Establishment and Maintenance of Stabilized Shoulders for Our Highways *

DALLAS D. DUPRE, JR.
Landscape Architect, Ohio Department of Highways

This subject is a broad one, and the problem involved is one which the present speaker believes to have been neglected or overlooked by the engineer through the years of highway development except where he has more or less unconsciously adopted a system of shoulder stabilization in his own locality—that is, his township, county, or state.

In Ohio at present shoulder stabilization, as a program, consists of applying to the surface of the subgraded shoulder a few inches of aggregate of various allowed qualities. I will not say this is bad, and I do not say it is good. As a rule, no regular stabilization program is practiced; and, as will be pointed out later in discussing seeding operations, I believe this procedure has proved of value.

To indicate that the matter of stabilized shoulders, as planned work, has not been given extensive study by the engineers, let me say that very little information has seemed to be available to the "Shoulder Committee" of the Roadside Development Section of the Highway Research Board. This committee, headed by Mr. Frank Brant, Landscape Engineer of the North Carolina State Highway Department, combed the country for all available information and found the pickings sparse, indeed. While the committee's prime object is to develop a procedure of establishing turf shoulders, it definitely sees the need of starting with a stabilized base of some sort.

This "paper" should not be considered as a technical discourse in any way, but a discourse on personal experiences and knowledge gained from listening to other people talk on the same subject. My subject refers to the establishment of stabilized shoulders and their maintenance. That last word, maintenance, is a big one in any highway organization, and the operation is a big item when considered from the dollars and cents viewpoint.

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* All illustrations were furnished through the courtesy of the Ohio Department of Highways.

In view of this, I am going to pass rather quickly over plain stabilized shoulders and come to a discussion of a type of shoulder that has proved itself easy to maintain—the turf or grassed shoulder. In a recent article in *Contractors and Engineers Monthly,* Mr. Wells, Landscape Architect with the New York State Highway Department, once again stated truthfully a proved fact—"sod shoulders are cheaper by far to maintain than aggregate shoulders". A shoulder, to be practical, must either be aggregate or turf. I am eliminating at this time any discussion of the bituminous or treated shoulder, this being another subject entirely. I consider this type as a pavement extension and not a shoulder.

What of the strictly stabilized shoulder, minus grass? Here is required the usual compaction of the subgrade. Various state specifications require or permit a mixture of coarse stone or aggregate with the

U. S. Route 23, Franklin County, Ohio. Shoulder has been stabilized, then seeded. Constructed, 1944; photo, 1945.

earth in the subgrade. Usually this consists of material from the old road, or chips, stones, and aggregate debris resulting from rock excavations. All of this is good, and furnishes a solid base. This base is then topped with aggregate material of various approved types, varying in

thicknesses and in width of application. There seems to be no general set standard. It mostly depends upon the plan engineer who put the finishing touches on that particular set of project plans.

This can be called the true stabilized shoulder, but it is a constant source of expense—dragging, blading, adding material, and rolling.

Experiments at Purdue University

Let us see if there isn't something better—at least something that will serve in, say, 99% of all cases. Is it possible to have a stabilized shoulder covered with vegetation, cheaply maintained? The answer is yes, proved many times in your own state of Indiana, in Ohio, in Virginia, and in other states.

To prove this statement, let me remind you of the work performed and the results obtained by your own State Highway Department, and the experimental work done for you by Dr. G. O. Mott, then Assistant Professor, Department of Agronomy, at this University. Dr. Mott set up his experiments as "trial plots" first, then carried them to your highways. His findings were as follows:

To have a stabilized turf shoulder, aggregates must be present to obtain sufficient supporting power for the anticipated load. To grow

U. S. Route 422, Geauga County, Ohio. Turf shoulders and median area on new project. Constructed, 1941; photo, 1942.

U. S. Route 127, Defiance-Williams counties, Ohio. "Side road" has been stabilized and seeded for use of market gardeners and farm equipment. Constructed, 1939.

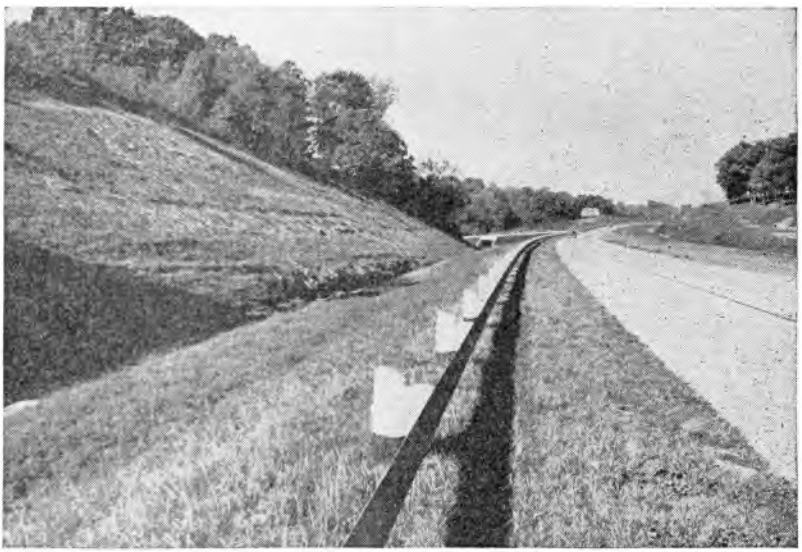
U. S. Route 30, Allen County, Ohio. Berm grading, not seeded. Grader operator scalped 100%. Shoulders were slightly high in spots. Weed growth is the only vegetation. Work done in spring of 1946; photo, July, 1946.

grasses, certain other materials must be present to create necessary favorable conditions.

It was found that pit-run gravel (bank-run, we call it in Ohio) or crusher-run stone, all passing a one-inch screen, will do the trick of furnishing the supporting power. These materials are standard or typical highway construction items. The depth or thickness of the material is governed by a study of existing or anticipated traffic on a given section of highway, considering the type of traffic, its volume, and the possible changes over a given period of years.

To grow grass in and on this aggregate one needs to provide sufficient pore space (or voids), proper pH (which means degree of acidity or alkalinity to satisfy the varieties of vegetation used), sufficient plant nutrients, and available water supply. By adding 5 to 10 percent of soil to the aggregates, some of the above items are taken care of. This soil, which should preferably be clay, aids compaction and at the same time the voids are preserved. It holds moisture, and the soil colloidal materials will hold the fertilizers which are added to give the main supply of plant nutrients.

Dr. Mott's work showed that the fertilizers—complete commercial types containing nitrogen, phosphorus, and potash—should be mixed throughout the soil and aggregates, and not applied as a surface feeding



U. S. Route 40, Muskingum County, Ohio. Shoulders have been constructed to regular highway specifications and seeded. Shale slopes have been seeded and mulched. Constructed, 1943; photo, 1944.

"Making" berm material by using a grader and creating a "false ditch." No use trying to seed here.

Berm roller. A manufactured roller, weight 500 to 1,500 pounds, depending on filler.

Berm drag and roller, used in spring. Roller is homemade. Weight—empty, 1,200 pounds; filled with sand, over 2,000 pounds.

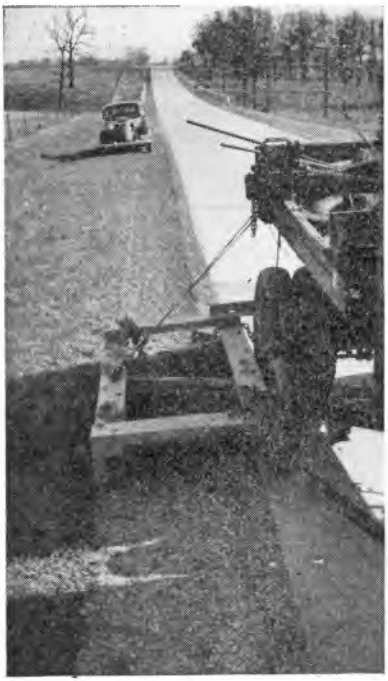
in the original operation. Later applications may be needed, however, as a stimulant to further growth and to promote root penetration. It was found that surface fertilizing prevented or discouraged root penetration if not preceded by the earlier thorough mixing in the original operation.

It was shown that grasses suitable to Indiana and Ohio will grow luxuriantly in the aggregates, provided nutrients were added, and regardless of a considerable depth of aggregates, even though this material was compacted to a density comparable to that required in roadbed construction.

Pit-run gravel, having a larger percentage of "fines," will support grass with only a 5% addition of soil, whereas crusher-run stone will require 10%. Nitrogen and phosphorus were found to be the most needed nutrients; potash was less important. A slight surface layer of top soil aided in seed germination but is not too essential. A straw mulch aids materially in preserving moisture, hastening germination, and preventing erosion until the grass takes over.

Ohio Practice

The above procedure puts the horse in front of the cart. In Ohio a number of years ago we started a practice of shoulder work which now may seem to put the cart first. We went on the premise that a regularly compacted earth shoulder, turfed over, would bear the greater



Left—Berm drag without roller, used excepting in spring.

Right—Berm drag in operation. "Tailgating" extra berm fill material.

percentage of our shoulder traffic load. In this we have been very nearly right—right enough to justify the program, still continuing.

Our shoulders, in fill, are compacted in eight-inch layers, compaction coming up to 90 to 100% minimum field compaction. The top two inches is not compacted and consists of such top soil or good earth, if any, resulting from scalping operations. This is a part of our standard construction specifications. Shoulders in cut are left pretty much as found, excepting that top soil is applied, in most cases, necessary excavation being made to allow for it.

From here we fertilize, lime, seed, and mulch, working right up to the edge of the pavement. And then we open the road to traffic.

Generally within a period of three to four months we know whether this type of shoulder will take the type and volume of traffic. If it can't take it, and such cases are few, then the maintenance department comes in and places aggregate to such depth and width as is judged necessary to do the job.

However, even here there are variations. Quite frequently it is sufficient to place some coarse stone, crushed limestone being the best, over the shoulder and roll it in, letting the grass continue to grow in the intervening spaces. The cost of a possible two or three treatments of this sort, if they will eventually give a satisfactory stable surface, is cheaper than the constant maintenance of the open or solid aggregate shoulder.

Shoulder Maintenance

The problem of maintenance of both types of shoulders—the straight aggregate and the grassed—can be briefly outlined. The maintenance of the aggregate type is best performed by equipment that will smooth the stone, level it with the pavement, and permit the even application and distribution of new stone when required. The box-drag as developed in Ohio does a swell job of this. In our opinion, the blade grader for general use is obsolete and condemned for this purpose.

Maintenance of established grass shoulders consists of "spaced" mowings, rolling, sweeping, and occasional light "scalping" in the early spring, and such repairs as are necessary to mend minor damage.

Good engineering is essential from start to finish. The grade of the shoulder for surface drainage and the handling of the underground water must receive due consideration. Shoulders not stable enough to handle the known traffic should not be camouflaged with grasses. "Buildup" of turf shoulders is almost a certainty, but can and should be handled or corrected judiciously and economically. Every chance should be given to the turf shoulder before abandoning it to the costly maintained shoulder. One rut or even a dozen may not mean that the traffic is too severe. Mend these early ruts with "like" material, and see whether the results are satisfactory or not before taking drastic action.