

without any regard to durability or suitability, will have to be reconstructed. Could we not, by no great increase in cost, so better construct this moderately priced road as to greatly increase its value as a road, thereby reducing the cost of maintenance and bringing the type to a closer approximation of the more costly pavements?

## HOW TO GET MORE EFFICIENT ROAD INSPECTION

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The efficiency of any process depends upon the quality of the materials used, the fitness of the mechanical equipment used, and the skill of the workmen employed in the handling of the materials and equipment. No one will question the statement that the finest material can be applied to the work in such a manner that the finished product will be practically worthless, or that the finest workmanship can not produce the best finished product with poor materials or equipment.

We all have ideals we hope to reach some day. We are going to give you our idea of an ideal road inspection system. We realize that it will not be possible for us to use this system under existing conditions, but we feel that if we have some definite goal ahead we are more apt to make some progress in that direction. As conditions change we may have to change our goal to meet them, but if the angle of deflection is not too large, we have not wasted any of our efforts in the progress made up to that time.

As the efficiency of road inspection depends largely upon the efficiency of the inspector, let us first consider some of the characteristics of the ideal inspector.

First: He should be a man of such temperament that he can make any necessary suggestions or criticisms in such a way, that those actively engaged in performing the work will feel that he is acting entirely for the benefit of the work, and not to show his authority. He should be able to judge the temperament of those with whom he has to deal, and act accordingly. It will only be necessary to make a suggestion to one contractor, while with another it will be necessary to check up and see that the suggestion is followed out. We believe that this question of personality should be given serious consideration, as harmony is the strength and support of all institutions, and any lack of it between the inspector and the contractor, or between the inspector and the engineer can only result in detriment to the work.

Second: He should be a man who has a working knowledge of all materials to be used in the work, and be able to decide as to their fitness for the particular kind of work to be done. If any of the materials are to be obtained locally, such as gravel or stone, he should make frequent inspections of the pit or quarry to see that material of inferior quality is not allowed to mix with material of proper quality in such proportions that it can not be detected when considered as a whole. Where the source of supply for the material is too far from the work to permit of this kind of inspection, he should inspect as much of the material as may be possible at the unloading point. He should see that all materials are properly stored from the time of unloading until they are actually applied to the work, and at that time should see that all materials are in a satisfactory condition to comply fully with the specifications.

Third: If the process of construction requires the mixture of materials, he should see that the materials are mixed in the proportions specified, and that the equipment used is such that the materials are properly mixed. He should give careful attention to the application of either raw or mixed materials to see that it conforms in every way to the specifications, as well as the stakes set by the engineer. The inspector should be furnished with a set of blue prints together with the specifications and should assist the engineer in setting the final stakes for the improvement, so that he will be thoroughly familiar with the plans and specifications as well as the actual points from which the work is being laid out. As we feel that the grading and drainage is of prime importance, the inspector should give particular attention to this part of the work.

So far we have been dealing with the requirements and duties of the inspector. We feel that the efficiency of our road inspection might be increased by a change in the method of handling some of the questions which are sure to arise as the work progresses. The inspector should be made to feel that he has a real job and that the quality of the work depends largely on him. We think that the inspector sometimes feels that he is appointed merely to comply with the law, and that anything that he may say or do will have little effect on the completed work. This feeling is aggravated by having the contractor appeal directly to the engineer for a decision on any question which may arise between the contractor and the inspector. We feel that this might well be corrected by the engineer announcing all his decisions through the inspector, and thus make him feel the responsibility of his work. You may wonder where such an inspector can be found, but please remember that this is an ideal, to be approached as nearly as possible. You are also probably thinking of the cost of securing such an inspector and are ready to quote our present law

on this subject. We freely admit that this can not be done under our present law, but if our present law does not provide for the best method, we should use such means as are in our power to secure the necessary legislation to provide for the more efficient method.

After the work has been inspected as outlined above some mechanical device might be used to test the road surface. We would suggest that this be done by a device that would not only record the rough spots, but would also leave a mark, (such as a spot of whitewash), at each rough spot.

### **Economy in Good Inspection**

To meet the requirements we have outlined, it will be necessary that the inspector have some engineering or contracting experience, and the rate of pay be such that it will attract such a man. It must be remembered that this work will be of a more or less temporary nature and that the rate of pay will have to be relatively larger than for similar work of a permanent nature.

The additional cost of construction resulting from the use of this method of inspection would be saved, at least in part, in the cost of maintenance. Any saving of this kind tends to reduce the general taxes which is an item worthy of our consideration at any and all times. It is not possible to show just what saving might be effected in this way, but we feel sure that a considerable part of the cost of maintenance might be avoided if a more careful inspection was made at the time of construction. Assuming that the average cost of construction of our roads of all types is \$25,000 per mile, and that two months is about the average time required to complete a mile of road, the cost of inspection under our present system would be about \$180 per mile, or about 0.7 per cent of the total cost.

Using the same assumptions as to cost of construction and time required to complete, and the further assumption that an inspector such as we have outlined could be secured for a salary of \$200 per month, the cost of inspection under the system we have outlined would be \$400 per mile, or about 1.6 per cent of the total cost of the work.

Some years ago, while in the employ of one of the larger railroad systems of the country, the writer was assigned to the work of inspecting piling which was being driven for use as temporary supports for the old bridge while a new one was being built. We were required to keep a record of the kind of timber in each pile, the diameter at each end, the exact length, and the penetration resulting from the last three blows of the hammer dropping from a given height. A sketch was placed in the office files giving this information for each pile, in spite of the fact that within a year all of these piles were removed.

At a later date the writer was assigned to the inspection of certain steel appliances for the same railroad system. This work included the inspection of the material as received at the factory, and the method of manufacture, as well as the finished product.

Later when employed in a small industrial factory where the product contained two malleable castings which were purchased from a foundry not controlled by the factory, we found that it was required that each casting have two test lugs which were cut off by an inspector to determine the quality of the material.

In passing through one of the largest auto factories at Detroit it was noticed that about one man in every ten or twelve wore a coat of distinctive style and material. Upon inquiry we were informed that these men were the inspectors, and that it was considered necessary to have an inspector for each operation required for the construction of a car.

While it is not possible for us to quote the exact cost of these inspections or the relative cost as compared to the total cost of the items mentioned, we feel sure that the percentage is much greater than that of the county road inspection which we are proposing. If, in view of the keen competition in the industrial world and the necessity of meeting the divided payments in the corporation world, it is felt that a rigid system of inspection is necessary, we should not hesitate to spend an equal or greater part of our public money for an adequate road inspection.

There are always those who will say that too rigid inspection reflects upon the integrity of the contractor, but we feel that the honest and conscientious contractor will welcome any fair system of inspection and the loss of the unscrupulous contractor would not seriously interfere with the construction of good roads.

As a summary of the entire discussion we would suggest the following:

1. Amend our road law so that we can pay the salary necessary to secure an efficient inspector.
2. Appoint an efficient and conscientious inspector.
3. Handle the work in such a way that he will feel the importance of his work.

We would like to say in closing that the inspection should continue after the road has been completed. The engineer should make inspection of the road from time to time so that any defects might be noted and such changes be made in the specifications or system of inspection as may be necessary to correct in future work, any defects which may be apparent.