

Maintaining Our Huge Investment in Highways

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The subject of this article as assigned, "Maintaining Our Huge Investment in Highways," might well have been "Maintaining Our Huge Investment in Highway Maintenance." Higher costs of labor, material and equipment, together with obsolescence, heavier traffic, higher required standards of service, etc., have served to push maintenance into a position of high relative importance when our "Huge Investment in Highways" is under consideration from any angle.

Currently the Michigan State Highway Department is spending approximately \$18 million annually on state trunkline maintenance and maintenance of all trunklines in the U. S. totals \$600 million. Add to this county and city maintenance costs for local roads and streets and the result certainly is a "Huge Investment."

Organized maintenance of highways is of comparatively recent origin. For many hundreds of years maintenance was performed more or less casually by slave labor and forced peasant labor. More recently under our own pathmaster system, farmers and others worked out taxes on the road, etc.

Highway construction has occupied the stellar role since early history, with maintenance tagging along more in the role of a necessary nuisance than as an important necessity in the protection and preservation of "Our Huge Investment in Highways."

Turning to the committee on uniform accounting of the American Association of State Highway Officials for a technical definition we find that highway maintenance is described as follows:

"Maintenance is the preserving and keeping of each type of roadway, roadside, structure and facility as nearly as possible in its original condition as constructed, or as subsequently improved, and the operation of highway facilities and services to provide satisfactory and safe highway transportation."

In addition to this technical definition we have a no less important obligation to keep John Q. Public satisfied. The ordinary traveler on our highways is interested in two things only while he is on the road. First, his personal safety and, second, his comfort. For this reason as far as he is concerned the most important part of "Maintaining Our Huge Investment in Highways" is the maintenance of the road surface. But comfort and safety and smooth highways involve many other fundamental and contributing activities besides the simple act of patching holes in the road.

What, for instance, of the weight limit control on trucks using the highways? This is preventive maintenance of great importance. In Michigan a force of some 90 patrolmen using portable scales, permanent scale house attendants, special permit clerks and other miscellaneous personnel work continuously to protect "Our Huge Highway Investment."

At one of our busiest scale house locations we average three trucks over the scales per minute the year around, 24 hours a day.

We make over three million separate weight inspections annually over the state highways of Michigan. This section of the Maintenance Division accounts for \$425,000 of our maintenance budget.

TRAFFIC SIGNS AND SIGNALS

The maintenance of traffic signs and signals occupies an important role in the contributions of the Maintenance Division to the comfort and convenience of the highway user. For instance, in Michigan, we maintain a total of about 300,000 highway signs, approximately 200,000 of which are in place at all times on our 9,000 miles of state trunklines. The remaining 100,000 are in stock or in some stage of refinishing or rehabilitation in our seven District Sign Shops or our main shop at Lansing.

Statistically speaking, highway signs average a little over 22 to the mile. I know of one location near a large Michigan city where we maintain 144 signs within a radius of one thousand feet of the crossing of two highways. I know this because my curiosity was aroused and I counted the signs myself. I am sure this number is exceeded in some other locations.

This section of the Maintenance Division has charge of our pavement marking, and this activity requires the use of eight special marking trucks besides pick-ups, transport trucks for material hauling, etc. Equipment, material and expense of operators and other personnel, totals around \$450,000 annually. This figure with approxi-

mately \$400,000 spent on signs and another \$65,000 on traffic signal maintenance takes a bite out of our budget to the extent of about \$1 million.

Traffic signals play no small part in the orderly control of traffic and protection of both motorist and pedestrian. The Michigan Highway Department maintains or contributes to the maintenance costs of 1,554 traffic signals. A signal superintendent with a force of about 11 men takes care of this work through direct efforts and with the cooperation of local, county, and municipal maintenance organizations.

All of the foregoing, as well as some other related activities, contribute very definitely to the problem of "Maintaining Our Huge Investment in Highways," but do not, of course, come strictly within the meaning of our technical definition of maintenance.

DRAINAGE

Highway maintenance, as such, always starts with drainage. Neglected drainage is the seat and starting point of most of the ills which befall our highways. Without proper drainage, the problem of sustaining proper riding surfaces, adequate shoulders and even satisfactory roadsides is multiplied many times.

This is an old principle well known to all of you, but it bears repeating. Water must not be allowed to stop moving. Once it has fallen on, or has flowed within the confines of your area of endeavor, you must see to it that it keeps on moving in an orderly manner along your drainage system to its ultimate disposal. Surface drainage starts, of course, at the center line of the traveled roadway, flows thence across the road metal and shoulders and into the side ditches, culverts, and other structures incidental to its uninterrupted exit. This reference is elementary of course, but it is also fundamental and of first importance. Drainage comes First.

BITUMINOUS PATCHING IN WINTER

Not too many years ago maintenance crews did little satisfactory bituminous patching during the winter. Built up patches were almost impossible to install, and pre-mix materials placed under adverse conditions, were soon knocked out by traffic and had to be replaced many times during the season. With the progressive increase in traffic volume, particularly truck traffic, the public demanded higher standards of comfort and safety on the road through all seasons of the year. A solution had to be found for our winter bituminous patching problems. New developments in this field, as far as Michigan is concerned,

include the use of emulsified asphalt for built up patches and certain patented and therefore unmentionable pre-mix patching materials. Instructions for the use of emulsified asphalt for built up patches will appear in a forthcoming Revision of the Michigan State Highway Department's Maintenance Manual and will read in part as follows:

"Using Asphalt Emulsion AE-1M (Inverted penetration). This process differs from ordinary methods to the extent that emulsion is placed in the hole FIRST and then the aggregate is added.

"After cleaning and preparing edges, AE-1M, at normal air temperature should be placed in the failure to approximately 1/3 of its depth. A portion of this material should be spread over the entire area of failure as a paint coat, by means of a tufted roofer's broom or broom brush. The failure should then be filled with aggregate until it is slightly higher than the surrounding sound pavement. The entire area should then be thoroughly compacted by tamping or rolling. Experience will show the proper amount of emulsion to use, which is just sufficient to flow slightly over the edge of the sound pavement, after the aggregate has been thoroughly compacted. By using smaller sized aggregate on the upper surface of the patch, the patch will have a tendency to be 'self-leveling' with the surrounding sound surface."

Maintenance patching crews now work consistently all winter except in the periods of violent storms, and the patches they install are expected to stay in place. Satisfactory results are being accomplished by these new methods.

SHOULDER MAINTENANCE

Shoulder ruts and low shoulders adjacent to pavement slabs, have always been a serious problem for the maintenance engineer and a source of danger and inconvenience to traffic. Recent developments in shoulder maintenance practice on Michigan trunklines include the addition of calcium chloride applications and a rubber tired roller to follow shoulder blading. New shoulder maintenance practices have been employed on many of our road sections over the past year and results so far are encouraging. There has been a noticeable improvement in shoulder conditions during the summer, which is the period of heavy tourist traffic, and I believe we have collected an extra dividend at times this winter when our shoulders get quite severe treatment during thaws. This winter the shoulders have been exposed for much longer periods than is normal, and our shoulder maintenance work has been noticeably lessened, indicating that the chloride and rolling give a more or less lasting benefit.

The Michigan Highway Department's revised manual will include the following in a section entitled, "Field Procedure For Maintenance of Shoulders—":

"The exact type of shoulder most desirable for any roadway depends on the type and width of the road surface, and the nature and volume of traffic using the highway. Through the cooperative efforts of the District Maintenance Engineers and the District Foresters, maps have been prepared for each district, designating the ideal types of shoulders for all trunkline highways. These maps should be kept up-to-date when road surfaces are changed by new construction, or when traffic conditions may change, and they should be used as a guide for the ultimate shoulder development for which you should strive.

"Sod shoulders are most desirable. However, under certain conditions of heavy traffic, especially truck traffic, it is impractical to maintain sod up to the edge of the metal. Under these conditions it may be advisable to resort to a modification of the full grass shoulder by placing other types of stabilized material along the edge of the metal.

"Inasmuch as the combination type shoulders are usually the result of maintenance operations, the various steps or stages of their development are given, as well as suggested procedures for repair of the various types, in case of failure.

"Step I. If the ruts continue to recur on sod shoulders, the original soil should be trenched out adjacent to the pavement to a depth of from 6 to 8 inches and wide enough to include the entire rut (usually 18 to 24 inches). A power grader having a short section of snow plow cutting edge attached to the lower edge of the regular grader blade should be used for this operation. You should note that when performing this operation only a half section of cutting edge is used on the grader moldboard so that material removed from the trench will be left on the pavement near its outer edge. This material should be picked up and disposed of immediately. The trench should then be backfilled with stabilized gravel having extra high binder content (add and thoroughly mix 10% by volume of approved binder soil to 22-B gravel). It is highly desirable that from 6 to 12 pounds of sodium or calcium chloride per cu. yd. of 22-B gravel be incorporated into this mix. The trench filling should be accomplished in at least two layers, thoroughly compacting each layer by driving loaded trucks with the right wheels in the trench. Upon completion, the shoulder should be level with both the adjacent pavement and the sod. Subsequent failures in the stabilized gravel portion of the shoulder should be repaired as set up for Stabilized Gravel Shoulders.

"Inasmuch as the serviceability of stabilized gravel shoulders depends on retaining the binder soil in the gravel, light surface applications of dust palliative may be advisable during the periods of protracted dry weather. The need for application of a dust palliative is evident when the shoulder starts raveling or becomes excessively dusty. Should the binder soil become lost, it may be necessary to add additional binder soil, following the same general procedure as set up in 'Stabilization' of gravel roads. Blading or reshaping of stabilized gravel shoulders should be done only after wetting with water tanks or after sufficient rainfall to soften the shoulder.

"Routine maintenance of the stabilized aggregate portions of any shoulder is best and most economically accomplished by patrol operations. This method, whereby serious ruts are not allowed to develop, is performed by a shoulder maintainer to which is attached a rubber tired roller.

"The use of the roller is very important and the proper amount of moisture must be present in the shoulder material at the time of rolling to insure proper compaction. If necessary, water tanks should be used to provide additional moisture. During periods of dry weather, rolling should be followed immediately by a light surface application of calcium chloride.

"Whenever possible the power unit should be operated on the shoulder of the road. The blades of the maintainer should be shorter than regular blades so that only necessary material is brought up to the edge of the metal and that a 'secondary ditch' is not formed by the cutting blade. The strike-off blade should be set to sweep the excess material immediately back on the shoulder."

SNOW REMOVAL AND ICE CONTROL

No paper coming from Michigan would be complete without a reference to snow removal and ice control. Since a large part of our time is occupied with winter maintenance, we naturally have developed some extra skills in this field through necessity.

I am recently in receipt of a pamphlet from the Highway Research Board which is part of their "Current Road Problems" series and is entitled, "Recommended Practice for Snow Removal and Treatment of Icy Pavements." This booklet is complete and covers mechanical and technical phases very adequately. It would be good reading for everyone concerned with winter maintenance.

With this source so readily available, I would like to omit too

many technical references here but perhaps a quick summary of our problems in Michigan might be of interest.

Our procedures in Michigan may not necessarily include the solution to the ice problem in every section of the country. Michigan, however, does have a peculiar relationship to a wide variety of winter problems in that we have three rather distinct climatic zones. In the southern part of our state our winter maintenance concerns are mostly with ice problems. Approximately 75% of our winter maintenance money is spent on ice control, and the other 25% on snow removal and snow fence. In the central portion of the state the division is about a 50-50 basis, and in the extreme northern zone we spend about 65% of our money on snow removal, and 35% on ice control which in the north includes much packed snow.

Closely paralleling these climatic zones, traffic conditions are divided pretty much in the same way. By far the heaviest part of our commercial or heavy trucking traffic is in the lower part of the state where our ice control problems are the most acute, and the volumes of traffic densities lessen as we go north in the state, through the less populated and less industrialized areas. With these variable conditions in mind, and considering the great variations in the ice control problems which occur from day to day and vary so greatly with the nature of individual storms, it is evident that our situation requires a wide variety of remedial measures.

Probably the most universal ice control problem in most localities results primarily from packed snow on the pavement. Snow plows which ride on shoes will always leave a small layer of snow on the pavement. This snow, when dry and cold, creates no particularly serious problem. However, as soon as rising temperatures or traffic loads start to turn it to ice, we are then confronted with an ice control problem. Obviously, the simplest solution for this condition would be to use equipment which will take all or most of the snow off the pavement during the snow removal operations. This is where our truck underbody blades perform a most useful service.

The second most common ice condition occurs with a temperature drop to a point just below freezing during a heavy mist or fog or light rain. Under these conditions, thin ice films are formed on the pavement in a short space of time, and the condition occurs simultaneously over large areas.

The third classification of ice control problems occurs when a wet snowfall turns to rain, and, either due to atmospheric temperatures or to low temperatures in the pavement or roadbed, a com-

paratively thick layer of ice is produced. This formation is slower than the sleet or thin ice condition, and is somewhat easier to cope with, due to the less critical time element involved. The whole problem of how to treat this condition, whether it occurs in one of the northern counties, where the occasions are rather infrequent, or on the highways in the southern sections where it occurs frequently, is one of stage treatment. To properly explain the various stages involved in ice control measures, it might be well to go back a few years when ice control measures consisted almost entirely of a little sand spread on the hills and curves of important roads, and maybe a few other dangerous locations known to the local maintenance men. This was our situation in Michigan 20 years ago. During the winter of 1933-34 the Michigan State Highway Department did its first complete sanding operations on selected trunklines. It was tried first as an experiment on the Detroit-Chicago route across our state, and the reaction of the public, particularly commercial truckers, was so favorable that it was decided to extend the practice of straight-of-way sanding to most of our trunkline system.

This, then, was the first step taken beyond minimum safety measures at hills and curves, and I might mention at this point that with the extension of the use of sand to straight-of-way sections, we also started to develop mechanical means of spreading sand. In the early days this was done almost entirely by hand, but it was soon found that satisfactory sanding for highways precluded hand methods, and that some mechanical means of spreading the sand was absolutely necessary for the economical use of the material and to obtain uniform coverage as well as speed in performing this operation.

The next phase in the improvement or development of our ice control methods consisted of the addition of what might be termed excess quantities of chloride salts in the abrasives. The purpose of these additional quantities, added just prior to spreading, was not altogether to further imbed the abrasives in the ice, but was aimed toward the partial or complete removal of the ice from the highway surface. The abrasive, of course, formed a layer of non-skid material at once and took care of the immediate ice problem, whereas the addition of chloride started the process of ice removal in its first stages.

The present practices in Michigan are aimed at the complete removal of ice from our trunkline highways as soon as practical by the use of underbody blades, or other mechanical means and by the application of chloride salts alone. This naturally is preceded by the application of some abrasive to hills, curves and other locations of

extra hazard, but we are using less sand and more straight chemical each year in the solution of our ice control problems. It is evident that in progressing from the first type of ice control, i. e., the application of chlorided sand, to the application of straight chloride salts, we have increased the importance of control spreading. We are now using more of a comparatively expensive material and we must, therefore, use the most efficient and economical means of applying these materials to the road without waste.

One of the biggest steps forward in the application of chlorided sand is the development of bin-type spreaders. These spreaders have a better control feeding than the older types and give us a longer spread per load of material. This saves time at the stockpile, in that the trucks do not have to be loaded so often and allows a faster coverage of critical areas where time is of prime importance in getting a situation under control. In Michigan most of the sand used on the roads now is applied by means of these bin-type spreaders. When straight chemicals are used, and by this I mean in the case of Michigan, rock salt, we do not use rotary spinners. In most cases the salt is applied through a spout of some kind that drops it from about truck-body height onto the pavement near the center line. The force of gravity gives the salt enough bounce to spread it sufficiently wide to cover a strip in the center part of the pavement which, after the salt has done its work, gives traffic at least a safe track for the wheels on the left-hand side of the car. In most cases the salt brine formed in the center of the pavement will follow the crown down to the edges and loosen the remaining ice sufficiently so that it can be knocked off by traffic or in some cases by a follow-up trip with our underbody blades. In Michigan we depend on underbody blades mounted on our trucks to a large extent, whereas I believe some of our neighboring states use patrol graders and other heavier equipment.

We are now using bulk salt in most locations in the state for ice control. We find that this is a big saving in both time and money over packaged material. The salt stores well outdoors if a cover of 3" to 6" of sand is placed over it and the pile used up during the winter season. We find that the small amount of sand mixed in with the salt when it is loaded has a good psychological effect on the public using the highways since it gives some evidence of our having been on the job even before the salt starts to work and this seems to satisfy most drivers. The rock salt itself has some effect as an abrasive before it melts.

An effort is made to clean up all bulk salt piles before spring since there is considerable loss experienced when this type of storage

is continued too long and the stockpile and its immediate vicinity become rather sloppy from the salt brine formed at the time of heavy spring rains.

In conclusion, I want to emphasize again that the investment in maintenance itself is huge and that there is a correspondingly heavy responsibility of maintenance men everywhere to see that this maintenance money is spent efficiently and economically in the public interest.