

In many instances, a smaller structure, properly constructed as to depth of footings, skew, etc., and with the channel properly cleaned and straightened, will serve the location better than a much larger structure with a channel that is crooked, or filled with sand bars or islands, and in which the water strikes the road grade or wingwalls first, and then meanders to the bridge opening.

It is fully as important to clean and straighten the channel below the structure, if needed, as it is above, because it is useless to carry the water to the bridge opening unless provision is made to carry it on down stream away from the structure and the road grade.

I have noticed, in driving over my county, and also in other counties, that many culverts do not serve the purpose intended, because it is almost impossible for the water to enter them, and if it does eventually enter, it can not drain away below.

Many of the small bridges and culverts could be greatly benefited by handwork on the channels, and a crew of men could be employed for some time in doing this work. Their work would be valuable, not only in providing better drainage of road grades, but no doubt in saving many small structures from destruction in flood times.

Many of these small bridges were constructed 30 or 40 years ago. The construction was not of the best, in many cases, very crude. But there are hundreds of them in our county, as well as in many of the counties of the state, and it would require many thousands of dollars to replace them all with modern structures.

If these structures can be made to serve another 10 or 20 years by an expenditure of \$25 to \$50 in channel work, it should be considered a good investment.

The larger channels call for dredge work, and it is surprising the amount of this kind of work that can be accomplished at a bridge site for the expenditure of a few hundred dollars.

A PROGRAM OF EARTH ROAD IMPROVEMENT

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In discussing this subject, it might be well to review briefly the cause for my county's suddenly finding itself the owner of a large number of unimproved earth roads. Exclusive of state highways, we have approximately 900 miles of roads in Ripley County. Prior to 1932, some 400 miles of these roads constituted the county system, all of which were surfaced with crushed stone.

In 1932, when the special session of the state legislature passed the law turning all township roads over to the county, only 100 of the 500 miles of township roads in Ripley County were surfaced. Of the 400 miles of earth roads, at least 200 miles were used as much as many of our county roads previously built by bond issue, many of the former being mail and school bus routes.

The fact that these roads were now classified as county roads and that the county would receive a larger share of the gasoline tax, led people to believe that the county would have more money available for roads than it needed, and that it would be an easy matter to get these earth roads improved at once. As a result, at every commissioner's meeting we were swamped with delegations requesting improvement of their particular roads.

Because of these many requests, we had to decide on some definite program for selection of the roads we would improve and then stick to it. In the first place, we decided that we would put no surfacing material on a road until it was properly graded and drained. Much material had been wasted in previous years through the surfacing of ungraded and undrained roads. In making our selection of roads to be improved, we have with few exceptions considered the following in the order named:

- (1) Roads which were both school bus and mail routes.
- (2) Roads which were either school bus or mail routes.
- (3) Roads which in proportion to their length would get the most homes out of the mud.
- (4) Roads which would shorten the distance between two important local points.

In addition to factors such as these above, special features such as a rural school, church, or cemetery would be given consideration.

In our effort to provide every home with at least one outlet road usable the year 'round, in several cases we have surfaced only a part of the road length. For instance, on a mile of earth road connecting two stone surfaced roads, there might be houses a quarter of a mile from each end. If this road was not a mail or school bus route, we usually graded the entire road, but surfaced only the portion that had to be used as an outlet to the surfaced road.

After deciding on our plan of selecting the road to grade, our next problem was equipment. With what money we had on hand, we purchased enough additional equipment to give us two grading units, each consisting of one 50 H.P. crawler-tvp tractor, one ten-foot-blade grader, and one two-yard scraper. These units work separately, one in the north and one in the south half of the county. In addition, we employed a former contractor with a similar unit for a part of each grading

season. For structure work we organized a bridge crew and equipped it with a truck and a one-bag concrete mixer.

During 1933 and 1934 we did not use any certain standards in grading. Several townships consolidated their schools, and the demand for grading was so heavy that under the circumstances we felt mileage was more important than a wide grade. On level land where the fences were far enough apart, we tried to get a 20-foot roadbed, but in cuts and hilly sections the width varied considerably.

However, in 1935 we started staking out our roads, improving alignment and grade, and getting a full 20-foot roadbed, with 26 feet between ditch lines. Our standards now as set up by the state highway department under the 1937 Act for a one-lane road are as follows:

- (1) 40-foot minimum right-of-way
- (2) 22-foot roadbed
- (3) 2-to-1 slope from berm line to ditch
- (4) 1½-to-1 back slope

During 1938 we constructed 2½ miles under these specifications, after approval by the state highway commission.

After a road was selected for improvement, we first went over the road with the assistant supervisor for the particular township in which it was situated, checking up on the necessary culverts and bridges and setting right-of-way and ditch-line stakes. Grade stakes were set only where major changes were necessary. The sizes and types of drainage structure having been decided upon, the bridge crew was sent on the job to do the work necessary before the grading started. As soon as possible, the grader unit started work with the assistant supervisor in charge. Our ditches average 18 inches in



Fig. 1. Clearing and grubbing preparatory to grading, draining, and surfacing an unimproved earth road in Ripley County.

depth and are usually V-type, and we leave from 4 to 6 inches of crown in the roadbed.

For drainage structures we use corrugated metal pipe in all cases where a 24-inch or smaller diameter will take care of the drainage area. In cases where footing conditions are bad, we sometimes use pipes of larger diameter. However, we have found that we can build a small culvert for less than we can buy a pipe when openings greater than a two-foot diameter are required. Except in special cases, pipes of sufficient length to eliminate head walls were used. We have in our county an abundance of good building stone, and in most cases we can get a stone foundation for footings. In construction of culverts and small bridges, we build our abutments heavy enough to take care of a reinforced concrete floor. On the more lightly travelled roads, we usually use a native timber floor, consisting of black locust stringers and white oak flooring. A floor of this type can be built at little cost, will last several years, and can be replaced at some future time with reinforced concrete.

As soon as the grade is completed and opened to traffic, it is maintained with motor graders. By fall it is usually well compacted by traffic and in good shape for surfacing. For surfacing material we use crushed limestone, No. 7 size, all passing through a one-inch square screen. When we are ready to surface the road, we use a motor grader to remove most of the crown, starting at the center and pushing the dirt to each side, leaving a small ridge approximately 5 feet each side of the center line. The crushed stone is then spread with trucks to a depth of 4 inches, and a width of 10 feet. This requires approximately 660 cubic yards per mile. The road is then regularly maintained, and any weak places that develop are



Fig. 2. A typical graded and drained section of earth road ready for crushed stone surfacing in Ripley County.

repaired. With regular maintenance and a small amount of stone added each year, these roads have held up much better than we anticipated.

The cost of this type of road, of course, varies considerably with the topography. However, I can safely say that our average cost on these roads, where there are no major structures, is about \$1,500 per mile, divided as follows: grading and draining \$600, and surfacing material \$900. This cost is arrived at by figuring our crushed stone at an average of \$1.40 per cubic yard on the road. However, many of the roads cost us much less, because of our WPA stone-crushing project, whereby we get much of our stone delivered on the road at an average cost of 63 cents per cubic yard. The roads which we graded last year, according to the standards set up by the state highway department, cost nearer \$1,800 per mile.

With but few exceptions, we have used all the WPA men available at crushing stone in privately-owned quarries. When we advertise for crushed stone at the first of each year, we receive bids on two conditions: first, regular crushing, and second, where we furnish the labor to the contractor. As a rule we let contracts to six or seven quarries scattered throughout the county. Whereas our regular price averages 98 cents per cubic yard, the price under the WPA contract averages 63 cents per cubic yard. In addition, by not requesting materials on our project, we have several trucks each month, paid for by WPA, with which we haul the stone on the road.

Under this program, in the five years from 1933 to 1937 inclusive, we graded 158 miles of earth roads and surfaced 128 miles with crushed stone. In 1938 we graded only 9 miles and surfaced 6 miles. This decrease was due to the loss of \$30,000 in revenue caused by the new method of gasoline tax distribution.

In 1933 we received in gasoline tax \$97,000. This sum gradually increased until in 1937 it amounted to \$128,000. In 1938 under the new distribution law, this dropped to \$98,000, and for 1939 we will receive approximately \$84,000.

Although there are still some 50 to 75 miles of earth roads in Ripley County which should be improved, with this reduction in revenue and the gradual increase in maintenance, it looks as if our grading program must be completely stopped until some other method of financing it can be devised.

OPERATION OF STONE QUARRIES AND CRUSHING PLANTS

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In June, 1936, I was appointed surveyor and road supervisor for Washington County. We had a balance of \$32,000