PROGRESS REPORT
EXPERIMENTAL STABILIZED TURF SHOULDERS FOR NEW JERSEY PARKWAYS

Oliver A. Deakin, Parkway Engineer
New Jersey State Highway Department

Description of Experimental Stabilized Turf Shoulders: Experimental mechanically stabilized turf shoulders were constructed during the late spring and early summer season of 1947 by the New Jersey State Highway Department. It was a test mechanically stabilized turf shoulder, extending for 1400 feet on each side of New Jersey State Highway Route 30, located between Woodsville and Lyndale, New Jersey. The shoulder was constructed ten (10') feet wide with a cross slope of five (5%) percent. The shoulder width consisted of a three (3') foot transition strip of bituminous concrete next to the concrete pavement, and seven (7') feet of mechanically stabilized turf. The fourteen hundred (1400') feet of stabilized turf shoulder was divided into seven two hundred (200') foot test plots, or a total of 14 test plots for twenty-eight hundred (2800') feet of continuous mechanically stabilized turf shoulder. Each two hundred foot test plot varied as to the volumetric proportions of stone aggregate (Trap Rock), bankrun sand and soil (clayey loam). Two typical cross sections were used in the construction of these experimental turf shoulders. Typical cross section number one was constructed with a subbase of eight (8") inches of bankrun sand that remained constant. The six inch (6") top course was designed in two separate layers of three (3") inches each. The bottom three inch layer of 1½-in. stone, bankrun sand, and soil remained constant. The top three (3") inch layer consisted of 1½-in. stone (Trap Rock) and soil (clayey loam). The design of Typical Cross Section number two and Section 1, No. 1-A Variable may be obtained from the attached detail plan entitled, "New Jersey State Highway Department, Experimental Stabilized Turf Shoulder", Figure 1.

Snow Removal: The question of how the stabilized turf shoulder would stand up under winter traffic and periodic snow plowing was of great interest to the Parkway, Soils, and Maintenance Divisions. By raising the height of the snow plow blade approximately 5-in.-6-in. above the turf, it was possible to plow the stabilized shoulder without doing any damage. The three (3') foot bituminous concrete shoulder also helped a great deal in keeping the snow plow from scraping up the turf. On January 27, 1948, the turf shoulders were inspected and they were found to be plowed full width with no evidence of damage. Wheel tracks indicated that considerable traffic had used the shoulder area without damage. Figure 2 illustrates this clearly.

Spring Thaw: By February 19, 1948, the large amount of snow, twenty-two (22") inches, had nearly completely melted off the stabilized turf shoulders. The shoulders were thawing out and drying up during a period of two weeks. On several occasions, trucks or passenger cars ran out on the stabilized turf shoulder and left ruts. The rut shown in Figure 3, between Station 218+0 to 220+0 left side, was in Section 1, Number 3 Variable. The depth of the rut measured 1-in.-1½-in. As soon as the passenger vehicle wheel hit the 1½-in. stone aggregate in this section, it did not sink any deeper. This indicated clearly the importance of getting the stone pulvi-mixed to the top of the shoulder and the need for careful inspection in order to keep the depth of the soil on top of the stone to a minimum. The stone aggregate should be mixed so it

just about shows up through the soil. In spite of this rutting, the shoulders proved that they were safe. This critical period lasted five days. Other shoulders in this vicinity that were considered to be of an improved type were just about impassable during the same period. See Figure 4. By March 22nd very little evidence of winter damage could be seen.

Spring Maintenance: The stabilized turf shoulders were checked on March 22, 1948, for the amount of heaving that took place during the winter months and it was found that the average heaving was .15 of a foot. The three foot (3') bituminous concrete transition strip showed very little change from its original position. It was .05 feet lower than the concrete pavement. In order to put the stabilized turf shoulder back into its original position, it was rolled with a five (5) ton roller. Two passes with the roller was made and the shoulder was back in its original position with a 5 percent cross slope.

Repair of Winter Damage: After completing the rolling operation, 12.5 cubic yards of soil was placed over the entire shoulder area. A commercial fertilizer having a 5-10-5 analysis was applied at the rate of 300 lbs. per acre. The grass seed mixture was New Jersey No. 1 mixture without clover. This grass mixture was made up of the following:

Kentucky Blue Grass	45%
Red Top	25%
Colonial Bent	10%
Imported Rye Grass	15%

The grass seed mixture was sown at the rate of 85 lbs per acre and raked into the soil and then rolled with an empty water ballast roller.

Repair Cost: Actual cost for rolling and repairing 1.6 acres of stabilized turf shoulders was as follows:

Salaries & Labor	$106.78
Trucks & Equipment	58.62
Materials	206.27
Total	$371.67

The cost per square yard for winter repairs was approximately five (5¢) cents per square yard. On larger shoulder areas, repair costs should run less because the equipment could be kept in operation all day. The rolling was done on April 22, 1948, and seeding started on April 27 and completed on April 28, 1948. As a result of this fertilizing and overseeding, we obtained a fine thick growth of turf.

Mowing Practice: Mowing was done with a "Whirlwind" rotary type of mower set to cut at a height of two and one-half (2½") inches. Landscape Maintenance Division mowed the shoulders eight times during the spring, summer, and fall. Mowing dates were: June 4, 18; July 9, 23; August 11, 26; September 14 and October 15th. The cost per mowing was $9.43, making a total cost for the season of $75.44. No drying out of the turf was observed during the entire season in spite of long periods of drought.

"Build-Up" Study: Much discussion and thought has been devoted to the subject of turf "build-up". In order to try to determine the exact causes for turf "build-up", we checked the stabilized turf shoulders after two growing seasons - 1947 and 1948.

Method: The cross slope was checked with a wooden templet which had a level built into it. This same templet was used when the cross slope of 5 percent was determined during construction. Figure 5 indicates the type of templet used. On November 19, 1948, the cross slope of the shoulders were checked and no "build-up" was observed. Grass clippings had been allowed to remain on the turf during two growing seasons. Shoulders hadn't changed in elevation since they had been rolled in the spring of 1948.

Turf Root Growth: Sample test hole was made at Station 2130 and eight feet right of pavement edge. After removing the sod, it was found to measure .12 of a foot, in thickness. Figure 6 shows clearly the fine thick sod that was developed. It was found that the roots of the grass were very dense and tough penetrating through the top course of soil, bankrun sand, and 2½-in. stone aggregate .97 of a foot or nearly one foot into the stone area. The stone area was approximately .85 of a foot thick. The total material had a wet density of 126 lbs per cubic foot; moisture content, 6.9 percent; and dry density, 118 lbs per cubic foot. Dry density of grass roots, 32.5 lbs per cubic foot. Figures 6-15 furnish the results of the latest tests made by the Soils Division and the Laboratory.

Conclusions:

1. Stabilized turf shoulders may be plowed with standard highway snow removal equipment by raising the blade to a height of 5 in.-6 in. above the ground level.

2. The frost heave in the turf shoulder caused by freezing during the winter can be corrected and restored to its original condition with the same 5 percent cross slope by rolling with a five ton roller in the spring after the turf has partially dried out.

3. It was found that the stabilized turf shoulder during the critical period of the spring thaw rutted when traveled on by trucks or passenger vehicles. The depth of rut varied from 1-in.-1½-in. Temperature for the day was 52°-55°F. As soon as the car tire cut through the layer of soil and struck the stone aggregate, the tire didn't penetrate any deeper. The stabilized turf shoulders proved safe for occasional traffic use even though they rutted.

4. It is recommended that the stabilized turf shoulder be rolled, topsoiled, fertilized and overseeded in the spring in order to repair the spring thaw damage to the turf and to assure a good strong turf growth. It was found the maintenance repair cost was five (5¢) cents per square yard. This was after one of our most severe winters on record.

5. After allowing the grass clippings to remain on the turf, it was found there was no turf "build-up". Cross slope of shoulders remained the same as they were

when rolled in the spring of 1948. Because of these facts, it is concluded that any "build-up" due to accumulation of grass clippings would require a long period of years to produce any noticeable change in the shoulder cross slope.

Acknowledgments: Acknowledgment is due Mr. Allen Ely, Soil Engineer, New Jersey State Highway Department, for his interest, advice, and cooperation in carrying on this study.

References: 1. "Preliminary Report Experimental Stabilized Turf Shoulders For New Jersey Parkways" - Oliver A. Deakin. Paper submitted to Roadside Committee of Highway Research Board, December 1947.

See pages 84 to 93 for Figures, Tables, and Comments.

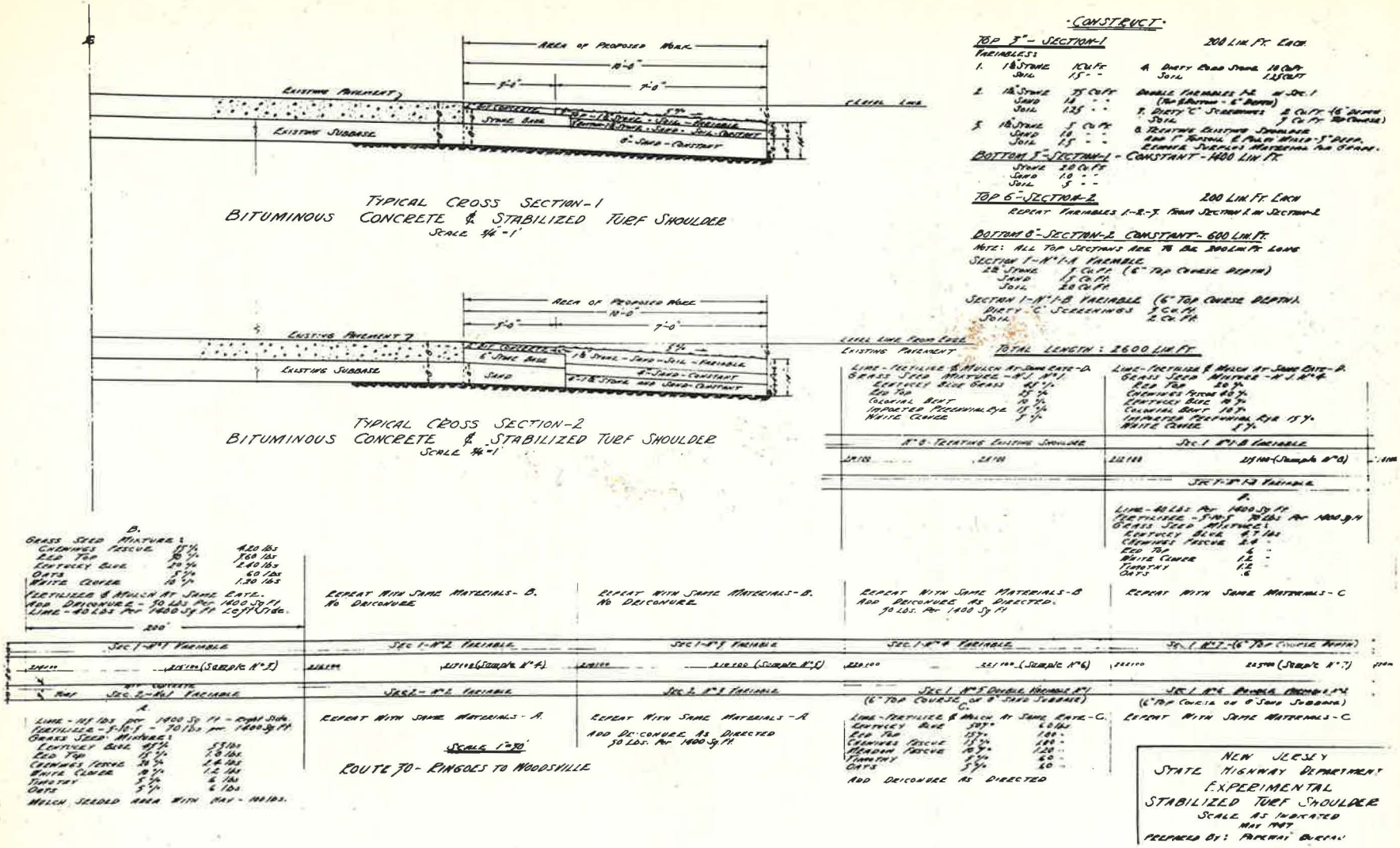


Figure 1. Detail Construction Plan For Experimental Stabilized Turf Shoulders.

Figure 2. Wheel Tracks Indicated that Considerable Traffic Had Used Shoulder. Jan. 27, 1948.

Figure 3. Rutted Turf Shoulder After Period of Thawing. Rut 1"-1½" deep. Feb. 19, 1948.

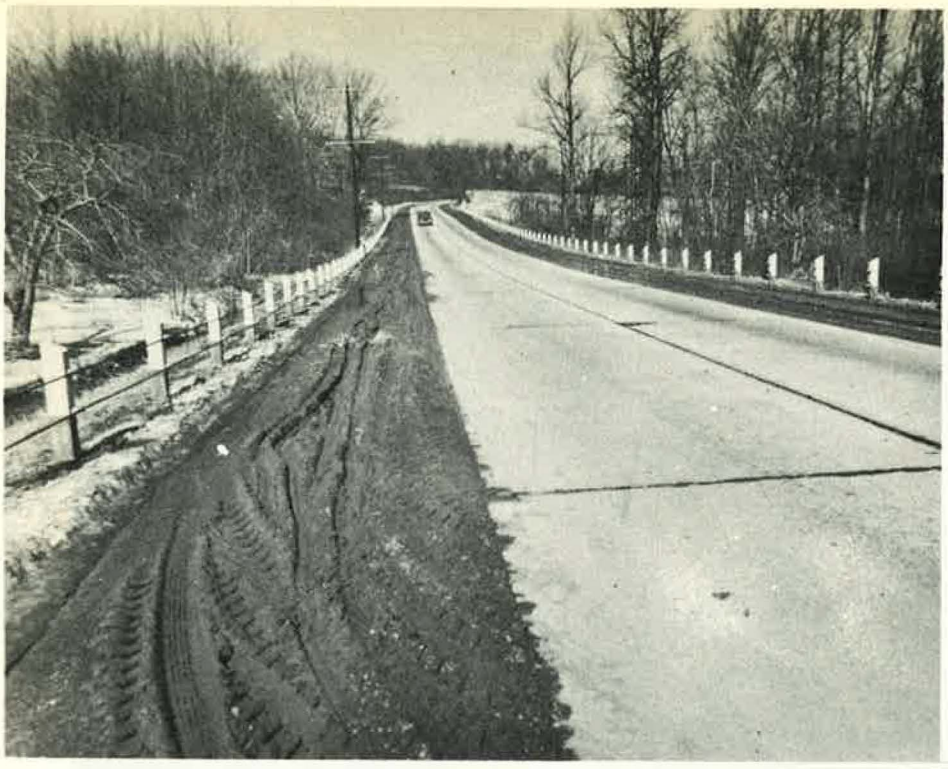


Figure 4. Other Highway Shoulder of an Improved Type Almost Impassable. Feb. 19, 1948.

Figure 5. Checking Turf "Build-Up" With Wooden Templet. November 19, 1948.

Figure 6. Good Thick Sod .12 of a Foot. November 15, 1948.

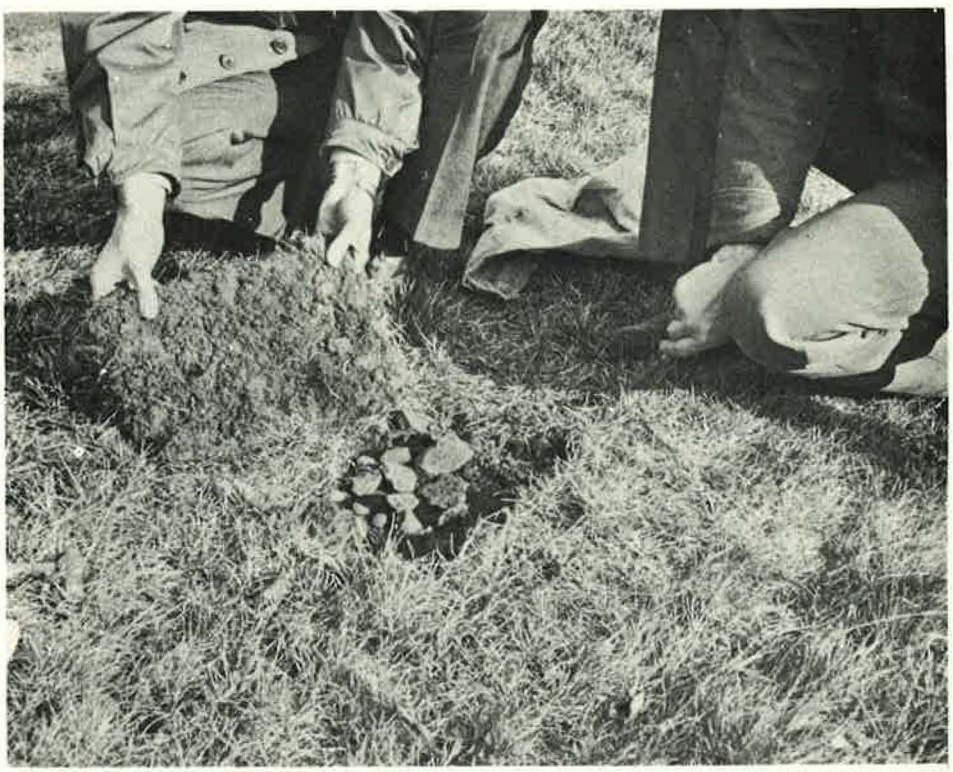


Figure 7. Removing Sod and Stone Aggregate From Test Hole - Station 213+71 R. Nov. 15, 1948.

Figure 8. Test Hole Station 213+0 - Total Depth of Stabilized Materials 1.20'. Nov. 15, 1948.

Figure 9. Sample Test Hole Station 217+09. Depth of Top Course .65 Ft. November 15, 1948.

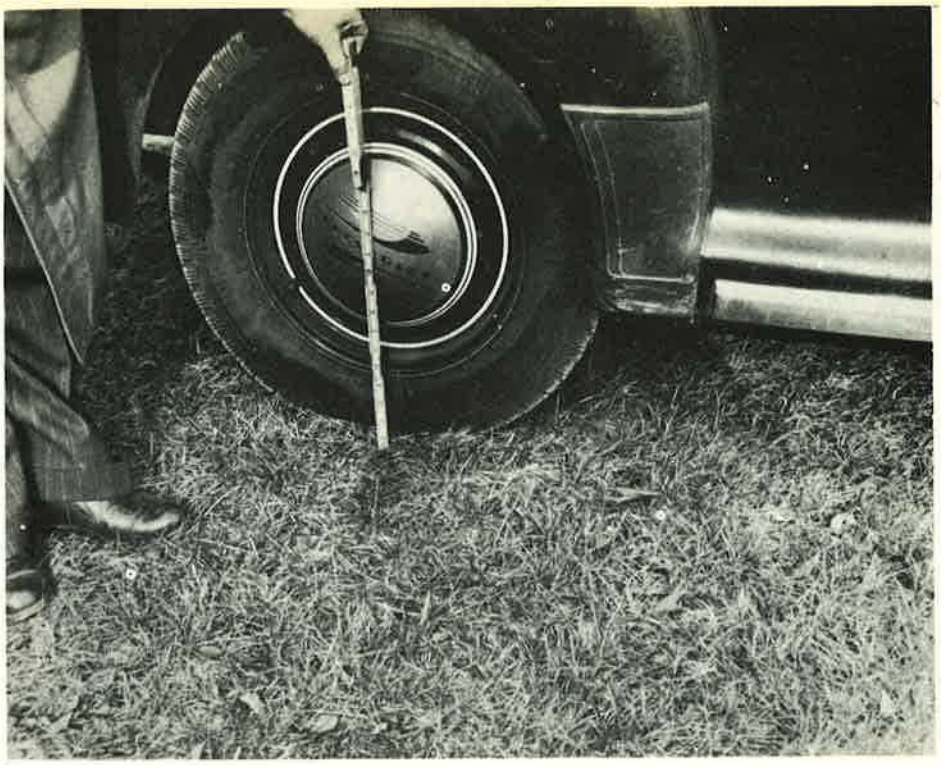
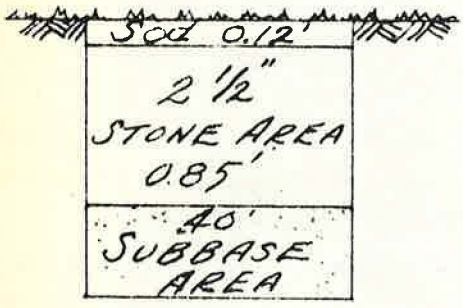


Figure 10. No Depression Caused By Passenger Car Tire. November 15, 1948.

Figure 11. Passenger Parked On Stabilized Shoulder. Nov. 15, 1948.

Figure 12. Stabilized Turf Shoulder Cover With a Dense, Tough, Growth of Vigorous Grass. Station 213+0. November 15, 1948.

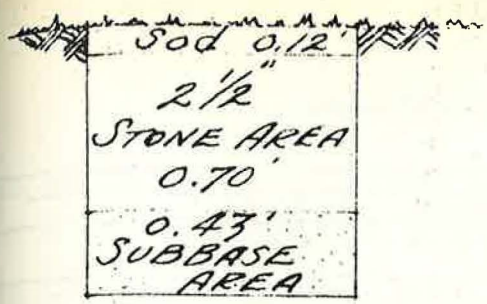


1. Sod: A sod cushion of average 0.12 ft was found. It was very dense and the roots tough. The roots penetrated approximately one ft. into the stone area.

2. Stone Area: This area consisted of 2½-in. stone, sand and soil. It was approximately 0.85 ft. deep.

Total Material - Wet Density: 126 lb. per cu. ft.
Moist. Content: 6.9 percent
Dry Density: 118 lb. per cu. ft.

Figure 13. Experimental Stabilized Turf Shoulder Study. Station 213+0. 8 ft. R. Edge Pavement. Route 30, Woodsville-Lyndale. Nov. 15, 1948.



1. Sod: A sod cushion of average 0.12 ft. was found. It was very dense and the roots tough. The roots penetrated approximately 0.82 ft. into the stone area.

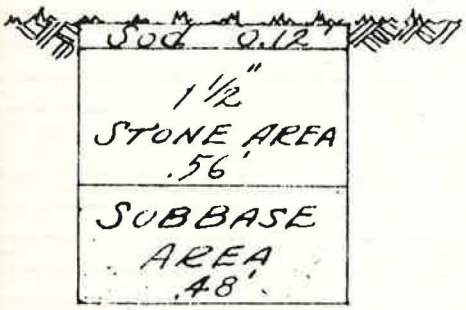
2. Stone Area: This area consisted of 2½ in. stone, sand and soil. It was approximately 0.70 ft. deep.

Total Material - Wet Density: 142 lb per cu. ft.
Moist. Content: 12.3 percent
Dry Density: 126 lb. per cu. ft.

3. Subbase Area: The subbase material is a clean gravely coarse sand. It was moist and dense. The 6 in. bleeder pipe appeared in good working order.

Total Material - Wet Density: 122 lb. per cu. ft.
Moist. Content: 11.8 percent
Dry Density: 108 lb. per cu. ft.

Figure 14. Experimental Stabilized Turf Shoulder Study. Station 213/71. 8-Ft. R. Edge Pavement. Nov. 15, 1948. Route 30, Woodsville-Lyndale.



1. Sod: A sod cushion of average 0.12 ft. was found. It was very dense and the roots tough. The roots penetrated approximately 7 inches into the stone area. Stone in this area was embedded in the Sod Cushion.

2. Stone Area: This area consisted of 1½-in. stone, sand and soil. It was approximately 7 inches deep.

Total Material - Wet Density: 137 lb. per cu. ft.
Moist. Content: 7.3 percent
Dry Density: 128 lb. per cu. ft.

3. Subbase Area: The subbase area is a clean gravely coarse sand. It appeared moist and dense. The 6-in. bleeder pipe showed evidence of good working order.

Total Material - Wet Density: 122 lb. per cu. ft.
Moist. Content: 8.8 percent
Dry Density: 112 lb. per cu. ft.

Figure 15. Experimental Stabilized Turf Shoulder Study. Station 217/09. 9 Ft. R. Edge Pavement. Nov. 15, 1948. Route 30, Woodsville-Lyndale.

STATE OF NEW JERSEY
STATE HIGHWAY DEPARTMENT
TESTING DIVISION

Serial No. I

REPORT OF ANALYSIS OF TURF SHOULDER SOILS

From Rt. 30 Woodsville - Lyndale, N. J.

Kind of Material Experimental Stabilized Turf Shoulders - 2½" Stone

Inspt. No.	Location
48-489	Station 213+71 8' R. Stone Area
48-490	Station 213+71 8' R. Sod
48-491	Station 213+71 8' R. Subbase Area
48-492	Station 213+0 8' R. Stone Area

Sampled by A. Crea	Per			
Inspectors Number	48-489	48-490	48-491	48-492
Date Taken				
Date Recd at Laboratory				
Job Sample Number				
Laboratory Serial No.	393196	393197	393198	393260
				3"-100
Tests 2½" Stone Area 100		Analyses 100		92
Total%Passing 2" Sieve	99		98	78
" " 1½" "	80		97	42
" " 1" "	78		92	36
" " 3/4" "	77		89	35
" " 3/8" "	74		83	33
" " No. 4 "	69		78	32
" " 10 "	60		72	28
" " 40 "	43		35	22
" " 60 "	35		15	18
" " 200 "	32		8	17
% Finer than .05 mm.	29		7	15
" " .005 mm.	8		2	4
" " .001 mm.	2		0	1
Specific Gravity	2.79		2.80	2.69
Liquid Limit	25.0		N.P.	25.5
Plastic Index	3.5		N.P.	3.3
Cal. Bearing Ratio				
% Swell 4 Days				
% Moisture Top 1"				
Moisture Content -%	12.3	None	11.8	6.9
Ignition Loss -%	4.65	7.18	2.33	4.45
Chemical (Organic) -%	.83	3.45	.23	1.10
P. H. Factor	6.8	5.7	6.1	6.7
% Roots, Grass, etc. by wt.		14.3		
" " " " by volume		46.0		
Wt/cu.ft. (dry) Roots, etc.		32.4		

STATE OF NEW JERSEY
STATE HIGHWAY DEPARTMENT
TESTING DIVISION

Serial No. 11

REPORT OF ANALYSIS OF TURF SHOULDER SOILS

From Rt. 30 Woodsville - Lyndale, N. J.

Kind of Material Experimental Stabilized Turf Shoulders - 1½" Stone

Inspt. No.	Location
48-493	Station 217+09 9' R. Sod
48-494	Station 217+09 9' R. Stone Area
48-496	Station 217+09 9' R. Subbase Area

Sampled by A. Crea Per

Inspectors Number	48-493	48-494	48-496
Date Taken			
Date Recd at Laboratory			
Job Sample Number			
Laboratory Serial No.	393261	393262	393263

Tests 1½" Stone Area	Analyses		
Total % Passing 2" Sieve		100	100
" " 1½" "		92	99
" " 1" "		66	88
" " 3/4" "		55	82
" " 3/8" "		50	74
" " No. 4 "		48	70
" " 10 "		40	65
" " 40 "		40	25
" " 60 "		29	7
" " 200 "		26	5
% Finer than .05 mm.		23	4
" " .005 mm.		6	1
" " .001 mm.		1	0
Specific Gravity		2.67	2.72
Liquid Limit		21.0	N.P.
Plastic Index		3.9	N.P.
Cal. Bearing Ratio			
% Swell 4 Days			
% Moisture Top 1"			
Moisture Content -%	None	7.3	8.8
Ignition Loss -%	9.09	3.60	2.25
Chemical (Organic) -%	3.87	.69	.14
P. H. Factor	5.4	6.0	6.0
% Roots, Grass, etc. by wt.	13.4		
" " " "by volume	44.1		
Wt/cu.ft. (dry) Roots, etc.	32.5		

COMMENTS

Comment

It was noted that experimental shoulders mentioned had a pitch or cross slope of five percent (this is equivalent to a six-inch drop at outer edge of a ten-foot shoulder). A number of States prefer a shoulder pitch for turf covered shoulders of one-inch per foot or a drop of ten inches on a ten-foot shoulder.

Comment

Could a series of shoulder test projects be set up in each State? A definite setup for shoulder research is needed with Mr. Iurka's and Dr. Monteith's project committees cooperating.

Comment

A setup for experimental installation of shoulders with stabilized soil and a seeded turf cover has been agreed upon. Two types of research are needed:

1. Based on construction of shoulders in various regions with selected mixtures of soil stabilized and rolled to desired densities.

2. Based on analysis of existing turf covered shoulders in various regions without selected soils or stabilization of existing soil.