REPORT OF SPECIAL PROJECT COMMITTEE ON STABILIZED TURF SHOULDERS

Harry H. Iurka, Chairman
Senior Landscape Engineer
New York State Department of Public Works

Mr. Iurka stated that his Project Committee had canvassed all sources of information concerning turf shoulders on stabilized earth, and offered the report by H. C. Nikola of Rutgers University, which follows.

STABLE SHOULDERS

Herbert C. Nikola
Research Assistant in Soils
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THIS PAPER is not intended as an answer to questions as to which type of shoulder is best fitted for a given set of conditions. Rather, it is designed to provide some basic information concerning the costs of construction and maintenance of shoulders, to point out the need for additional cost data, and to indicate some of the properties of granular soil material mixtures used to construct stabilized turf shoulders in humid areas. It also outlines a few points that need study in determining the causes of build-up of turf shoulders. Finally, it is the author's purpose to stimulate interest in a cooperative effort to solve some of the problems associated with the selection of the proper shoulder to meet the stability requirements of various types of roadways.

The title of this paper was selected to emphasize a major point concerning highway shoulders. The primary purpose of a shoulder is to provide added safety for traffic operation. All further discussion concerning specific types of shoulders will be considered in that light.

Different types of shoulders must be used to provide safety under different traffic loads. No attempt will be made to define the conditions under which a specific shoulder type should be used since this can best be decided upon through cooperative effort among highway designers, construction men, and maintenance personnel.

Cost of construction is one of the first considerations. The major portion of the cost data presented pertains to work completed or in progress in the metropolitan area of New York and New Jersey. The relative costs of these various types of shoulders should be about the same in all humid areas of the United States. Therefore, anyone with a detailed knowledge concerning the costs of similar shoulders in other humid areas can derive an approximate cost figure for any of the types listed. Included in this report are several types of shoulders not stabilized during construction but in common usage. Cost data on them are necessary to present an overall picture. Table 1 lists approximate costs for construction of 11 types of shoulders. Included in this table is the construction cost for a section of bituminous transition strip used in New Jersey on the Garden State Parkway, Route 4. This 3-ft. strip was placed between the concrete pavement and the stabilized turf shoulder.

TABLE 1

SHOULDER CONSTRUCTION COSTS[a]

Type of shoulder	Cost per sq. yd.
2½ in. asphaltic concrete on 5 in. stone base	$ 3.40
Soil, cement stabilized	2.50
Bituminous stabilized gravel mix (plant mix - 5 in. depth)	3.00
Bituminous mulch gravel (3 in. plant mix on 6 in. gravel foundation)	2.00
Bituminous concrete[c] (4 in. base course - 3 in. intermediate - 1 in. top)	2.50
Stabilized turf - 6 in. depth[b]	1.40
Stabilized soil - turf cover - 6 in. depth	1.25
Bituminous stabilized earth - 4 in. depth	1.35
Improved stone - 8 in. depth[c]	1.25
Run-of-bank gravel[c] (not stabilized, not turfed)	.60
Oiled (surface)	.40
Transition strip - N. J. Parkway[c] (3-foot width, modified penetration macadam - 7 in. depth)	2.05

[a] - Cost data from current bids or estimates
[b] - New Jersey Parkway, Route 4 - average cost for 10-mile section now in use
[c] - Cost data, courtesy of Oliver A. Deakin, Parkway and Landscape Engineer, New Jersey State Highway Department

If the estimated traffic volume of a proposed road is related to a series of adequate cross-sections from which the level of stability required for the shoulder area can be determined, a type of shoulder can be chosen that will fit the need in conformity with cost, with the possibility of considerable savings over a period of time.

Before a specific type of shoulder can be decided on, some knowledge of maintenance costs is required. That maintenance of shoulders and approaches is of importance is brought out in the December 1948 report of the Highway Research Board's Project Committee on Maintenance Costs, J. S. Bright, chairman. This report shows that 10 percent of the dollar used for maintaining and operating state highway systems was spent on shoulders and approaches. This amounted to approximately 45 million dollars on state highway systems in 1947 and 90 million dollars for the nation as a whole, including counties, townships, and municipalities. Unfortunately there are few detailed cost data available from which specific information can be obtained as to maintenance costs over a period of time on a given type of shoulder.

It seems best to use the available maintenance data to indicate relative rather than specific costs for shoulder maintenance. T. A. Steele of CAA reported that the cost of maintaining turf shoulders was less than that for bituminous surfaces. According to the Air Force Manual 90-1, entitled "Grounds - Construction and Maintenance" February, 1949, the cost of maintaining turf areas on airports throughout the country was less than for areas treated with oil palliatives. In an article by E. L. Worthington of West Virginia, it was reported that, for Minnesota, cost of maintenance for turfed shoulders differed very little from that of gravel shoulders. The cost of maintaining turf shoulders is not greater and, in fact, is generally considered to be less than that of several other types of shoulders. Data on costs of construction and maintenance indicate that stabilized turf shoulders have a definite place on modern highways. They are one of the more inexpensive shoulders to construct and to maintain.

Considerable discussion has been devoted in previous meetings to details on many of the shoulder types listed in Table 1. For this reason only the stabilized turf shoulders will be considered here. In addition to providing a stable surface, it must

be capable of supporting a turf cover. This brings in a problem not generally associated with other types of shoulders, i.e., seeding, fertilizing, and mowing.

Some of the properties of the soil material in these shoulders merit discussion. The AASHO specifications for materials for stabilized surface course include three types of stabilized mixtures. These are sand-clay mortar; coarse-graded aggregate; and gravel, stone, or slag screenings, or sand. All of these have been satisfactory. The mixtures specified fall into four textural classes, all with a relatively high sand content.

The capacity of soils of this texture to store nutrient elements is relatively small and, therefore, a program of maintenance fertilization must be considered. Careful attention must be given the shoulder during the initial period of establishment, but thereafter routine inspections of the turf will suffice to determine when additional fertilizer applications are required. A turf cover is known to be a good source of organic matter. Since soils of similar texture in a given climatic region tend to attain an equilibrium as to their organic-matter content, the use of a high-organic topsoil as a binder in shoulder mixtures does not appear logical. It would seem more economical to use a binder that meets the stability requirements of the engineer regardless of whether or not it contains any considerable amount of organic matter. It has been demonstrated that sufficient nutrients can be placed in stabilized granular material to support the establishmsnt of a turf cover. If this binder contains some organic matter and still meets the requirements for stability, benefit could be derived from its presence. The ability to hold nutrients and moisture is greater when a small amount of organic matter is present.

It has been reported that stabilized turf shoulders generally build up over a period of years. The exact causes of the build-up are not known. But several very good explanations have been advanced. On the basis of these and other thoughts on the subject, the following set of tests is suggested as an aid in determining the primary causes for it. The following variables merit study:

I. Three shoulder types based on the AASHO specifications for materials for stabilized surface course.
   - Sand-clay mortar
   - Coarse-graded aggregate
   - Gravel, stone or slag screenings, or sand

II. Two pavement gradients - cross pavement
   - Toward shoulder
   - Toward center line

III. Four types of topography
   - Steep roadside slope rising from shoulder area
   - Plowed and cultivated fields beyond shoulder area
   - Field and area beyond shoulder area in permanent cover
   - Roadside slope away from shoulder area (as on fill slope)

IV. Three degrees of traffic
   - Heavy
   - Light
   - Automobiles only (noncommercial traffic)

V. Four types of drainage
   Relatively steep gradient away from pavement
   Relatively gentle gradient away from pavement
   Relatively steep gradient in drainage channel
   Relatively gentle gradient in drainage channel

VI. Three locations of shoulder
   Rural areas - nonpaved access roads
   Suburban areas - paved access roads
   Parkway - in area of no access roads

VII. Two mowing practices
   All mowing clippings removed
   All mowing clippings left in place

If this plan, or a major portion of it, could be put into operation in various locations, preferably in several different areas throughout the United States, it is believed that information of considerable value could be obtained. The program would require elevation records of the shoulder area over a period of time and a study of the soil material in the build-up zone of the shoulder in relation to the soils in the surrounding areas.

The following points concerning shoulders should be considered whenever a highway design plan is under consideration: (1) cost of different types of shoulders vary over a considerable range; (2) dependent upon the type of highway, which is related to the traffic load, a given shoulder will provide adequate stability and best value for money expended; (3) stabilized turf shoulders have a definite place on our modern highways; (4) stabilized turf shoulders present an additional problem in that they introduce the subject of turf coverings; (5) stabilized turf shoulders are relatively economical to construct and to maintain; (6) more information is needed concerning the cause of build-up of stabilized turf shoulders and a series of tests, designed to determine why build-up takes place, is offered for consideration. ← INSERT

INSERT

Typical cost data are given for a number of shoulder types: asphaltic concrete, cement-stabilized soil, bituminous stabilization, improved stone, gravel, oiled surfaces, and transition strip (modified penetration macadam). /AUTHOR/

Sincere appreciation is ex
New York State Department of Publi
terest, without which this paper c
Firman E. Bear, chairman, Soils De
advice.

DISCUSSION

MR. IURKA: I would like to underline one of Mr. Nikola's statements regarding the use of topsoil. Our first requirement on an earth shoulder is stability (ability to carry traffic loads without rutting); the second is that the shoulder support a growth of turf.

If topsoil provides stability, well and good. Sometimes topsoil definitely does not add to shoulder stability. We should remember this point in writing our specifications.

Another point: An earth shoulder must be economical in cost as well as being well designed from a traffic-bearing point of view. The soil materials available do not always meet the 1948 recommendations of the AASHO committee. It would be impossible always to meet such a standard soil specification with existing soils. The fact that organic matter may be desirable from the point of view of turf growth, but undesirable from that of shoulder stability, may lead us to consideration of use of chemicals for soil improvement.

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