SHOULDER CONSTRUCTION PRACTICES IN MICHIGAN

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At the request of the Chairman of Project Committee on Shoulders, Highway Research Board, this report has been prepared covering in general, the common practices of the Michigan State Highway Department in the construction of stable turf shoulders. The report includes a discussion of the types of construction employed, the construction procedure for each, including final preparations and seeding and subsequent maintenance.

GENERAL SHOULDER CONSTRUCTION - Michigan employes in general, two types of shoulder construction, depending upon traffic conditions. The most widely used is the standard 8 foot width designed for turf growth. The other type is employed only on the more heavily traveled routes, especially from the standpoint of commercial traffic where it is difficult to maintain grass growth adjacent to pavement. In this case, the shoulder is made 10 feet wide with a two foot stabilized aggregate ribbon adjacent to pavement edge. The remaining 8 feet between stabilized ribbon and shoulder edge is designed for turf growth.

Construction Procedure for 8 Foot Standard Shoulders - Specifications stipulate that shoulder construction should progress in the following manner. See figures 1 and 2.

The earth grade is constructed according to dimensions shown on the plans. For well drained granular soils including bankrun gravels, sands and loamy sands having no plasticity, no subbase is required. When plastic soils, such as clays, sandy clays, and silty clays are encountered, a 15 inch granular cushion is constructed on the prepared subgrade. The foundation material is thoroughly consolidated by normal equipment operations during construction of the project. Laboratory density control is required, only on special projects.

The grade for the finished pavement surface is set so that the trenching for surfacing, including curb or gutter, if called for, together with any special shoulder surfacing material, will provide ample material to construct the shoulder to a height of 2/3 or 3/4 the depth of the pavement surface.

Sufficient selected binder soil is next added to the existing shoulder material to bring the shoulders to the surface of the pavement or slightly higher.

Finally, the binder soil is carefully mixed with the shoulder material to a minimum depth of 6 inches, after which the shoulder is thoroughly consolidated by excessive passes of tractor or truck equipment and then trimmed to grade.

The seeding of the shoulder is performed by the Maintenance Division of the Highway Department instead of being a part of the contract.

Construction of Partially Stabilized 10 Foot Shoulders - The construction of this type of shoulder is essentially the same as that previously described, except that at the end of the last construction stage, the shoulder material adjacent to the surface is removed by trenching to a width of 24 inches and to a depth of 6 inches. This space is refilled with stabilized aggregate surface coarse material, as described later, and thoroughly compacted. The balance of the shoulder is seeded for turf by Maintenance Division.

The stabilized ribbon is eventually given a double seal treatment by Maintenance Division when shoulder conditions have become stable and when conditions warrant it.

Seeding of Prepared Shoulders - Seeding of the constructed shoulders is performed by the Maintenance Division of the Highway Department. From experience, this has proved advantageous. It permits early completion of the project by the contractor and permits seeding to be done at the most opportune time under the most favorable conditions. The seeding operation takes place in April or May following completion of the project by the contractor. Shoulder preparation and seeding is not done in the fall because of soft shoulder conditions which prevail throughout the fall and winter months. A common practice employed by the Department to protect shoulder surfaces from "over-winter"erosion, is to apply mulch material to the outside three feet of shoulder surface and carry this material onto the inside ditch slope in such a manner that the rather sharp break at the point where the shoulder edge and inside ditch slope intersect, will be protected. Seeding into this mulched area is done the following spring.

The completed shoulder as left by the contractor, is brought to a friable condition by scarifying, harrowing or disking to a depth of 3-4 inches as required by the type of soil and degree of consolidation of existing shoulder material. At the beginning of this loosening process, fertilizer is applied by mechanical spreaders or by hand methods at the rate of 1200 pounds per acre. The fertilizer consists of 800 pounds of an organic fertilizer, such as Milorganite and 400 pounds of the chemical fertilizer 10-6-4 when available. A 6-10-4 fertilizer is sometimes used in place of 10-6-4 when the latter is not available.

Following this operation, mulching material is worked into the top one inch of the shoulder by disking or covering slightly by waste shoulder soil. The "working-in" mulch operation is done primarily to prevent the shoulder material from being displaced by the suction caused by traffic as well as wind and water action. The most beneficial results of mulch are realized when the material lies flat on the soil surface and is not anchored in the soil in sort of a "stubble" appearance. It should not be too thoroughly incorporated into the soil. The mulch material usually consists of hay or straw obtained locally and applied at the rate of 2-3 tons per acre.

A seed mixture consisting of 60 parts of Perennial Rye Grass, 20 parts of Red Top and 20 parts of Alsike clover is applied to the mulched seed bed at rate of 50 pounds per acre. From experience, this seed mixture has proved successful and economical. Seeding is usually accomplished by a graindrill with seed tray or, in some cases, by a spinner type seeder. Following the seeding operation, the surface

may be rolled or left to be consolidated by rainfall. A fairly heavy chain, similar to a logging chain, is often dragged across newly seeded areas to lightly cover the seed.

The cost of above seeding and mulching operation costs approximately $100.00 per acre of shoulder 8 feet wide. The seeding alone costs approximately $50.00 per acre.

Subsequent Maintenance on Shoulders - In the event that traffic volume is of such a nature that turf cannot be successfully maintained over the entire width of shoulder, the following so-called ribbon treatments are resorted to by the Maintenance Division, depending upon traffic conditions. (1) Stabilized gravel varying from 2-5 feet in width, or stabilized aggregate 2 feet wide with a seal coat, or a stabilized aggregate base 2 feet wide with a 2 inch bituminous plant mix wearing coarse, usually oil aggregate mixture. See Figure 3. Under extremely bad conditions of traffic wear or erosion, such as on hills, the entire shoulder is sealed with a bituminous treatment.

Turf shoulders which have subsided along the metal are built up by light applications of a soil-gravel mixture of proper thickness to allow the grass underneath to penetrate through and reestablish itself.

From past experience, the Maintenance Division has determined that turf shoulders can be maintained successfully when total average daily vehicle count is less than 2000 on pavements less than 22 feet in width. Above that figure it has been found necessary to resort to a modification of the turf shoulder, such as the use of stabilized ribbon construction adjacent to the pavement edge.

Shoulder Materials - Fundamentally, the soil material commonly used for shoulder construction will consist of bankrun sand or gravel, dune sand of an approved granular mixture. According to specifications, this material must all pass a 2-in. sieve with 60-100 percent passing the 1-in. sieve and 0-25 percent passing the No. 4 sieve, and the loss by washing of the material shall be limited to a maximum of 10 percent by weight of the entire sample. If the above type of material is not available within economic hauling distance, other granular materials may be used on basis of laboratory tests. This material may be comparable to the Public Roads Administration classification of A-3.

Salvaged topsoil is used extensively for stabilizing granular soil material. It is selected on the basis of the stability it will furnish and the fertility required for grass growth.

Binder soil for stabilizing 22A material usually consists of a loam or sandy clay or clay. The material is selected on basis of Plastic Index with limits between 9 and 15. This corresponds to Public Roads Administration soil classification A-2.

Surfacing aggregate for stabilized ribbon construction consists of 22A material meeting following requirements to which binder soil is added to give required stability with a resulting Plastic Index of the mixture between 1 to 6.

22A Material

Sieve Size	Percent Passing
3/4 Inch Sieve	100%
3/8 Inch Sieve	60-80%
10 Inch Sieve	25-40%
200 Inch Sieve	0-10%*

*Between these limits the percentage passing No. 200 shall be determined by Laboratory tests.

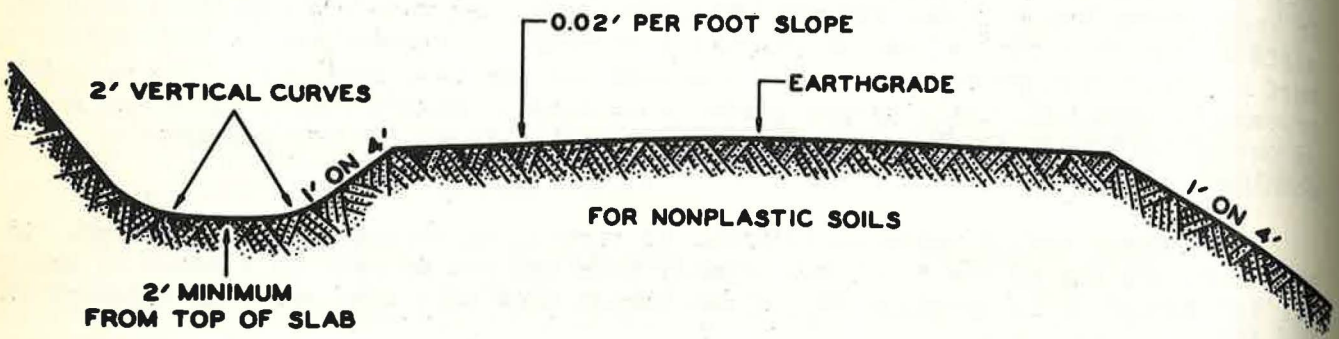
CORRECTION OF SHOULDER BUILD UP - Turf shoulder build up correction is usually left to the discretion of district maintenance personnel. In general, the following practices prevail. For normal build up, not more than about one inch of the turf is removed at any one time by grader blade during growing season in the Spring and Fall. In cases where the shoulder becomes considerably higher than the adjoining pavement surface, the shoulder is lowered gradually by removing successive one inch layers of turf as grass root growth progresses downward and new turf develops. This scraping process is continual until proper grade is obtained. Occasionally, reseeding is necessary on this type of work. This is done without any further preparation of the shoulder.

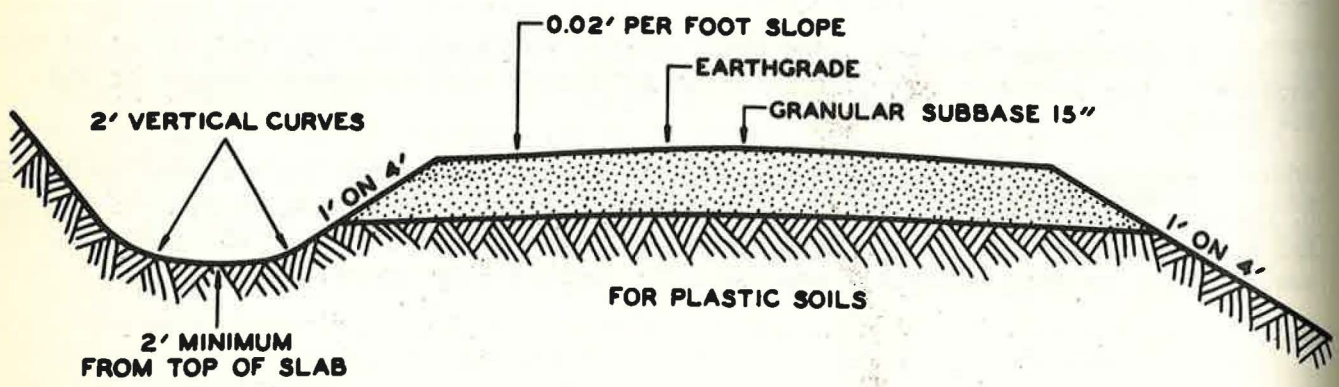
Another method quite successful, is carried on during the winter thaws. At that time the top of the shoulders usually thaw and become soft to a depth of one to two inches and it is possible to cut and scrape this soft turf material sideways into the ditch.

Rolling, when shoulders are soft, has not been employed to control shoulder build up.

A pulvimixer has been used with success to loosen the top inch or so of the shoulder. The loosened shoulder material is then bladed to remove excess or fill low spots.

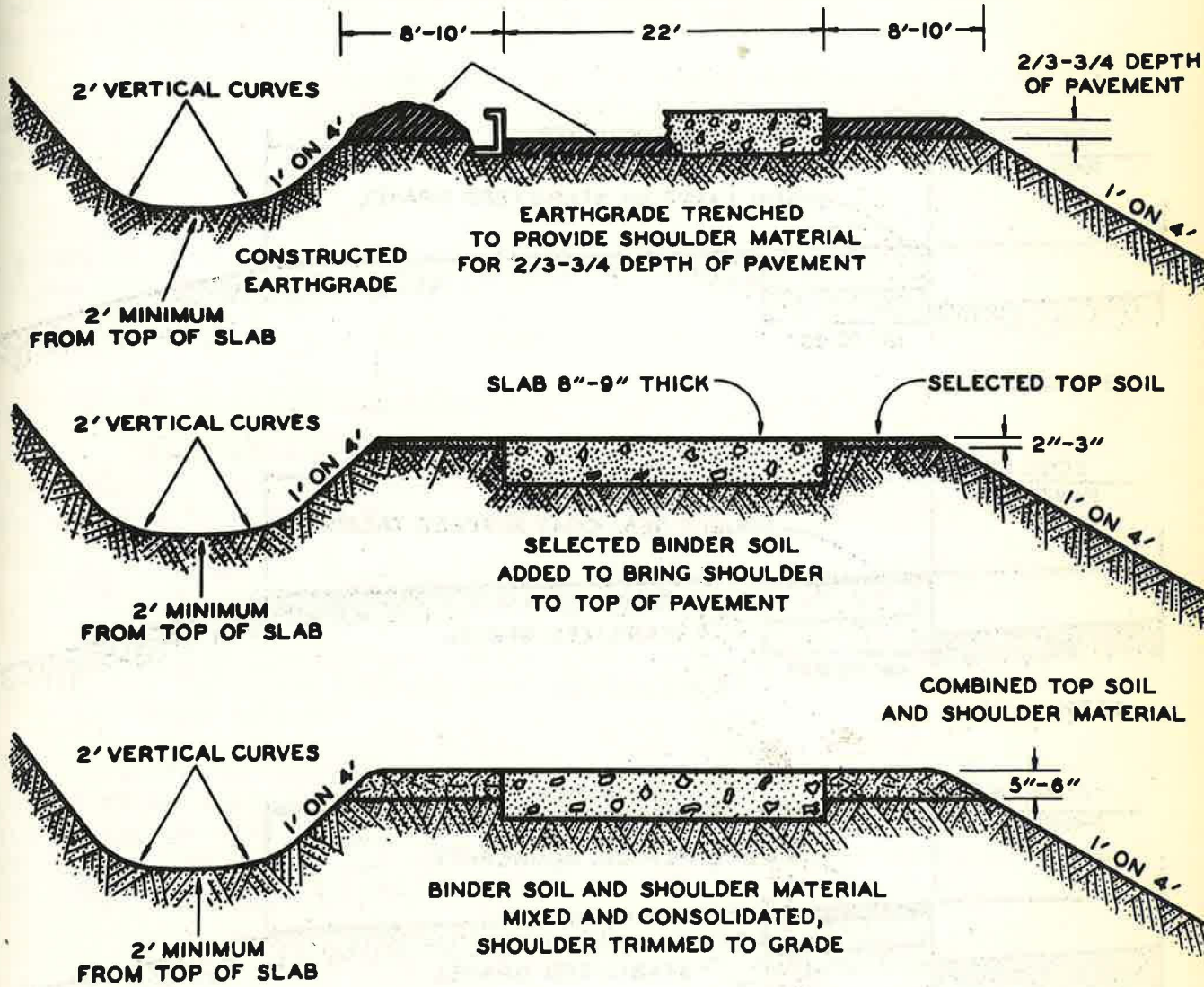
ACKNOWLEDGMENT - Acknowledgment is made of the work on this report by Mr. E. C. Eckert, Chief Forester, Maintenance Division in charge of seeding operations, and Mr. A. E. Matthews, Assistant Soils Engineer, Testing and Research Division, for his contribution on soil materials and shoulder construction operations.



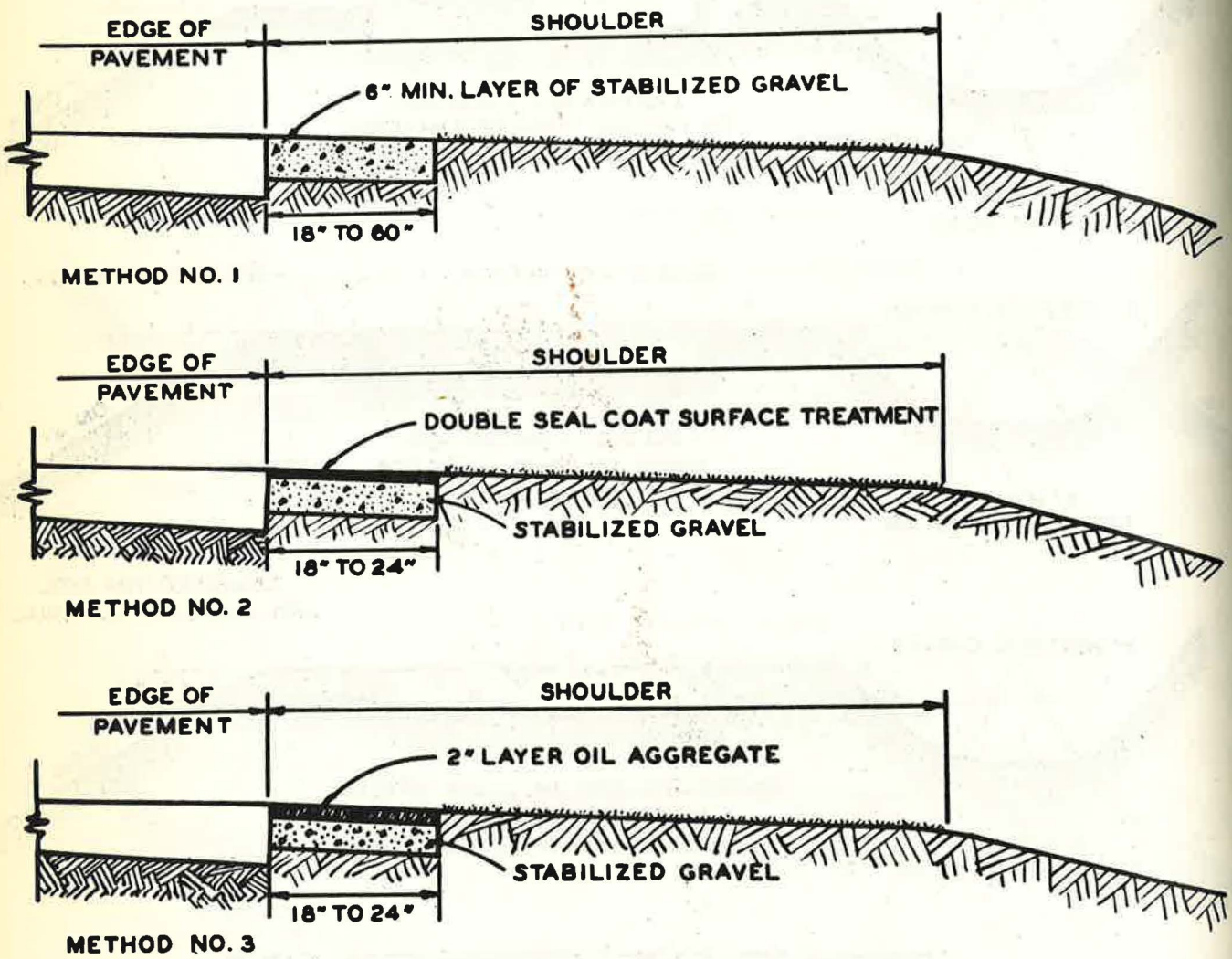


TYPICAL EARTHGRADE SECTIONS

Figure 1



METHOD OF CONSTRUCTING SHOULDERS



STABILIZED SHOULDER STRIP METHODS

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Figure 3

COMMENTS

The hazard involved in having a "drop-off" at the edge of the pavement slab was discussed by various committee members. Ohio and Louisiana for example, roll their earth shoulders to a point one inch below the traffic lane surface.

Mr. Finney maintained that all drop-off should be eliminated in shoulder construction. In any case he said the big problem in Michigan's gravel and sand shoulders, was to build-up the usual natural subsidence of such gravel shoulders during maintenance operation.

Some took position that minor drop-off of shoulder at edge of pavement was not a serious traffic hazard. Others believed that a drop-off of more than an inch or so was very dangerous to traffic.

Apparently this question of drop-off hazard is a moot one.

Comment by a Committee Member

There appears to be strong evidence on the shoulder build-up problem in these discussions concerning Mr. Iurka's report and the above paper, by Mr. Finney, leading to these following tentative conclusions:

(1) States such as Ohio or North Carolina with characteristic clayey shoulder soils report shoulder build-up as a serious problem.

(2) States like Michigan, Maine, etc., with typical gravelly shoulder soils report that shoulders subside rather than build up after frost action.

It seems therefore a fair conclusion that turf cover is of minor importance in shoulder build-up. Most of build-up appears to be caused by the fact that fine-textured shoulder soils tend to swell when acted upon by frost or water. Gravelly or coarse sandy soils do not swell when saturated with water, nor does frost heave cause permanent shoulder build-up in such granular soils.