

# Highway Maintenance Can Be Improved

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It is with a feeling of deference and temerity that I come from Missouri to Indiana to talk about improving highway maintenance. Last September, on my way to and from the annual meeting of the American Association of State Highway Officials in New York, I passed through Indiana on Route 40 going to the meeting and through northern Indiana returning from the meeting. I have nothing but praise for the quality of maintenance that I observed on these trips. In fact, I told Norman Schafer, Secretary of your State Highway Commission, that I wanted to come over here and spend a few days with him inspecting the highways in Indiana in order to pick up some pointers on how you were able to maintain the highways in such fine condition. So my comments will be based on Missouri conditions. If they help you folks in Indiana in any way, I will be most happy.

Possibly all agencies charged with the responsibility of maintaining roads had more or less the same experience during the war years in that none of us had enough men, materials, or machinery to properly take care of our roads; and, as a result, we had to carry on only the most essential types of maintenance activities. In a lot of instances, this meant that the work was limited to road surface maintenance, and even that was sometimes work of an emergency nature. Drainage and right-of-way work was left undone.

Progress since the end of the war in getting maintenance work back to pre-war standard has not been too satisfactory. There is an open question in my mind as to whether or not our pre-war standards are going to be satisfactory yardsticks with which to measure post-war quality. Highway maintenance must progress with the vehicle and the desires of the road user; yet we possess a curious mixture of superstition and reverence for the past. We are prone to do the same things in the same old way in which they have always been done.

We are guided and influenced by past reasons and reasoning to a far greater extent than we realize, and to a much greater extent than we should be. Many of the things we now enjoy would have been deemed fantastic a few years ago. Yet there are those today who are ready to say of proposed innovations, "It can't be done!—'Impossible' ". Charles Kettering answered, "The impossible merely takes a little longer."

#### FACTORS IN HIGHWAY MAINTENANCE

Highway maintenance involves the proper blending of four factors: men, materials, machinery, and methods. Progressive consideration has been given to the improvement of materials and machinery; but it is an unfortunate fact that adequate consideration has not been given to the selection, training, and compensation of highway mainte-



Right-of-way mowing. Low-growing grasses with occasional trees present the best type of roadside planting.

nance personnel. Maintenance materials are, in general, selected in accordance with carefully prepared specifications, tested for adequacy and compliance, and painstakingly placed in or on the road in finished form. The same careful attention is given to the selection, improvement, and operation of machinery. In far too many instances, it has not been and is not the practice to give the same careful consideration to the selection and care of men that has been and is being given to

the selection of materials and machinery. The human element presents problems which are, by their very nature, more complex and involved than those encountered in the selection of materials and machinery. It is clearly more difficult to test men for skill, judgment, and dependability than it is to test materials for compliance with specifications or machinery for performance; but it is far more necessary and vital in accomplishing the desired results in highway maintenance.

#### PERSONNEL

In my opinion the greatest opportunity for improving highway maintenance lies with the improvement of maintenance personnel. The proper selection and training of maintenance personnel and the retention of the deserving personnel on the job is the real key to top maintenance performance both in a high standard of workmanship and in low costs. The improvement of no other factor involved in highway maintenance will pay greater dividends.



Gravel road maintenance. Note use of motor graders working in tandem. Best results are accomplished by this method.

Improvement in maintenance personnel can be accomplished by, first, selecting men on their ability to do the job based on a knowledge of their skill developed by education and previous training, and their

willingness and physical ability to do the work; second, the proper training on the job; and third, the retention of the good men by establishing the right incentive. Proper selection, training, and incentive are the main essentials for securing and retaining good men on the job.



Preparing subgrade to receive concrete patch.

The right incentives will increase the quantity and quality of the work of any worker and, by the word worker, I am referring to all employees in the maintenance organization. In a very recent bulletin published by the Highway Research Board entitled *Salary and Wage Practices of State Highway Departments*, which is the work of a committee whose Chairman is Sam C. Hadden, former Chairman of the Indiana Highway Commission, the following statements about incentives are made:

What does the employee have a right to expect in his relations with the highway organizations of which he is a member? (1) Security in his position. (2) Remuneration in accordance with the class of work done. (3) Opportunity to advance in position and pay, in accordance with ability. (4) A chance to gain knowledge and ability, and accordingly, to improve the work of his department. (5) A level of income sufficient to make him happy in his choice of a career in the public service, as against other work opportunities. The public, as his employer, has a stake in assuring him on all these counts.

When jobs change abruptly, regardless of what new talent is recruited, valuable experience is thrown away. Where the future is uncertain, capable men are dissuaded from going to work for the Department. Where equal performance does not bring equal reward, the morale of an organization is poor. Where pay is stingy, trained men are lost as soon as better opportunities beckon, as some highway departments have found out during the past few years.

Everybody knows these things. The job is to get the principles translated—in one way or another—into universal practice. The indicated need is for the highway administrations themselves to take a greater interest in personnel policy. They can do something about it if they will recognize that a problem exists, and if they will take time enough to understand a few basic principles.



Concrete replacement using wet-batch method. Note use of vibrator to insure better joint between old and new concrete.

At another point in the same highway research bulletin is a quotation from a text on roadmaking by W. M. Gillespie, professor of civil engineering at Union College, published in 1847, 100 years ago, which reads in part as follows: “. . . the principle of putting unskilled men at work at the difficult art of road making is a false one. . . . Skill, labor, and time cannot be obtained and secured without being adequately paid for”. This is just as sound today as it was 100 years ago. There are many more incentives than those listed above that tend to improve the output of a worker.

## WHAT THE WORKER WANTS

A little more detailed discussion of what the worker desires in a job and the incentives that urge him onward and upward might be helpful. It is believed that the average worker desires economic security more than anything else that comes within the range of his needs. Economic security comprises protection against unjust and indiscriminate discharge, such as release for purely political reasons. It also implies freedom from seasonal unemployment. The worker desires not only a steady job but a steady job at good wages. He desires an income sufficiently large and regular to enable him to maintain a decent standard of living for himself and family. He desires



Drying aggregate before applying bituminous material.

that provision be made for a retirement plan that will insure for him some degree of security in his old age.

The worker wants not only a fair day's wage for a fair day's work, but he feels that there should be a fair relationship between basic rates of pay for different jobs according to the difficulty, responsibility, and other characteristics of each job. A fair relationship between basic rates of pay should be determined by some type of job evaluation or job ranking plan. Job evaluation consists mainly of an analysis of pricing of jobs, or, as one author defines it, "a measure-

ment of the *qualities* and *abilities* necessary to carry the *load* under the assigned *conditions* of work.”

The workman wants protection against physical injury and from the elements. Highway maintenance men are almost continually exposed to minor injury and, during a great part of the time, they are exposed to serious injury. The greatest possible practical protection that can be afforded by safety devices, signs, barricades, and flagmen will tend to increase the efficiency of the workmen. Protection against the elements in the form of well heated, ventilated and lighted buildings, and machinery equipped with heated cabs, when practical, will make a positive contribution to the output of the worker. Insistence



Applying bituminous material to aggregate.

on good housekeeping both in the buildings and on the machinery will definitely result in better work on the road.

The desirable job conditions mentioned in the foregoing paragraph will increase the happiness of the employee in his job. Other items that will make contribution in this matter of happiness in a job are for those in authority to listen to the worker's suggestions, and praise him for his good work. This will develop initiative. Call him by his first name and talk with him about his hobbies and family.

And finally, in the matter of personnel, I believe that the incentive that will produce the best results is the development of faith on the part of the employees that the department wants, above all, to

develop its human resources and to reward workers according to their merit and responsibilities; to reward them with all the good things—not money alone—that every man works for.



Road-mixing bituminous material and aggregate.

I do not want to leave a wrong impression by the foregoing statements regarding the benefits that the worker should receive. In return for these benefits, I also believe that the worker should give his best to the job, and that, if he doesn't give his best or if his best efforts do not measure up to the established standards, the inefficient worker should be replaced.

#### MATERIALS AND MACHINERY

I firmly believe that the main difference between good maintenance and bad maintenance is the human element by which the material is processed and the machinery is operated.

Great strides have been made in the last few years in the improvement of materials and machinery, and there is no doubt that that improvement will continue in the future. I have no specific thoughts in regard to detailed improvements of materials and machinery other than to say that it is my belief that both a reduction of unit costs and an improvement in workmanship can be accomplished by the development of more efficient machinery and its wider use in maintenance work.



## METHODS

The fourth and last, but not the least, component in highway maintenance is methods. Here is where the ingenuity of a trained personnel will make its greatest showing.

Foremost among highway maintenance methods—and, incidentally, one that often receives far too little attention—is the method of drainage. Good drainage is basic. There are arid regions, of course, where drainage is possibly not important, but in most localities drainage cannot be disregarded. Some of us have been through those



\* Loading mixed material for hauling to point of use—either for decking or patching.

periods of development in the building of highways when good drainage suffered by the overemphasis on safety and roadside appearance. These two latter items are important and highway safety is extremely important. The matter of drainage, however, cannot be disregarded in the development of these other items. While on the subject of drainage, I would like to express an opinion about trench-type construction of surfaces. Many years ago it was learned that the aggregate-surfaced roads gave better service when constructed and maintained by the feather-edge method than by the trench-type method. I believe that better results could be obtained with all road surfaces if the trench-type construction were not used. So in many places, and

in many ways, highway maintenance can be greatly improved by improving drainage.

### SHOULDERS

Another problem common to all types of road surfaces is the maintenance of shoulders. This subject was very ably covered by Professor Petty in a recent issue of his *Highway Extension News*. In fact, I thought it was so good that we sent copies of it to all of the maintenance foremen in Missouri. There seems to be some argument among engineers regarding the function of the shoulder along



Mud-jack crew filling voids under concrete pavement.

the travelled way. Regardless of whether it is put there to provide a dodging area, a parking space for vehicles, or a lateral support for the pavement, its surface should be kept smooth, firm, and even at its juncture with and sloping away from the travelled way. Shoulders should be sodded, stabilized, oiled, or hard-surfaced, depending upon the nature of the soil, the highway alignment, the width of the pavement, and the type and density of traffic.

The improvement of highway shoulders is a step in the over-all improvement of highway maintenance.

### ROADSIDES

Right-of-way maintenance and erosion-control methods must be rated as problems to be considered in improving highway maintenance.

I believe that a highway right-of-way completely covered by a low-growing grass from shoulder line to right-of-way line is the ideal to be most desired. This type of cover is also believed desirable on the shoulders of low-traffic roads. The ground cover found most desirable in Missouri is Kentucky blue grass. Since blue grass will not grow under all soil and climatic conditions, however, it is necessary to conduct investigations and experiments to find the type of ground cover most suitable for the locality involved. Korean Lespedeza has proved very successful in Missouri. The right type of ground cover does control erosion as well as improve the appearance of the highway. Right-



Road magnet used to remove pieces of metal from road surface.

of-way mowing at the right time helps control weeds, encourages the growth of the desirable grasses, and makes the roadside more pleasing in appearance to the traveler. So any improvement in right-of-way maintenance methods makes a contribution to the general improvement of highway maintenance.

#### SIGNING AND MARKING

Highway signing and marking is the responsibility of the maintenance organization in many highway departments. Clean, properly placed signs and markers make a great contribution to improvement of signing; and marking can be improved, in my opinion, by the use of

more route markers both in rural and urban areas, but especially in urban areas. It is our policy in Missouri to place a route marker just past the intersecting street on the marked route through every town or city. In rural areas, a route marker is placed beyond each side road, and never is the distance between markers on important routes greater than three miles. This is expensive, but it pays big dividends in satisfied road users.

Also, a very important phase of marking is the proper placing of pavement striping for channelization of traffic, indicating zones where overtaking and passing a vehicle would be unsafe, and other special



Pavement marker built by the Equipment Bureau of the Missouri State Highway Department.

markings at intersections. Since this phase of marking is placed on the travelled surface of the roadway, not only has it to be carefully designed, but also much thought and effort must be given to the maintenance economics of its placing. Since we in Missouri seal the centerline and other cracks on our concrete pavement with more-or-less standard types of crack-pouring materials, we have been unable to place pigmented white or yellow centerline stripes on the centerline because of the solvent action the striping paint has on the crack-pouring material. From a maintenance standpoint, therefore, it has been more practical to stripe our concrete centerline with a tar-base black stain-type paint.

Likewise, from a purely maintenance viewpoint, we considered it expedient to place our "no passing zone" striping in the center of the driving lanes rather than adjacent to the centerline. The reason for this is simple. We could not develop or find a traffic paint that would satisfactorily withstand the wear when it was placed immediately under the dual tires of heavy trucks. So far, this system, born as a solution to a maintenance problem, has been so successful that we in Missouri are most enthusiastic about it.

Better signing and marking is a definite part of any proposed program of better highway maintenance.



Pavement marker in action.

### MAINTAINING THE ROAD SURFACE

And now comes the final and most important phase of "methods", those maintenance methods which have a direct bearing on the travelled way, the road surface. It is my opinion that the road user desires above all else that the highway have a smooth and safe riding surface. He wants the surface to be free of holes, corrugations, loose aggregate, slick areas, and any other hazard that might interfere with his safe and comfortable passage over the road.

I believe that an aggregate-surfaced road can be maintained in the most desirable condition by surface stabilization, which is ac-

complished by mixing suitable soil and aggregates in the right proportions. This type of aggregate surface maintenance provides a smoother riding surface with less dust, a negligible windrow of loose aggregate along the shoulder, a minimum of surface blading, lower aggregate replacement costs, and lower maintenance costs.

Bituminous surface maintenance involves base repairing, patching, decking, and sealing. It is my belief that a weak and unstable bituminous surface can be strengthened best, and most economically, by adding additional thicknesses on top of the existing surface rather than by tearing up the old, repairing the base, and replacing the surface. Of course small springy spots or bad soil pockets sometimes have to be removed and replaced with new materials. In no phase of maintenance, however, does the maintenance man's experience and judgment count for more than in his selection of treatments for bituminous surface difficulties.

Concrete pavement maintenance presents complex problems in a number of states, and the most critical of these problems is the one commonly known as slab pumping. Slab pumping, according to a subcommittee of the maintenance department of the Highway Research Board, is caused by the deflections of slabs at joints and cracks and along pavement edges, under heavy loads after the accumulation of water in the subgrade soils. It results in displacement and ejection of water carrying soil particles in suspension. Continued slab pumping will cause the loss of sufficient subgrade soil to weaken the subgrade support, causing eventual failure of the pavement. The subcommittee further found that four basic conditions must be present simultaneously to create a pumping slab. They are: (1) subgrade soils of such nature that they may pump through open joints or cracks or at pavement edges, (2) "free" water under the pavement, (3) frequent heavy axle loads, (4) joints or cracks in the pavement.

A great amount of valuable research work in the preventing and correcting of slab pumping has been and is being conducted by your Joint Highway Research Project here in Indiana, under the able direction of Professor Ken Woods and his associates. This work is followed with great interest and the results are received with appreciation by other highway departments. It is an invaluable contribution to highway knowledge.

We have made some progress in Missouri in correcting and controlling slab pumping by four different and distinct operations, which are: (1) jacking a soil-cement slurry mixture under the pavement to fill the large voids and stabilize the rocking slabs, (2) undersealing all

affected areas with a 30-40 penetration asphalt, (3) replacing the badly broken pavement with new concrete patches, and (4) placing a bituminous surface over the entire affected area to re-establish the riding surface and waterproof the surface, thereby preventing in so far as possible the further entrance of free water into the subgrade.

Summarizing, I repeat an earlier statement that highway maintenance can be improved by improving its components, which are men, materials, machinery, and method. The greatest opportunity for improvement depends upon men.