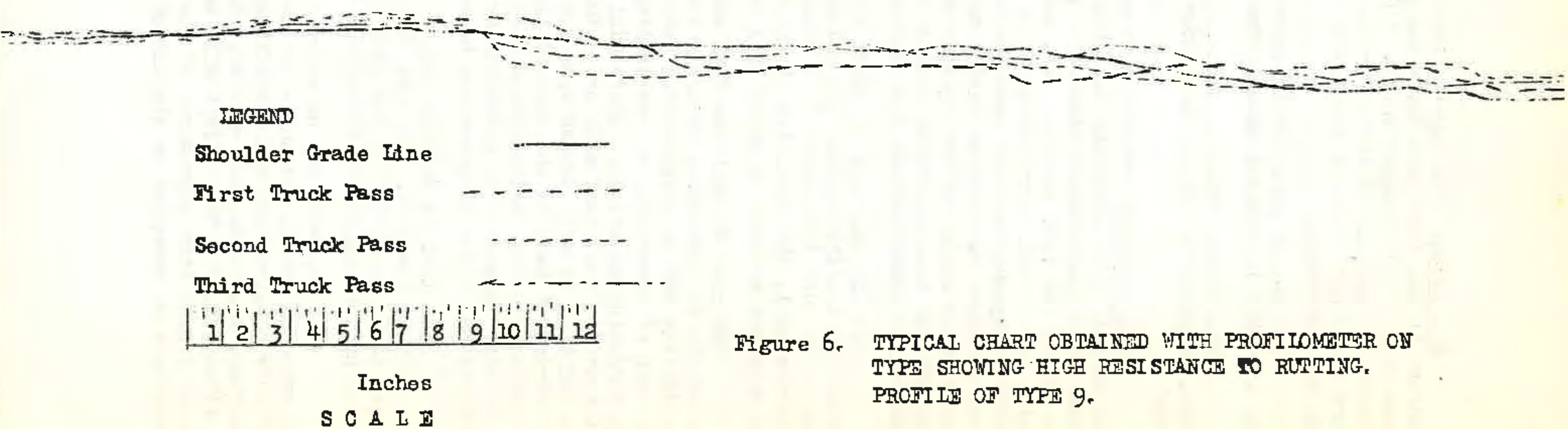


Figure 6. TYPICAL CHART OBTAINED WITH PROFILOMETER ON TYPE SHOWING HIGH RESISTANCE TO RUTTING. PROFILE OF TYPE 9.

DISCUSSION

Mr. Iurka: The report from Illinois is a very interesting one. Of greatest interest is the fact that there was penetration of less than 1.10 inches of some of these stabilized shoulder soils. This was in spite of the 1-inch layer of topsoil placed over the stabilized material. The implication is that without the topsoil there would have been no impression on the shoulders tested even though surrounding soil was saturated.

The second point of interest is that the depth of stabilized material was only 4 inches in several cases. Two inches of that depth were not compacted.

Mr. George McAlpin, Soils Engineer of the New York Department of Public Works, is present. He may have some questions to bring up regarding the Illinois report.

Mr. McAlpin: "Relative to questions regarding the Illinois report, I would like to call your attention to Table 3. It is a summary of test data regarding subgrade and soil-aggregate mixtures. Note that the constants were measured before and during the test periods. Mr. Russell of the Bureau of Materials, State of Illinois, points out significantly that the moisture in the subgrades were nearly constant throughout the test sections regardless of types of soil-aggregate mixture. These moisture percentages varied on both sides of the optimum content. As a rule they were in excess of the optimum percentage of moisture. During construction, densities of soil-aggregate mixture and moisture content were recorded. Mr. Russell recorded the same factors also during the traffic tests.

"In the majority of cases the density of soil-aggregate mixtures decreased during the traffic tests. The moisture content, however, generally increased. I feel quite sure that there is a relationship between the type and condition of the subgrade soil, the densities at which soil aggregates were placed, and the density and moisture content at which they resulted after the traffic tests.

"To come to what New York considers the primary design problem in shoulders, as well as in pavements, we are not dealing with a surface or top layer alone, but are dealing with a system which includes both subgrade and surfacing materials. In the case of pavements, we are dealing with the subgrade plus the base course, plus the surfacing materials. There will be a state of equilibrium, depending upon climatic conditions, that will bring that entire system into equilibrium. The strength you end up with will depend upon all components in the system and not in only one of the three, or two, in the case of the shoulders. This means that it is quite necessary to evaluate the subgrade soil as well as the material added to the shoulder. It is also necessary to determine by some procedure what the resulting stability will be for those types of materials brought in for shoulder treatment.

"The loss in density during the traffic test is something we have been thinking about in New York. We have been doing some rolling with pneumatic-tire rollers to see if we can increase the density with increased stability, and whether that increase can be maintained throughout the spring, summer, and fall seasons.

"I think this may be possible. I am very pleased that the solution of growing grass on stabilized soils has been thought of. We are going to do more and more shoulder construction with stabilized materials. We have discussed this with your Chairman, Mr. Iurka, and with Mr. Wells, the State's Principal Landscape Engineer in Albany, N. Y. The attempt will be, first, to provide a stabilized material. This material will take cognizance of the subgrade as well as the surface material. That summarizes my comments on stabilized turf shoulders."