NEW JERSEY TESTS on STABILIZED TURF SHOULDERS

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Traffic tests were performed at eight locations to aid in evaluating the stability and soil characteristics of portions of stabilized turf shoulders in current use in New Jersey on March 11 and 16, 1953. Additional density determinations were made during the week of November 30, 1953.

Locations of the eight test sections are as follows:

Areas 1 through 3 - Garden State Parkway, between Route 27 interchange and Clark Township interchange.
Areas 4 through 8 - Garden State Parkway, Tom's River Bypass - Experimental stabilized turf shoulder, Sections 21 and 22.
NJ-STS-1* - Northbound lane. Gas station area. End of block 765. Start of block 764.
NJ-STS-2 - Northbound lane. North of Central Avenue interchange. End of block 1115. Start of block 1116.
NJ-STS-3 - Southbound lane. 0.4 mile south of Inman Avenue Overpass. End of block 308. Start of block 307.
NJ-STS-4 - Southbound lane. Start of slab 119.
NJ-STS-5 - Southbound lane. Start of slab 123.
NJ-STS-6 - Southbound lane. Start of slab 128.
NJ-STS-7 - Southbound lane. Start of block 133.
NJ-STS-8 - Parallel to test area NJ-STS-7. Nine feet off test area 7. Start of block 133. Not a stabilized area. Not a shoulder.

Equipment:

1. Truck

GMC - 1947 - Dump
Single axle - dual wheel
Tire pressure - 60 psi.
Outside-to-outside distance of rear tires - 8 ft.
Width, double wheel - 23 in.
Tire size - 10 x 20
Tailgate to bumper length - 18 ft.
Body width - 7 ft.
Body length - 9 ft.
Body height - 2 ft.
Total weight - 10,850 lb.

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* Coded to represent:
NJ - New Jersey
STS - Stabilized turf shoulder
1 - Individual area designation

Weight on rear wheels (unloaded) - 5,600 lb.
Weight to bring rear-axle load to 18,000 lb - 14,000 lb.
Ballast - coarse white sand
Weight on rear wheels (loaded) - 18,000 lb.

2. Graduated scale.

3. Rigid bridge to span wheel marks.

4. Sand cone soil density equipment.

Procedure:

1. Rating of turf cover before test.

2. Loaded truck traveling in low gear passed over test section.

3. Test section 12 ft. long and centered on shoulder parallel to pavement.

4. Readings of wheel penetration taken at 4 ft. intervals beginning at start of section.

5. Two readings taken at each point.

6. Readings taken prior to test, after first pass, after final pass and, if necessary, at several intermediate passes.

7. Density determinations made after final pass in undisturbed portion of test area. Two determinations made between inside of tire print and edge of pavement within test section.

8. Soil samples taken to determine soil characteristics and fertility level.

Conditions:

Tests on areas 1 through 3 were performed on a cool, cloudy day two days after a moderately heavy rain. Soil was near saturation at sites 1 and 2 and saturated at site 3. Water was standing on the surface adjacent to test area 3. Thaw had occurred prior to test.

On areas 4 through 8, tests were conducted on a clear, cool day following a heavy rain. Soil was very close to saturation. Only surface of soil was frozen during winter and thaw completed prior to traffic test.

Density tests were performed during the week of November 30 before start of freezing weather. Figure 1 shows the loaded truck, rigid bridge, and graduated scale in place for determining wheel penetration following one pass of loaded truck on test area NJ-STS-2.

Results:

TABLE 1

Average Penetration of Loaded Truck Wheels

Test Area	Penetration After One Pass	Penetration After Four Passes	Maximum Penetration	Passes to Reach Max.
name	inches	inches	inches	number
NJ-STS-1	3/16	4/16	4/16	2
" -2	3/16	11/16	13/16	6
" -3*	1/16	3/16	3/16	3
" -4	2/16	5/16	7/16	7
" -5	2/16	4/16	4/16	2
" -6	2/16	4/16	4/16	2
" -7	2/16	3/16	3/16	2
" -8**	1-4/16	3-7/16	4-1/16	***

* One small area in test section where, after five passes, penetration was 1½ in. Inspection showed no large stone in this small area. Profile was: layer of medium-textured soil (about 3 in. deep) over a layer of coarse sand (about 2 in. deep). This area was apparently not mixed at time of construction.

** Side bulge, indicating shear failure after two passes.

*** Ruts too deep after five passes to operate truck safely. Test stopped. Maximum penetration not attained.

Figures 2 through 5 illustrate the effect of the traffic test on a stabilized and a non-stabilized area. Test area NJ-STS-7 is shown in Fig. 2 before test. Figure 3 is same area following four passes of the loaded truck. Maximum penetration had been attained after two passes. The same sequence is shown for the non-stabilized area NJ-STS-8 in Figs. 4 and 5. Maximum penetration not attained as ruts became too deep for safe operation of the test vehicle.

Fig. 1. Test equipment after one pass on test Area 2. Rigid bridge and graduated scale in position to measure penetration. Loaded truck in background.

Table 2 shows field density data for the test areas for the March traffic tests and the November density tests. Tables 3, 4, 5, and 6 present data from soil samples obtained during the spring tests.

Fig. 2. Test Area NJ-STS-7 prior to traffic test.

Fig. 3. Test Area NJ-STS-7 after four passes of loaded truck.

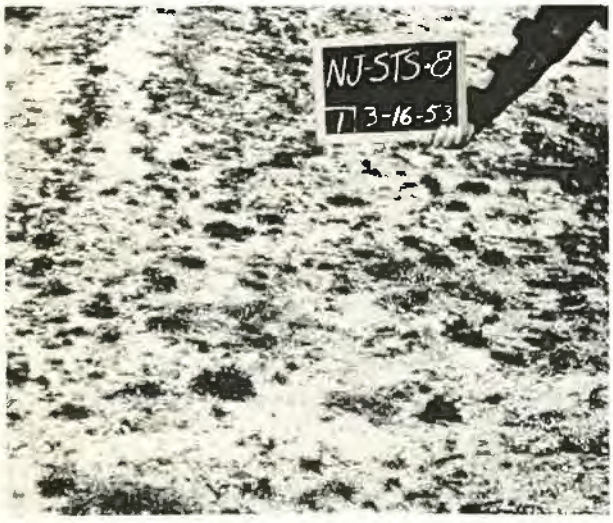

Fig. 4. Test Area NJ-STS-8 prior to traffic test.

Fig. 5. Test Area NJ-STS-8 after four passes of loaded truck.

TABLE 2

Soil Density

Test Area	March 1953 Determination 1 Density	March 1953 Determination 1 Moisture Content	March 1953 Determination 2 Density	March 1953 Determination 2 Moisture Content	November 1953 Rutgers Univ.* Density	November 1953 Rutgers Univ.* Moisture Content	November 1953 N.J.S.H.D.* Density	November 1953 N.J.S.H.D.* Moisture Content
	pcf.	%	pcf.	%	pcf.	%	pcf.	%
NJ-STS-1	133	6.7	140	4.4	140	5.8	**	**
" -2	**	**	128	7.7	128	11.2	**	**
" -3	**	**	**	**	118	11.3	**	**
" -4	117	10.1	120	9.1	125	6.2	122	5.8
" -5	**	**	**	**	131	6.0	130	5.0
" -6	124	6.1	129	5.6	138	5.2	135	4.4
" -7	131	6.5	128	7.2	141	4.8	131	6.3
" -8	102	11.5	104	17.0	103	9.6	112	5.4

* Test performed jointly by personnel Soils Division, New Jersey State Highway Department, and Soils Department, Rutgers University.
** No data available.

TABLE 3

Atterburg Constants

Test Area	Determination 1 Liquid Limit	Determination 1 Plastic Limit	Determination 1 Plasticity Index	Determination 2 Liquid Limit	Determination 2 Plastic Limit	Determination 2 Plasticity Index
NJ-STS-1	20	20	NP	19	16	3
" -2	22	17	5	21	16	5
" -3	20	17	3	20	16	4
" -4	NP*	NP	NP	NP	NP	NP
" -5	NP	NP	NP	NP	NP	NP
" -6	NP	NP	NP	NP	NP	NP
" -7	NP	NP	NP	NP	NP	NP
" -8	19	16	3	20	15	5

*non-plastic.

TABLE 4

Grain-Size Analyses

Test Area	Determination	Total % Passing Sieve 3- in.	2½- in.	2- in.	1½- in.	1- in.	3/4- in.	3/8- in.	No. 4	No. 10	No. 40	No. 60	No. 200	.05 mm.	.005 mm.	.001 mm.	% Finer Than HRB Subgrade Classification
NJ-STS-1	1	100	100	62	57	37	33	31	29	25	17	12	8	7	3	1	A-1-a
	2	100	88	60	43	30	30	29	26	23	15	11	7	7	6	3	A-1-a
NJ-STS-2	1	100	100	100	69	41	37	32	29	22	16	12	9	8	3	1	A-1-a
	2	100	100	84	58	48	44	42	39	34	25	20	14	13	5	1	A-1-a
NJ-STS-3	1	100	100	100	92	89	88	85	77	68	42	29	20	18	8	2	A-1-b
	2	100	100	92	88	80	80	78	74	65	45	33	23	21	10	3	A-1-b
NJ-STS-4	1	100	100	100	100	100	96	80	69	57	32	16	7	6	3	1	A-1-b
	2	100	100	100	100	100	97	81	71	60	30	15	6	6	2	1	A-1-b
NJ-STS-5	1	100	100	100	100	98	91	72	64	58	29	14	7	6	3	1	A-1-b
	2	100	100	100	100	99	99	78	72	65	34	17	8	7	3	1	A-1-b
NJ-STS-6	1	100	100	100	100	99	97	67	54	48	26	12	5	5	2	1	A-1-a
	2	100	100	100	98	95	94	82	66	59	32	15	7	6	2	1	A-1-b
NJ-STS-7	1	100	100	85	76	65	63	55	49	43	22	11	5	5	2	1	A-1-a
	2	100	100	81	76	74	71	61	53	44	19	9	4	4	2	1	A-1-a
NJ-STS-8	1	100	100	100	100	98	97	90	81	72	46	31	22	21	10	3	A-1-b
	2	100	100	100	100	100	99	95	87	77	53	37	26	24	11	3	A-2-4

TABLE 5

Nutrient Status

Test Area	pH	Available Nutrients - Pounds an Acre Calcium	Magnesium	Phosphorus	Potassium
NJ-STS-1	5.6	900	120	11	100
" -2	6.8	1020	150	12	100
" -3	6.4	1140	120	4	130
" -4	6.2	1140	60	32	95
" -5	5.5	900	75	31	75
" -6	6.5	1890	110	45	55
" -7	6.9	2460	100	27	80
" -8	6.4	1710	90	30	100

TABLE 6

Vegetative Cover

Test Area	Total Cover Percent	Main Species	Comments
NJ-STS-1	35	Red fescue	Nonuniform distribution
" -2	80	Red fescue	Uniform distribution
" -3	85	Red fescue	Uniform distribution
" -4	85	Ryegrass, fescue, bluegrass	Poor near pavement edge
" -5	80	Ryegrass, some fescue, bluegrass	Poor near pavement edge
" -6	60	Ryegrass, fescue, bluegrass	Nonuniform distribution
" -7	60	Ryegrass, fescue bluegrass	Nonuniform distribution
" -8	5	Ryegrass, fescue	Seeded previous fall

Fig. 6. Loaded truck leaving test area NJ-STS-8 and reentering stabilized turf shoulder.

Comments:

Winter of 1952-1953 was relatively mild and did not present a major problem in frost penetration. Spring thaw was not of the nature that would result in too great a loss of bearing strength. Results obtained should not be used too rigidly for predicting success or stability of the shoulders tested but are of value to reject or pass on their instability. Testing was done immediately following heavy spring rains which, in the case of test areas NJ-STS-4 through 8, put the moisture content as high as is probably ever attained in these soils. Test areas NJ-STS-1 through 3 will probably be subjected to conditions during a severe winter with the following spring thaw more conducive to loss of bearing strength than occurred the spring of 1953.

Test area NJ-STS-8 was included to emphasize the need to consider stability of the soil materials before considering turf establishment. Figure 6 shows the loaded truck leaving this test area and climbing up on the stabilized turf shoulder. Turf can be established on these stabile shoulders.

Test areas NJ-STS-2 and 4 of the stabilized materials were the only two showing any appreciable penetration of the truck wheels under the 18,000-lb. rear-axle load.