

# Stabilization of Gravel Roads in Genesee County Michigan

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To most of you here the name Genesee county, Michigan, probably has very little meaning. Genesee county is located about 60 miles north of Detroit and has an area of 648 square miles. In the county there are 1,535 miles of highway outside of the incorporated cities and villages. Of this total 1,050 miles are of the gravel surface type.

In Genesee county, as in other counties, in Michigan, there is a considerable mileage of roadway in the local road system which in the past was graded and surfaced to minimum standards which adequately took care of the traffic needs of the time.

Since World War II changes have taken place in the requirements which these local roads must meet which can no longer be ignored. In Genesee county alone, 6,493 houses have been built outside the incorporated cities and villages since 1946 and this trend toward decentralization is definitely on the increase. The 1951 motor vehicle registration in the county showed sufficient vehicles to supply one vehicle for every 2.2 persons in the county. With a total population of 271,000 persons this amounts to 80 cars per mile of road, or in other words we could space cars 66 feet apart on every mile of road in the county, outside of the incorporated cities and villages, at one time.

To add to this tremendous increase in traffic is the fact that the city of Flint which houses the Buick and Chevrolet automobile plants, the Fisher Body plant, and the A. C. spark plug plant, is located in the very center of the county and is surrounded by some 15 dormitory towns whose principal purpose is to supply housing for the workers in Flint. As you can see this creates a large amount of traffic at certain times of the day on most of the local roads.

In the past these local roads which are now carrying this traffic, were considered as farm to market roads, but I do not believe that they can properly be considered as strictly farm to market roads

any longer. They have taken on many of the aspects of city streets. Present costs prohibit the use of the higher type bituminous and concrete construction on these local roads. To solve the problem the Genesee County Road Commission has turned to stabilization as a possible answer.

Before I describe the types of stabilization that are being tried and used, I would like to explain that the soils in Genesee county are typical of the glaciated areas of Michigan. They consist primarily of heavier clays with a Michigan State Highway Department classification of Miami, Conover and Brookston, which would all fall in the B. P. R. classification of silt-clay material with more than 35 per cent passing a No. 200 sieve. There are some Fox and Bellfontaine sands with small deposits of Coloma. At one time gravel was plentiful but such deposits have been greatly depleted by the demand of construction in the past.

#### USE OF CALCIUM CHLORIDE

Three types of stabilization have been tried within the last three years. The major type being used at the present time is stabilization with calcium chloride in the liquid form. Last year we used close to three million gallons of 38 per cent solution, or an equivalent of 10,000 flake tons on the existing gravel roads. This calcium chloride was applied at the rate of 3,000 gallons or nine flake tons per mile on the local roads in three applications of 1,000 gallons each, and at a rate of 4,000 gallons or 12 flake tons per mile on the heavier traveled primary roads in a similar manner.

In making these 1,000 gallon/mile applications, eight 2,000-gallon distributors equipped with positive displacement pumps, which discharge .46 of a gallon per revolution were used. The drive shaft of this pump is connected by means of a bicycle type chain directly to a cog wheel welded to the rear wheel of the distributor. In this manner the rate of application is always synchronized with the forward movement of the distributor.

The distributor would discharge 500 gallons/mile on the first pass on one side of the road and the other 500 gallons/mile on the return pass on the other side of the road. A minimum overlap of two feet was maintained in the center of the road so as to get additional calcium chloride where the maximum wear occurs. Also it was noted that the extra calcium chloride in the center of the road gradually worked its way to the sides of the road during a rain.

We are considering using 1500 gallons/mile or the equivalent 4.5 flake tons with the third 500 gallon/mile pass being made down the center of the road to allow for the excessive wear at this point.

To facilitate the handling of the calcium chloride we have installed two 42,000 gallon tanks in outlying districts and one 20,000 gallon tank at a central point in Flint. During the summer season these tanks are kept full by the manufacturers of the calcium chloride and our distributors are loaded directly from them.

In conjunction with this type of stabilization, if it is required to add clay to the existing gravel due to graduation deficiencies, the gravel is scarified and the necessary clay added. This material is then passed through a pulvimixer and calcium chloride, at the rate of 2,000 gallons or the equivalent 6 tons/mile is immediately applied.

We are also using calcium chloride in the stabilization of sub-bases in new construction of the higher type road. In this construction, of which  $10\frac{1}{2}$  miles of first stage work was completed in 1951, calcium chloride in the flake form was added in the amount of 10 pounds/ton to the stabilized aggregate. This aggregate was of the plant mixed type with the required clay added as determined by the Michigan State Highway Department "Blending and Stabilizing Gravel Design Sheet." A Plasticity Index of seven was called for in the design mix which may have been a little high for the second stage of construction intended.

The economic value of calcium chloride has proved very favorable. In an address before the A. R. B. A. in Houston, Texas, on January 22 of this year, J. T. Sharpensteen, the county highway engineer for the Genesee County Road Commission showed that in 1948 when no calcium chloride was used the total maintenance costs were \$891,929 while in 1949, when calcium chloride was used on practically all gravel roads the total maintenance cost was \$720,321 showing a savings of \$171,608 and he points out that the type of maintenance in both years was practically the same and that no adjustment has been made in the figures for inflationary trends.

Along with calcium chloride stabilization we have been experimenting with various other types of stabilization.

#### USE OF SOIL-CEMENT

In 1951, two miles of road was chosen for soil-cement stabilization. One mile was on the Judd road which is in the southern part of the county and was known as Project No. 534. The other mile was on the McKinley road in the northern part of the county and was known as Project No. 103.

The material to be stabilized in both cases was in the U. S. B. P. R. soil group, A-1-b(0). Based on the conditions of the moisture-density specimens for these soils the Portland Cement Association recommended that 8 per cent cement by volume, an optimum moisture content of approximately 7.8 per cent and an optimum density of 131 pounds/cu. ft. be used for both projects.

The construction procedure was as follows:

The existing roadbed was first scarified to a depth of 7 to 8 inches, using three patrol graders. The material was then broken up with two pulvimixers and the cement was spread on the roadway. On these projects we used sack cement which was unloaded directly from the haulers truck to the roadbed. The proper scheduling of these trucks so that no delay occurs after they have arrived on the job is important. The cement sacks were laid in transverse rows 5 feet apart with four sacks to a row. They were broken open and the loose cement was then spread evenly over the roadway with a spike-tooth drag. The material was then dry-mixed with the pulvimixers until a uniform color was obtained throughout.

When the mix was completed, three 2,000 gallon water distributors were added to the mixing train in order to bring the mix to the optimum moisture content.

The water distributors used had the same positive displacement type pumps as are used in our calcium chloride stabilization and it was found that this type of pump does not get enough water to the roadbed fast enough and thus delays the job, unduly. In any future soil-cement stabilization it is planned to use the pressure type pump and thus speed up this operation.

After the proper amount of water had been added a three-drum sheepsfoot roller was used to compact the mix from the bottom up. This roller was operated until it walked itself out of the mix and the remaining mulch on top was less than an inch in thickness.

The surface was then shaped with a patrol grader and compaction planes were removed with a spike-tooth drag.

The final compaction was done with two rubber-tired rollers and one 8-10 ton flat-wheel roller.

On both projects a seal coat was immediately applied to help with the curing and provide a wearing surface. The total cost of stabilization on the Judd road including the seal coat was \$9,872. The cost of the McKinley road was \$11,156. The increase in cost on the McKinley road was in part due to the fact that a double seal was applied.

Both of these projects have come through this year's spring breakup in good shape. It is planned to put a 2-inch mat on this two miles of road in the near future. On the basis of this work, seven miles of soil-cement stabilization is planned for this summer. It is believed that by the use of bulk cement, a considerable saving can be made in both cement costs and man hours.

### USE OF BITUMINOUS MATERIALS

A third type of stabilization was used on a one-mile section of the Stanley road. Known as Project No. 803, it was undertaken in the fall of 1950. On this project the stabilizing material was AE 7, which is a slow setting asphalt emulsion. The existing material on the roadbed was scarified with patrol graders, passed through the pulvimixers and windrowed. About 600 cubic yards of gravel was added to the existing material at this time because of a gradation deficiency. The grade in this case was quite narrow and a split windrow was used. The pulverized material was then pulled in, in 2-inch layers, and the A. E. 7 applied at the rate of 1 gallon per square yard to each layer. As each layer was mixed it was laid down, rolled with rubber tired rollers and allowed to cure before the next layer was processed. A 6-inch stabilized base was thus constructed in three, 2-inch layers.

During the construction of this project a few difficulties were encountered. Much of the grade was narrow and two windrows had to be used, one on each shoulder, and the establishment of adequate turn-arounds for the equipment trains was difficult. Secondly, it rained to such an extent that in some cases the curing of a single layer took longer than anticipated and thus the processing of the next layer was delayed.

It was planned to seal this base in the fall of 1950 but due to the excessive moisture caused by the adverse weather conditions, this was not accomplished. The cost of stabilizing this one mile of base with A. E. 7 was \$13,825.

In 1951, a 2-inch road-mixed surface was placed over this base at a cost of \$5,432. An S. C. 3 was used along with a Michigan State Highway Department Spec. 22A gravel for this surfacing material. This project has now gone through two spring breakups in satisfactory condition. As to what the final serviceability of these projects will be, only time can tell but there are several things we have learned during this construction that I'd like to pass on to you.

## ENGINEER YOUR PROJECT

Get it down in black and white just what procedure you will follow, step by step, what equipment can be used, how your construction trains will be made up, just what paths they will follow during construction, where your turn-arounds will be, after which step in construction the different pieces of equipment will be added to your construction trains, and then follow your plan as closely as possible and it will pay off in dollars and cents.

There are three fundamental requirements which we have found must be met in stabilization.

1. See to it that there is an adequate amount of the material you are stabilizing with in your mix. The manufacturer of the material can help in determining the correct amount to use.

2. Obtain and maintain the proper moisture content in the sub-base material throughout construction.

3. Compact the mixed material to the proper density and see that it is compacted from the bottom up.

We feel that if these fundamental requirements are met the stabilization job will be successful.