APPENDIX D

STABILIZED (TURF) SHOULDERS

Experience in this type of shoulder construction is limited to a few States; nevertheless, material progress in stabilized shoulder development has been reported in a number of cases since the war.

Repeated requests for information on specifications for stabilized turf shoulders have prompted the assembly of the following reference data. This brief record of progress in the design of stabilized shoulders is intended to bring together facts of increasing interest in relation to road service and safety, maintenance, snow control, and over-all highway appearance.

1. 1945 PROCEEDINGS, 25th Annual Meeting, Highway Research Board, pages 104-116.

   -This is the first published survey on the design of stabilized earth shoulders for turf cover. A summary of interesting facts on State highway plans, specifications, and field reports is included with a series of field research projects on new highways proposed as the best "laboratory" for improved earth shoulder design to meet modern standards of engineering.

2. 1946 PROCEEDINGS, 26th Annual Meeting, Highway Research Board, pages 258-268.

   -This is an interim report on research procedure for cooperative study by the States, illustrated by a series of field tests begun on Long Island by the New York State Department of Public Works in 1945. Michigan is another State that has established experimental shoulder plots for the study of turf shoulders on existing highways.

3. 1947 PROCEEDINGS, 27th Annual Meeting, Highway Research Board, pages 145 and 146.

   -This is the 1947 status report on mechanically stabilized shoulders constructed on Long Island in 1945, 1946, and 1947, together with a report on new tests relating to traffic loads and shoulder "build-up" to determine the degree of stability.

   -Included also is a preliminary report on experimental stabilized turf shoulders for parkway use in New Jersey, where a sample section was constructed before the fall of 1947. A progress report on study of turf growth on soil mixtures available for highway shoulder construction in Michigan, without loamy topsoil, is also included. This series of tests was begun in 1943 at Michigan State College.

Note: For complete details of the tests, see pages 38 to 83 of the 1947 Report of the Committee on Roadside Development, published by the Highway Research Board, September 1948.

4. 1948 Report of Committee on Roadside Development, including special papers presented at the 28th Annual Meeting of the Highway Research Board, published September 1949.

-Report of Project Committee on Shoulders (page 58) gives functions of road shoulder, and relation of pavement and shoulder with recommendations. Problems to be studied include an appendix of standard specifications for materials for stabilized surface course (AASHO:M61-42).

-Shoulder Construction Practices in Michigan (page 72), for 8-foot standard shoulders and for 10-foot partially stabilized shoulders, with typical earth grade sections and methods of construction, including stabilized shoulder strip methods.

-Progress Report on Experimental Stabilized Turf Shoulders for New Jersey Parkways (page 80), with detail construction plans, figures, tables, and comments, pages 84 to 93. See also March, 1951 CONTRACTORS AND ENGINEERS MONTHLY, pp. 46-50.

-Turf on Stabilized Soils (page 95), under different climatic conditions, with conclusions and several illustrations of turf runway investigations and studies.

5. 1949 Report of Committee on Roadside Development, including special papers, presented at the 29th Annual Meeting of the Highway Research Board, issued in November 1950.

-Report of Special Committee on Shoulders with discussions (pages 4-9).

-Outline of main problems of roadside grading and drainage design (pages 12-52).

To compare and analyze the types of shoulder and ditch (gutter) designs in relation to traffic service and highway safety and maintenance, attention is called to the paragraph on "The Objectives of Rounded Slope and Channel Design" on pages 24 and 25; and to typical highway cross sections shown in figures 23, 26, 30, 31, and 33, pages 45 to 50, inclusive. These typical cross sections are from recent contract plans submitted by States in all regions.

6. 1950 Report of Committee on Roadside Development presented at the 30th Annual Meeting to be published in 1951. (See Table of Contents when issued.)

7. "INDEX TO PUBLICATIONS--1921-1949"

-Pages 40 and 42 list sources of information on road shoulder research and design that can be found in Reports and Proceedings of the Highway Research Board. These publications should be on file in the Division and District Offices.

Emphasis on turf cover for earth shoulders in a number of the references is significant and timely in view of high maintenance costs. Generally speaking, bare earth shoulders tend to be covered eventually by grass, weeds, or other vegetation, in areas upwards of about 15 inches of annual rainfall. To insure free run-off of surface water from the pavement, the design should provide positive drainage by pitching the surface at about one-inch per foot of shoulder width.

Considering earth shoulders in general, the following trends in design practice have been observed among the States:

(a) The pitch of earth shoulder is usually not flatter than 3/4 inch per foot of width.

(b) The ratio of earth-graded slope from outer edge of shoulder to bottom of ditch (gutter) is usually 4:1, or flatter.

(c) Depth of bottom of gutter below elevation of pavement is usually 24 inches or more. Width of side drainage sections is increased as necessary for control of snow drifting and for snow storage or other special reasons.

(d) Surface and subgrade drainage across the shoulder area is being improved to counteract possible "pumping" of pavement slabs.

One of the recent examples of this trend in design for more positive drainage is the new cross section of the Pennsylvania Turnpike Extension as published on page 35 of the June 1950 issue of CONTRACTORS & ENGINEERS MONTHLY, copies of which should be available. The 10-foot stabilized shoulder has a cross slope of one inch per foot, the pitch of the subgrade being parallel with the surface, and the 6-inch special subgrade (subbase material) being carried across the entire width of roadbed to the side drainage at a slope of 1/6 inch per foot under the pavement.

The Texas State Highway Department specifies a cross slope of one-quarter inch per foot for earth subgrades under the pavement. This type of design is similar in principle to Figure 12 on page 115 of the 1945 PROCEEDINGS listed above.

8. SAMPLE SPECIFICATIONS for Stabilized Turf Shoulders, taken from the supplementary specifications for New Jersey Project U-188 (14), are attached as guide information only.

This project is on Route 4 Parkway, Sections 5B and 6C, in Woodbridge and Cranford Townships. The paving of these two sections consists of two 24-foot plain concrete lanes with macadam and stabilized turf shoulders, separated by an earth center island (median), about 3½ miles in length. The estimate, dated October 11, 1949, anticipated an average daily traffic of 10,000 passenger vehicles, with peak days probably as high as 30,000.

About 30,000 square yards of stabilized turf shoulders were constructed in these sections. Bids on this item (No. 15) in the estimate received from seven bidders ranged in price from $1.15 to $1.72 per square yard. The low bidder on the project submitted a unit price of $1.70 for each section of the work.

The State reports that on the first ten-mile section of the parkway, 71,956 square yards of stabilized turf shoulders were constructed at an average price of $1.43 per square yard. The State feels that this type of stabilized turf shoulder will reduce maintenance cost as well as improve the appearance of the parkway. In conjunction with the construction of the stabilized turf shoulders, 45,565 square yards of hay mulch was applied to assure good growth of turf out of regular recognized seeding periods. (See "New Jersey's First Parkway" in AASHO Committee Proceedings, Miami, Florida, December 1950.)

9. Attached is an informational copy of the October 5, 1950, report by the Illinois Division of Highways on the Experimental Shoulder Stabilization constructed as a part of Illinois Project S-188 (1). The experimental portion of this project consisted of constructing various mixtures of soils and granular materials to determine what mixture would be most satisfactory from the standpoint of the growth of grass and stability under traffic. The State is applying these findings as far as feasible in highway construction, especially on the expressway type of development in the Chicago area.

APPENDIX E

NEW JERSEY SUPPLEMENTARY SPECIFICATIONS

Division 2, Section 10

STABILIZED TURF SHOULDERS

Article 2.10.1 Description

Turf shoulder shall be constructed of a mixture of broken stone or slag, bank-run or washed sand, topsoil and fertilizer at the prescribed locations, to the prescribed lines, grades and dimensions, and in accordance with the Plans and Specifications.

Article 2.10.2 Materials

The broken stone or slag shall be 2½-inch in size complying with the requirements of Article 2.13.2, except that if slag is used, samples of the slag shall be submitted to the Engineer for an acidity test. The slag shall have a hydrogen ion value of not less than 5.0 and not more than 7.0.

Topsoil and fertilizer shall comply with the requirements of Article 2.11.2 of Standard Specifications except that topsoil shall have an organic content not less than 2 percent nor more than 4 percent. The lower percentage of organic content is preferable.

The bank-run or washed sand shall be so graded that 100 percent will pass a 3/4-inch sieve, 90 to 100 percent will pass a No. 4 sieve, and 0 to 7 percent will pass a No. 200 sieve. All percentages to be based on the total weight of the sample.

The material shall be mixed according to the following volumetric proportions:

2½-inch stone or slag	3 parts by volume
Bank-run or washed sand	1½ parts by volume
Topsoil	2 parts by volume

Hydrated lime shall conform to the requirements therefor specified in Article 3.13.2, Page 127 of Standard Specifications.

The grass seed mixture for Stabilized Turf Shoulders shall be as follows:

Kentucky Bluegrass	50%
Chewings Fescue	25%
Red Top	15%
White Clover	5%
Oats or Rye	5%

When seeding during the spring use oats. At all other times use rye.

Article 2.10.3 Methods of Construction

The stabilized turf shoulder shall be constructed in one course to the lines and grades prescribed on the plans. The materials shall be placed in three layers; the 2½-inch stone or slag spread on the subbase, the bank-run sand and gravel spread over the stone, and the topsoil spread over the sand and gravel. The material then shall be mixed completely with pulvi-mixer making a minimum of two passes over the materials. A pass is defined as one passage of all the materials through the mixing chamber of the pulvi-mixer. Stone shall be brought to the surface of the shoulder. The depth of topsoil layer at the surface of the shoulder shall not exceed ¼ inch. After the material has been pulvi-mixed, it shall be rolled with a minimum of two passes of a 3-wheel, 5-ton smooth roller. A pass shall be defined as one passage of a rear wheel of the roller over the entire area of the shoulder.

If, in constructing the macadam shoulders, the Contractor places the stabilized turf shoulder material at the same time as the macadam stone is spread and compacts portions of it with rollers weighing more than the specified five tons, the turf shoulder material shall be scarified for its full depth so as to loosen the stone before pulvi-mixing, if necessary, at his own cost and expense.

The placing of fertilizer and seeding shall be done in conformity with Article 2.11.3, Pages 59 and 60 of the Standard specifications as amended herein with the following exceptions:

The fertilizer shall be spread at the rate of 1000 pounds per acre and the seed at a rate of 180 pounds of grass mixture and 10 pounds of grain per acre.

When seeding of the stabilized turf is done between May 15 and August 15, a hay mulch shall be uniformly spread over the turf shoulder, within 24 hours after seeding, at the rate of 100 pounds over 1400 square feet and held in place by brush or other approved means, and the turf shoulder shall be watered by sprinkling with an amount sufficient to moisten the turf shoulder to a depth of 2 to 3 inches every third day after the previous sprinkling or adequate rainfall. Sprinkling shall be done in a manner which will not wash out seeds or seedlings.

Sour hay may be used as a mulch. The mulching material may be held in place by using brush or by using twine and peg method. The twine used shall be binder twine or treated sisal fiber. The pegs shall be No. 50d or No. 60d, steel wire nails or wood pegs ½-in. by ½-in. by 8-in. long.

Three lines running parallel to the pavement are placed so that the first line of twine is 4 in. from the edge of the macadam shoulder; the second, 8 in. and the third 20 in. The two lines of twine nearest and parallel to the pavement are held by pegs placed 4 ft. apart. The twine cross ties and pegs extend 4 in. from the bituminous macadam shoulder edge to 1 ft. beyond the edge of the stabilized shoulder. Cross ties should be placed 4 ft. apart.

If any of the mulch is displaced before the grass seed is germinated and the grass has made a growth of 1 inch to 1½ inch, it shall be put back in place, or, if necessary, replaced by the Contractor.

When turf has grown to a height of 1½ to 2 inches, the hay mulch shall be removed with a hand hay fork. Any hay which cannot be removed easily shall be allowed to remain.

Article 2.10.4 Quantity and Payment

The quantity of stabilized turf shoulder for which payment will be made will be the area actually pulvi-mixed and constructed in accordance with the plans or as directed by the Engineer. The strip of turf shoulder six inches wide and three inches deep along the edge of the bituminous macadam shoulder shall not be included in the area measured for payment.

Payment will be made for the quantity as above determined, measured in square yards, at the price per square yard bid for the item Stabilized Turf Shoulder in the Proposal, which price shall include furnishing, placing and compacting the shoulder material, including ground limestone, fertilizer and grass seed, preparing and compacting the subgrade, constructing the turf shoulder strip six inches wide and three inches deep along the edge of bituminous macadam shoulder without measurement and payment therefor, watering, mulching, material, labor, equipment and all else necessary therefor and other work in connection therewith and incidental thereto.