However, we must not fool ourselves by thinking that a very thin crust of metal will carry heavy traffic in this climate where we have deep frost action and a rainy period which may come immediately after it thaws. *This type has its limitations and they must be recognized.* It would be more than wasteful to indiscriminately build it and thus place much of it where it is not appropriate.

RESURFACING OLD ROADS WITH ROCK ASPHALT

By W. C. Dickey,
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My concern here is a discussion of Mr. Hinkle's very able paper, in so far as he has dealt with "Resurfacing Old Roads with ¾-inch Rock Asphalt on Bituminous Macadam". My experience along this line was gained on the Indiana State Maintenance Contract No. 83 at Alexandria during the fall and early winter of last year. This contract was awarded to the Stone Construction Company on August 9th and I drew the assignment of being the man on the "firing line" for our company.

Mr. Hinkle has covered the high points of this work. In other words, he has "planed off the high points", and it therefore falls to my lot to "fill in" the low ones so we may have a smooth riding surface on our theorizing journey.

With the belief that you are more interested in the construction of the rock asphalt top course, I will try to give you an insight into some of the "trials and tribulations" in our attempt to complete the work in 1927, get the best quality possible and obtain a smooth riding surface. In passing will say we completed the job, have the quality and a passably smooth surface.

Mr. Hinkle has told you relative to unloading, grinding, steaming, spreading, etc., but I wish to say we did very little steaming. We unloaded the material for about one-half mile by hand and ground about half of this on the road, the other half being broken up by hand. From then on, all the rock asphalt was unloaded with a crane, ground at the unloading point and hauled to the road. The only steaming we did was as an experiment one day to help in the unloading when the material was digging hard in extremely cold weather.

We were quite successful in getting a good surface by our spreading methods—I believe at least as good as that ever obtained by any other method. Our rolling and planing oper-

ations to approach the ideal in a smooth-riding surface are interesting and I will take up the different methods separately together with the results obtained.

The first half-mile of rock asphalt was unloaded by hand. This method was somewhat slow and tedious, but we are of the opinion the results in all ways were no different from those obtained by other methods.

A considerable time elapsed between the spreading, rolling and planing, and the surface, after the rock asphalt settled, was not all that could be desired, mainly because of short waves being very apparent. An attempt was made to smooth this by using sharpened shovels, lutes, etc., but with no appreciable success. We later obtained a very fine and smooth surface as follows: We planed this surface with an Adams No. 6 maintainer before rolling it, making just three trips, one on each side and one in the middle of the road. We endeavored to plane off the rock asphalt to the depth of the deepest depressions with the cutting blades and smooth the loosened material evenly over the surface. This was a successful operation and eliminated all the short waves or bumps. On the rest of the surface of the north mile, ground material was used. After planing this rough surface, the entire mile was rolled, once over, with a 5-ton tandem roller and the entire mile planed. The planing operation consisted of one round trip at the side, one near the middle and then one at the sides again. After this planing we again rolled. Then we followed with the planer, this time adding loose, ground rock asphalt in sufficient quantity to fill any depressions which occurred. The operations were continued until a smooth surface was obtained.

Although the hand-broken and raked portion of this surface was slightly open when completed, it closed rapidly under traffic and appeared no different than the other surfaces within thirty days. This mile contains the only rock asphalt not ground at the unloading point and spread on the road with lutes.

The next mile was, with one exception, alternately rolled with the 5-ton tandem roller, then planed, adding loose material to the planer until the surface was smooth. The exception was an 800-foot strip on one side of the road the surface of which was planed before rolling, three trips of the planer being made. No material was fed into the planer at any time.

The next operation which differed from these was tried on a 1,200-foot strip just north of the city limits of Alexandria. Here we rolled with the 5-ton tandem roller and instead of planing and rerolling before starting the feeding in operation, we started feeding in with the first planing. It was much more difficult to get a smooth surface here and required much more loose material than we had been using up to this time. Later we came from the south end and added more

material and did more rolling, to bring this section up to the same standard as the balance of that part of the road north of Alexandria.

Unfortunately, we were not favored with as good weather conditions for our rock asphalt work on the section south of Alexandria as we had on the north section. Starting at the south end of the south section, we used the method of alternate rolling and planing, filling in loose material for nearly one mile. Then, for about 2,300 feet, we again tried the method of filling in loose material immediately after planing began. We were not able to do much, if any, planing here, and, as the surface was not smooth, we had to fill in rock asphalt at the rate of about 148 tons per mile to get the surface we desired. Although this method might be practical in very warm weather, it did not appear to be successful so late in the season.

The next mile was rolled two days before planing. No material was fed in until after preliminary planing and then rock asphalt was fed in at the rate of about 58 tons per mile. The majority of the rolling of this mile was done with a 10-ton, three-wheel roller. A short section on the south end of the next mile was manipulated about the same as the previous mile, and then for about 2,500 feet we planed thoroughly before rolling. This was done in very cool weather. It was then rolled and planed, adding only an amount of material equal to 11 tons per mile. The balance of this mile, about 1,600 feet, was rolled with a 10-ton, three-wheel roller before being spread and compressed very hard. Practically nothing could be planed, owing to the fact that whenever the blades did start to cut they would tear the rock asphalt off down to the base. The operation here, therefore, consisted mainly in filling in and rolling. The rock asphalt filled in here was at the rate of 55 tons per mile. The balance of the road was first planed, then rolled and then filled in at the rate of about 12 tons per mile.

An objection was raised to planing before rolling on the theory that the area covered by the tractor and planer wheels would be more firmly compressed than the balance of the surface, thus producing ridges after the rock asphalt reached its final compression under traffic. Only time can tell whether these ridges will occur.

We were very successful in getting a smooth riding surface over the three railroad crossings which we paved, using the same design, material and methods of construction as in the road proper.

In our particular case a light roller seemed to be the best in warm weather and a heavy one the best in cool weather, providing the rock asphalt had been spread at least four days. It made considerable difference as to the time elapsed between

the first rolling and planing, as the longer the time the less success in planing.

Our experience appears to show that fine material fed into the planer does not stick so well in cold weather, regardless of the weight of roller or amount of rolling.

The time which should elapse between spreading and rolling and planing will vary greatly as so many things affect the manipulation of the material. Some of these are: weather in general, temperature of the air and material and whether the rock asphalt is ground, steamed or hand broken. Our experience on the one small section of the north end seems to show that it is quite possible to get excellent results by planing and rolling until a smooth surface is obtained, without adding any extra material, providing the weather is warm enough.

It was very amusing at times to hear the theories advanced by people who never had any experience along similar lines of work; also, there was a wide variance between the theories of engineers, contractors and others with road building experience, and it was my observation that practically all theories were exploded in one way or another before the work was completed. However, we can look back and remember that with only one or two exceptions every method advanced by officials directly concerned and which appeared to have any merit whatever was tried out. We are also glad to know there is a record of the different operations and methods used, and as time goes on we may, by observation, be enabled to more intelligently determine just what are the proper methods to pursue in the construction of a road of this kind.

It is my belief that the methods used in this type of construction will of necessity vary greatly with the seasons, air temperature, etc., and in my opinion no iron-clad rules can be laid down as there will often be times when someone with authority on the job will have to use the proverbial "fool's judgment" in order to obtain the best results.

RAILROAD-HIGHWAY CROSSING ACCIDENTS

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Nearly everybody knows carelessness is the major cause of street and highway accidents. This knowledge comes through reports of accidents in the daily newspapers that indicate an utter lack of care on the part of a certain percentage