

Shall have charge of assistants in their work.

Shall require assistants to file with him, upon dates designated by the auditor, an itemized monthly report of cost of labor and materials for preceding month, showing duties, hours, and kind of service, names of parties performing service, where performed, and kinds and quantity of material used and where used.

Shall pass upon report as a voucher, and, when it is approved, file it for allowance by board of commissioners.

Shall petition board of county commissioners for entry upon lands when necessary for drainage purposes or for timber, stone, gravel, or other material necessary for highway maintenance, estimating cost of these materials.

With approval and payment of damages upon allowance of board of county commissioners, surveyor shall enter upon such lands for purposes named, provided no appeal is taken from commissioners' action.

Shall prepare a map showing length and character of each road.

Shall give names or numbers of all roads.

Surveyor shall be entitled to salary as surveyor or supervisor, depending upon the largest amount, but shall not receive both salaries.

Shall attend Annual Road School sessions at expense of county.

## NEW DEVELOPMENTS IN MAINTENANCE OPERATIONS

By C. W. McClain, Engineer of Maintenance, Indiana State  
Highway Commission, Indianapolis, Indiana

Maintenance operations are so ever-changing that it is difficult to say what is new, and quite often it is a misnomer to call them developments. This characteristic of maintenance calls for constant vigilance and alertness and many times discourages maintenance men in their constant struggle to combat the ever-destructive forces of traffic, elements of weather, and the growing demand of the traveling public to expect uniform solutions in similar situations regardless of geographic location.

Maintenance of streets and highways consists of the preservation, repair, improvement, and development of surfaces, roadbeds, and structures, and of the facilitating and promoting of safety of traffic movements.

I will take up these different items in the order named in an attempt to point out recent methods used in attempted solutions.

### PRESERVATION

Under this term falls the attempt to keep, as far as possible, the existing conditions on a highway or street as nearly intact as possible. Dragging loose metal surfaces, cleaning

ditches and drains, mowing weeds and cleaning roadsides, painting and cleaning structures and signs, and pouring cracks and joints in hard surfaces are some of the principal items in this part of the work.

*Dragging Loose Metal Surfaces.* The tendency in this operation is towards faster-moving equipment, which enables one operator to cover more miles in his working time or a smaller mileage oftener. Snow plows, underbody scrapers for surfaces and shoulders, and motor graders offer many developments. These are in the easier and speedier control of the cutting blades, all tending towards one-man operation. Electric controls are supplementing or replacing hydraulic, multiple blades are partially replacing single blades, and Diesel power is gaining much prominence.

*Cleaning Ditches and Drains.* Methods of doing this work are not developed in any new way, but a recognition of the importance of doing this class of work well is increasing. It falls in the list of rather uninteresting details, which accounts for its tendency to be neglected. Clean, well-functioning side ditches have augmented the tendency towards side-ditch paving, a class of work that is coming in rapidly. Many road paving and grading contracts now have ditch-paving items included.

*Mowing Weeds and Cleaning Roadsides.* A few years ago weed mowing methods inclined towards power-drawn or self-propelled equipment. In my opinion this method is expensive. Furnishing mowers and hiring teams locally, or hiring both the farmer's team and mower appeals to me as being more economical and has the added advantage of providing, in many cases, much-needed work for local residents. Clean roadsides give travelers a degree of confidence which promotes safety. Fixed objects which constitute real hazards are uncovered and can be seen and more easily avoided. Well-groomed roadsides instill a spirit of pride in the patrolmen that carries into the other parts of their work.

*Cleaning and Painting Structures and Signs.* Many good steel structures have been ruined in a few years by allowing debris to accumulate around the end-posts. Maintenance crews should be instructed to keep bridge seats and the lower part of batter posts always clean and painted.

Signs to be effective should be quickly and easily legible. The use of steel signs in place of wood seems to convey more quickly the desired message and in a uniform way. The change from the old wooden signs to metal is going forward. Use of the proper grade of paint or enamel should be studied, and good advice from reputable paint firms is easily available.

*Pouring Cracks and Joints.* Experiments are being run on elimination of this class of work entirely, but, until these experiments offer definite results, crack and joint filling should continue. Unfortunately, the choice of proper filling material

is in an embryo state. Nation-wide experiments on crack and joint fillers are going forward, and it is to be hoped that definite recommendations can be made in the near future. Mastic fillers of both tar and asphalt are being used with varying results. Mixtures of bituminous materials and either sawdust, cork, or rubber, have been tried. The problem is to find a material that will alternately compress and expand and still cling to the sides of the joint. Spraying the edges with a light spray of kerosene is a recent development which holds promise of causing material to adhere to the sides of the cracked pavement. Experiments with sulphur as a filler have been tried but almost abandoned because of the danger encountered in handling it. This problem of the proper filling material is still unsolved, and continued experimenting should go forward.

#### REPAIR

This part of the work is the next step beyond that of mere preservation. It includes the patching of all types of both hard and flexible surfaces of driving widths and shoulders, the replacement of guard rails by the cable and flexible types, the restoring of bridge members and floors, and the upkeep and repair of equipment.

*Patching of Surface.* This class of work is frequently neglected to the point of allowing surfaces to become hazardous to traffic and permitting failures to spread unduly over great areas. To assure proper methods of repair and as a guarantee that the work be done at the proper time, properly equipped gangs for this work offer a solution. Men with the ability to make uniform and smooth patches "are born and not made." These men should be chosen with care. Methods of patching with the various materials are well outlined in literature put out by reputable companies dealing in such material. The instructions for this work contained in their literature are presented in detail and well thought out. Because of the great increase in traffic speed, shoulder patching should receive the same care and attention as the driving surface.

*Replacement of Structure Parts.* As you all have observed, one of the apparent favorite exercises of motorists is the battering of end posts of steel bridges. From my experience I have found it safer and more economical to let the furnishing of material and its installation to steel companies familiar with this class of work.

Broken guard rail posts of either cable or rail should be replaced immediately. The very fact the guard rail was hit at a particular location is good evidence it is liable to be hit again at the same place. I should like to stress that repairs of this nature be made promptly. Such promptness may save a life. Bridge floors ought to be repaired at once and, if replaced, attention is called to the desirability of using creosoted lum-

ber, if lumber is used. Its added life, due to treatment, is well worth the difference in cost. There is not a great deal new to be said about equipment upkeep, but it should be stressed again that a "stitch in time saves nine." Keep equipment well lubricated and painted.

#### IMPROVEMENT

It is sometimes difficult to distinguish between maintenance and more or less permanent changes which fall in the class of minor betterments. Under this heading come culvert and small structure extensions, installation of French drains and perforated pipe, small changes in stream channels, super-elevation of curves, rounding of dangerous corners, and such items as, because of their miscellaneous nature, do not lend themselves to contracts, but are of enough importance to be dangerous to traffic if not done. This class of work is a transition between strictly maintenance and unquestionably construction work.

#### SAFETY OF TRAFFIC MOVEMENTS

This embraces quite a large field of maintenance activities and is becoming increasingly important as vehicle speed increases. Placing and upkeep of markers and signs, both plain and reflector type, centerline and traffic lane stripes, railroad protective devices, snow and ice removal, flood control emergencies, regulations of traffic in weight, length, height, and width, are some of the problems directly connected with traffic problems usually assigned to the maintenance division.

*Markers and Signs.* Under this heading falls that large class of information that must be imparted to the traveling public while in motion. It is a literal instance of "reading while you run" due to the great increase in traffic speed. Two methods are used to impart this information speedily and accurately: either symbols or words, or a combination of the two. The tendency now is to use symbols wherever possible, and I am of the opinion the tendency has gone too far. A few well-chosen words combined with the proper symbols are, to my mind, much safer and far more liable to convey the proper message to the traveler. The use of reflector buttons in road signs has gained much recognition and rightfully is gaining more. A word of warning should be issued to those buying signs that various makes of buttons vary greatly in their ability to reflect light. It should always be borne in mind that any road is better unsigned than poorly signed. A driver on a signed road has the right to expect that all hazards are marked and, in addition, that all similar hazards are marked uniformly. If the road is unsigned, the driver recognizes the increased risk, is more alert, and proceeds with greater care.

*Pavement Striping.* This safety measure has not had enough attention, both in method of applying and universal use. Effort is being made to increase the effectiveness of center and multiple traffic lane marks for night driving. We have experimented with white and yellow traffic paint and also bituminous material. The paint lines are effective for the driver under his own lights, but fade out under lights of approaching cars just when he needs the added protection most. To eliminate this objection, we have gone to cut-back asphalt with about one and one-half pounds of powdered asphalt to the gallon added. This does two very desirable things: it leaves a very glossy surface which shines under light and, because of the quick-drying effect of the asphalt powder, eliminates the use of sand covering. This work is best done when air temperatures are not over 35°F. Some criticism is made because the line is slippery when wet, but the small width involved minimizes danger of prolonged skidding. The slight skidding involved tends only to encourage traffic to cross the line only when necessary.

Another effective method, especially on black pavement, is the cut-back asphalt line followed immediately with fine white limestone screening. This makes a very lasting line and depends on its white color and some appreciable thickness for its effectiveness.

A mark along each edge of the pavement and none in the center is getting some attention. It is claimed the edge is easier followed than a center line. As long as our motor vehicles are left-hand drive, I am inclined to think the center line is preferable.

*Railroad Protection Devices.* It is obvious that grade separations, however desirable, will never catch up with the urgent need for protection at rail and highway crossings. To supplement this remedy and speed up protection many devices have come into the field.

There has been a great improvement in the reliability and effectiveness of alternating flasher lights and also the wig-wag type. Great improvements have also been made in the design of gates. One of the newest devices is a motor-controlled positive barrier which comes up from the pavement level to a sufficient height to stop traffic when a train is approaching. This whole field is getting much thought and attention.

*Snow and Ice Removal.* The necessity of prompt snow removal is taken for granted, but the promptness depends on the importance of the road. Many of us have been stampeded into loading up on snow removal equipment at great expense beyond the economic need for such equipment. Our newest equipment consists of small straight blades attached to high-speed light trucks. This enables the men to make frequent trips and, in most cases, keep ahead of the storm, unless it is especially severe. Supplementing this high-speed removal

equipment should be a few heavy-type V-plows for heavy drifts and very deep snows.

Ice is recognized as a very distinct hazard and should be removed as quickly as possible. Sand, stone grits, or cinders should be stored at strategic points on curves and grades and applied promptly when ice forms. Calcium or sodium chloride is recommended as an admixture to the stock piles to prevent their freezing and to aid in embedding the grit particles in the icy surface.

High speed spreaders are recommended which will handle mixtures of grit and either calcium or sodium chloride. These can be used on greater lengths of road. After the chemicals have sufficiently melted the ice, it can be removed with a grader, thus eliminating the hazard entirely. The greatest effectiveness gained from any method of ice control depends on promptness.

*Emergencies.* Under this heading are such activities as adequate warning at flooded locations, removal of debris after storms and wrecks, and in many cases first aid to the injured.

The whole maintenance field has many problems and ramifications which are not apparent to the layman.

## NEW DEVELOPMENTS IN ROAD MAINTENANCE EQUIPMENT

By Earl B. Lockridge, Field Engineer of Maintenance,  
Indiana State Highway Commission, Indianapolis,  
Indiana

It has often been said that there is nothing new. We just discover or take notice of things which have always existed and with which we are more or less familiar but which we suddenly see in a new light. In the matter of equipment, new developments ordinarily mean merely the application of old principles in a new or different way.

It is rather presumptuous for me to attempt to speak to a group so well advised as the county surveyors, county road supervisors, and county commissioners of the state of Indiana, about new developments in road maintenance equipment. I realize that many of you are in daily contact with all types of maintenance equipment, and, no doubt, have been instrumental in the development of some of the most recent and most useful improvements. With this fact in mind I shall attempt to deal with generalities only and trust that there will be frank discussion from this entire group which will result in the maximum benefits to be derived.

I shall first mention motorized equipment, since this is the motor age and the greater part of our equipment is propelled or operated by some type of motor. Before the automobile, truck, and tractor came into general use, the farmer