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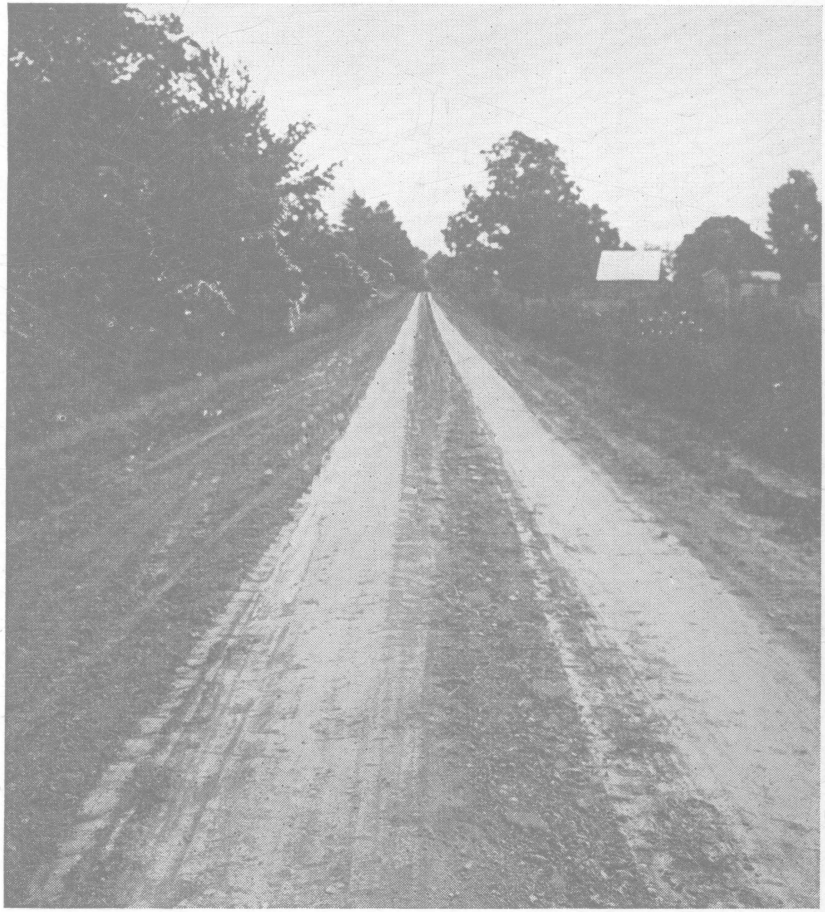
The Grading of Earth Roads



"THE BEST EARTH ROAD IN OHIO" *(see page 18)*

By

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With a Statement by L. A. Boulay, Director of Highways and Public Works

Introduction

FROM observation in the past few years in more than half of the counties in the state some interesting conditions have been brought to light relative to our public highways.

There is an enormous earth road mileage in the state, especially in the eastern and southeastern sections. In some counties in these sections the earth roads comprise 90 per cent of the total mileage. Material and financial resources will not permit of the general improvement of many of these roads for years to come, except by grading and maintaining the present earth road.

A large percentage of this earth road mileage is under the jurisdiction of the township trustees, most of whom are farmers, who do not have the time to devote to a detailed study of proper grading and maintenance methods.

Frequent change of trustees by election, and the small remuneration for service of such officials as fixed by statute, have been contributing factors to present earth road conditions.

In the past 18 months of experimental work on grading by the Department of Agricultural Engineering of the Ohio State University, it has been demonstrated that an earth road can be improved 100 per cent and maintained in comparatively good serviceable condition at small cost.

In order to transmit the information that has been acquired through a number of grading demonstrations, this bulletin is being offered to illustrate and describe, step by step, the necessary operations required to drain, construct, and maintain a standard earth road in the most economical way.

Unfavorable weather conditions prevented accurate cost accounts of the experimental projects, therefore costs will be referred to only in a general manner.

The Grading of Earth Roads

The following statement of L. A. Boulay, director of highways and public works in Ohio, sets forth the necessity of grading, draining, and maintaining the earth roads of the state, thus allowing the farmers easy access to town and markets:

> The earth road is the primary and original type of road, and forms the foundation for any further improvement. Ohio today has approximately 46,000 miles of earth roads, 1650 miles being on the Inter-county Highway System.
>
> The practice seems to have been to improve our roads, both state and county, with hard surface, or with stone and

Illustrating Ohio's "Mud" Tax

gravel, and allow the earth roads to remain in their original state, forgetting, as we have, that these earth roads in a great many instances can be graded, drained, and maintained for a very small amount of money, and will save in highway transportation in one year many times what the cost of maintenance amounts to. Earth roads are allowed to remain in an impassable condition when a little money spent on them will effect wonders if done in an intelligent and systematic manner.

A number of the states have a regular system of earth road maintenance on state, county, and township roads, but

Ohio seems to be rather lax in this regard. The function of any road-building organization, whether state or county, is not so much the building of high type roads, as the getting of traffic over the roads.

Drainage and systematic dragging of earth roads on the patrol system should be given serious attention by township trustees, for, with the limited finances available for township work, this is the only way to open routes and keep the people from isolation at times.

The farmer at one time was content with his weekly visit to the nearest town, but nowadays he wants to visit his neighbors when the daily chores are done, he wants to go to a movie with his family, and to attend the public meetings. He also wants to be able to send his children to an acceptable school, and to be within easy access of a doctor, and a church where he may worship.

The only way that this can be accomplished in sections where there is a limitation on finances is to develop some scheme of earth-road maintenance, so as to provide transportation facilities to the farmer for as many days in the year as possible.

A chain is only as strong as its weakest link, and a road is only as good as its worst spot. Mud holes that retain water and moisture long after the rest of the road is dry should not be permitted to exist. The cost of hauling machines through these barriers to traffic will, if spent intelligently, more than remedy the evil. Drainage alone will provide the answer in nearly every instance. The "mud" tax is the largest tax that is paid today, because it is a hidden tax and can hardly be estimated in dollars.

In the words of T. H. McDonald, Chief of the Federal Bureau of Public Roads, "we are paying for these roads whether we have them or not," because lack of highway facilities means lowered property valuations, inaccessibility to markets. isolation, and higher transportation costs.

L. A. BOULAY,
Director of Highways and Public Works.

Earth Road Troubles

The outstanding cause of bad roads is poor drainage or a total lack of it. Side ditches frequently are found to be higher than the middle of the road, and in some places is found one ditch instead of two, and that one in the middle of the road. Road drainage is just as essential as farm-land drainage.

Fig. 1 shows a wooden culvert, completely clogged with dirt, removed from the road prior to grading operations. At the place from where this culvert was removed the water had no means of escape other than by flowing over the road and by seepage. Drainage is the all-important and primary consideration in road grading.

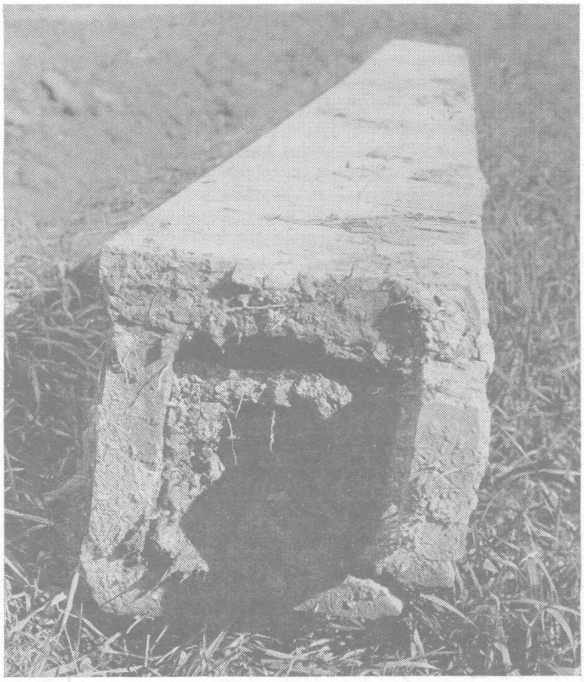

Fig. 1.—Culvert clogged with dirt, removed before grading

It is possible to have a well-drained road surface and an ideal side ditch, but yet have a poor road because of its narrow width and high crown. Fig. 2 illustrates this point very well. The position and slope of the machines plainly indicate the width of road and type of crown, and shows a road which is very dangerous and difficult to use when the surface is slippery. Six feet additional width would insure a more serviceable, more easily maintained, and less dangerous road.

Road-making Demonstrations

Clearing of the Right of Way

The sections of road that were used in these projects were of fairly good alignment, but entirely too narrow as a roadway and right of way. Underbrush, stumps, and trees were removed by township trustees.

Where right of way is too narrow there is no better time than at this stage of development to make the expansion at a minimum of cost. It is real economy to establish, in the beginning, the proper grade, alignment, and drainage structures, so that further improvements may be made at a minimum of time, cost, and inconvenience to traffic.

Fig. 2.—Wrong method of earth-road grading. Crown is roof-shaped and too narrow. It is dangerous when surface is slippery

Equipment

In each of the projects an 8-foot grader was used. It was equipped with a detachable back sloper and a steering tongue, permitting the grader to work offset to either side of the tractor.

Operation of Grader

The secret of successful and economical road grading lies in the ability of the grader operator. Hence, some general points, together with illustrations, will serve to aid those whose work it is to operate the grader.

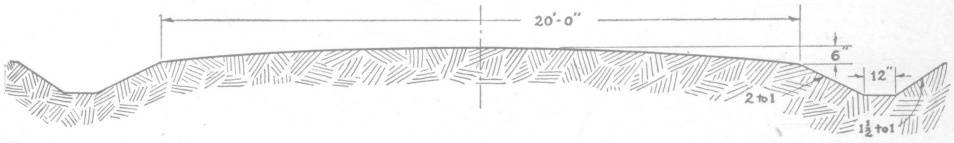

Fig. 3.—Cross section of standard earth road—note gentle curvature of crown and side ditch

The first round is the most important, and on this round the operator should be guided by stakes to make the cut true to line; this round is the guide for all future rounds, and is also the first step in cutting the ditch.

Figure 3 shows a cross section of a standard earth road. The driving surface is at least 20 feet wide. It has sufficient crown to insure good drainage, but is not too steep for safe driving. Note the depth and slope of side ditches.

Fig. 4.—Condition of road just before grading operations began. Photographed June, 1924

In Fig. 4 is shown a road just before grading, the condition of which is characteristic of thousands of miles of Ohio's undeveloped earth roads. The photograph was taken June 16, 1924.

In Fig. 5 is shown the same road after the first round has been made, removing sods from site of ditch to a place in the road which will serve as a shoulder.

Fig. 5.—Sods removed from site of ditch to the shoulder line in the first round

Fig. 6.—Another view of the first round, showing how sods are cut and properly placed

Fig. 7.—Ditch is being deepened in second round. The loose earth is moved over the top of sods

Fig. 8.—Back sloper attached in third-round operation; first step in shaping side ditch

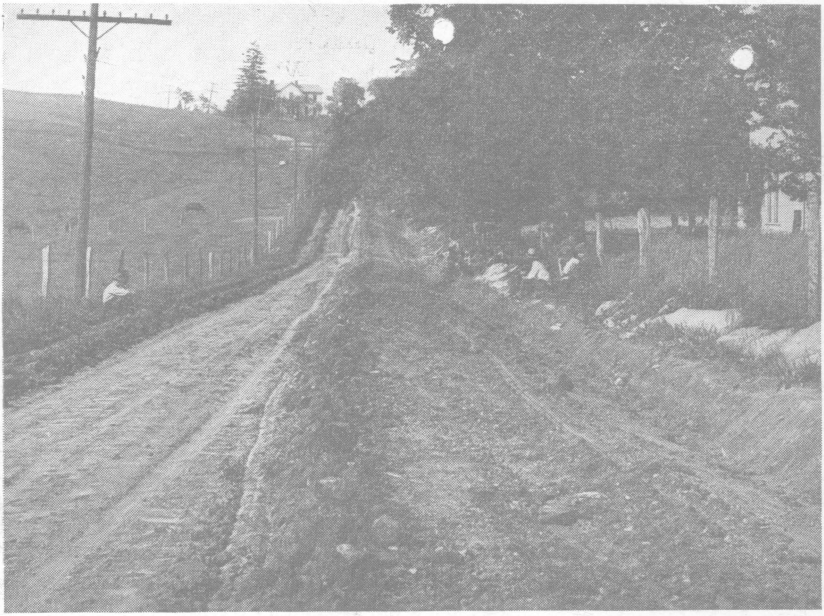

Fig. 9.—Loose earth of second and third rounds has been moved toward the center of road

Fig. 10.—Completing the operation at the same point as shown in Fig. 9, moving in the opposite direction

The grader blade should not be set too deep the first round in order to cut the sods thin and pliable, thus making the total volume of sods small and easy to cover. When grading is complete road surface should be free from sods.

In Fig. 6 is shown a front view of the grader in operation on the first round.

By referring to Figs. 10 and 11 the relative positions of the tractor and grader may be observed. There are distinct advantages to the offset hitch. It keeps the tractor out of the ditch and oftentimes out of mud and water, thereby providing the most effective footing.

Fig. 11.—Giving the finishing touch to the side ditch

In the first two rounds the sods are cut to pieces and rolled down. In the third round the loose earth is transferred toward the center of the road, leaving the sods unmoved. The successive rounds of the tractor upon the shoulder create in the finished road a firm and well-defined shoulder.

In the second round, as shown in Fig. 7, a deeper cut of the ditch has been made and the earth is being delivered upon the shoulder of the road at the heel of the blade.

Figure 8 shows the back sloper attached in the third round. This is the first step in shaping the ditch in addition to making a

Fig. 12.—Transferring the loose earth of the former rounds to the center of the road

Fig. 13.—Grading operations completed. Several rounds of the road drag will give a smooth surface

deeper cut. The earth is delivered at the heel of the blade as in the second round.

Figures 9 and 10 illustrate the fourth round of the grader. The loose earth is being transferred toward the middle of the road. The draft being lighter in this round the blade should be so set as to transfer loose earth a maximum distance with one operation.

Fig. 14.—Ideal side ditch construction of graded road

On account of lighter draft, time and equipment can be better utilized by speeding up the tractor on this round.

In Fig. 11 the side ditch is given the final touch, namely, another good draft of loose earth is moved just inside the shoulder line. This is transferred toward the center of the road in the next round.

The ditch shown in this figure was given an average depth of 18 inches. Width of driving surface of the completed road was about 20 feet. The distance from shoulder line to the bottom of the ditch was 4 feet. This afforded plenty of driving surface and a sufficient drainage channel, shaped to eliminate danger.

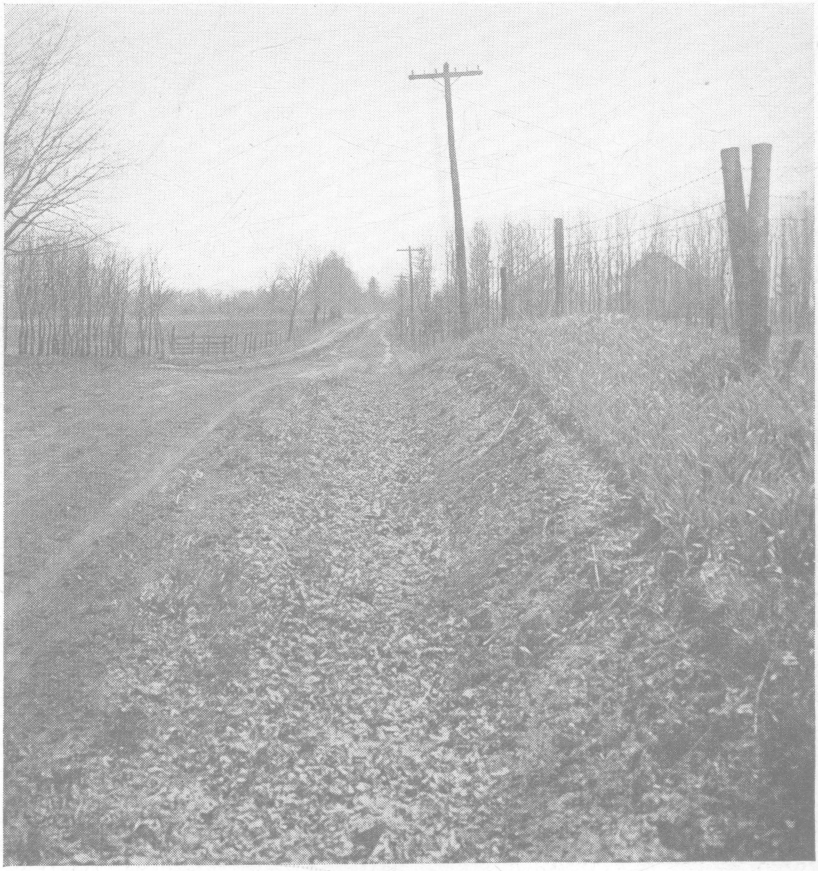

Fig. 15.—Same ditch as in Fig. 14, photographed one year later. Note how well the shape has been retained

Figure 12 illustrates the beginning of the last round of the grader moving the loose earth to the center of the road. In Fig. 13 the operation in the last round is complete. The surface of the road at this stage is rather rough. To give a smooth surface it should be finished with a road drag or patrol grader which breaks up the clods, fills the depressions, and compacts the earth.

Items of Grading Costs

Several factors influence the cost of earth-road grading. Most important of these is the original condition of the road with respect to width, drainage, trees, and brush. The type of soil and the weather conditions are other important factors. If the soil is a wet, heavy clay, the blade will not scour readily and more rounds will be required.

Under average conditions, ½ mile is a good day's work for two men with an 8-foot grader and a 15-30 tractor. It is important to have plenty of power.

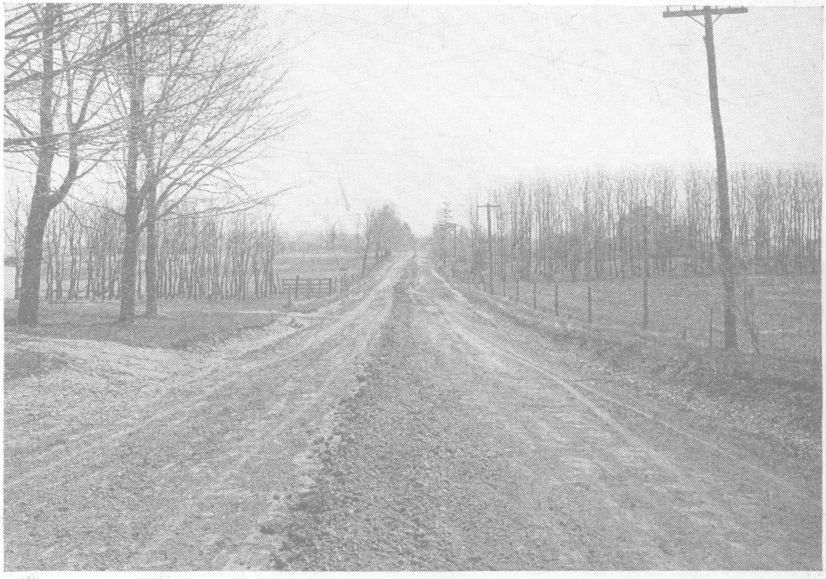

Fig. 16.—Graded road after one year's service with consistent maintenance

In most cases, it will be necessary to lengthen the culverts. Many will have to be replaced by larger ones. It is usually advisable to remove small culverts before grading operations begin, and replace them after the work is completed.

Side-ditch Construction

It is one thing merely to construct a side ditch, but quite another to construct it so that it will be little affected by freezing and thawing. In Fig. 14 is shown an ideal type of side ditch photographed immediately after road was graded. Figure 15, photographed just one year later, shows how well the side ditch has

Fig. 17.—Graded road upon which maintenance has been neglected

Fig. 18.—Road upon which both grading and maintenance have been neglected

retained its original shape. A little cleaning will make it good as new.

An even and gradual slope of the ditch from the shoulder of the road to the bottom of the ditch will permit a good response to the grader blade.

Maintenance

On the cover page is shown a road graded May 2, 1923. This photograph was taken in August, 1924, after nearly 16 months of maintenance and service. This road is a product of consistent maintenance.

Upon it the value of winter dragging was tested to a point beyond question of doubt by Horatio Markley of Morrow County, Ohio. Floating was done just before a hard freeze in the late afternoon after traffic was practically suspended for the day. This provided a hard, smooth surface as long as the freeze lasted.

This road before grading was frequently impassable during the winter and spring months, and a poor road at any time—very narrow and minus drainage. After grading and consistent maintenance it renders splendid service about nine months in the year, and is passable throughout the year.

In Fig. 16 this road is shown as it appeared May 2, 1924, just one year from date of grading.

Figure 17 shows the same road a mile beyond, as it appeared the same day. This road was graded two years prior to this date, but the maintenance feature was neglected.

In Fig. 18 is shown another section of the same road, photographed at the same time. It is ½ mile beyond that shown in Fig. 14, in the opposite direction, plainly indicating a total lack of grading and maintenance.

Maintenance Costs

It cost $25 to resurface, deepen, and clean side ditches on ½ mile of road as shown in Fig. 14, while it required the same amount to repair one mud hole in a road similar to Fig. 16, just a mile distant. Maintenance without proper drainage is of little consequence and a certain economic loss.

The annual cost of reconditioning the properly graded earth road is small compared to that of the undeveloped road.

Persistent maintenance is the price paid for good roads.

THE OHIO STATE UNIVERSITY, COLUMBUS, COOPERATING WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE

Agricultural College Extension Service, H. C RAMSOWER, *Director*

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