The studies are being conducted in co-operation, and by interviews, with the county agricultural agent, the county surveyor, and many county and city officials and citizens who have a thorough and practical understanding of local problems.

SURVEY OF ROAD CONDITIONS BEFORE RESURFACING

George Gault,
Wayne County Surveyor,
Richmond

A great many mistakes in road building and road maintenance might be avoided if a careful survey of road conditions were made before the work was started. We are interpreting the word “resurfacing” to mean any change in the surface of the road after the first vehicle has passed over the road. In most cases it is not possible to take the time to run a transit line and a line of levels, and to cross-section the road to be improved. Much information, however, can be obtained by simply observing the road at different times of the year and in different kinds of weather. These observations should develop the following information:

1. Whether any changes in alignment should be made.
2. Whether any grade changes should be made.
3. Whether any additional right-of-way is necessary.
4. The general drainage of the right-of-way.
5. The condition of all drainage structures.
6. The character of the subgrade and the present surface.

These points are not listed in the order of their importance, but rather in the order in which they should be considered; and we will, therefore, discuss them briefly in the order named.

ALIGNMENT

Motor vehicles are being made to travel at higher rates of speed each year, and heavy trucks are now being driven over our roads at higher speeds than the light passenger cars of a few years ago. We all know that the wear on the road surface is much greater on curves than on tangents. It is often possible by shortening the road by the elimination of sharp bends to save enough in the cost of construction and maintenance to justify the purchase of the land which may be necessary to make the change. This is in addition to increasing the safety of the traveling public. If it is not possible to eliminate the curves or sharp bends, we should make the curves of as great a radius as possible, and give the proper superelevation to the roadway. If time and funds permit, we believe it will pay to run a straight line on roads
which appear to be straight. It will generally be found that
some irregularities exist in the present road; and by chang­
ing the width of the material added to the berms at different
locations, the general appearance of the road can be greatly
improved. The alignment of any connecting or cross-roads
should be considered, and provision should be made for any
changes in their alignment which may be made in the future.

GRADE CHANGES

Improvement in alignment as outlined above will not be
of much benefit if we permit sharp changes in the grades to
obstruct the sight-distance of the motorist. The most of
our roads were originally laid out with practically no grad­
ing, for it was only necessary that the grades be such that
they could be climbed by a horse. When wagons were used
for transporting loads over the roads, it was possible to
limit the loads to the load that could be pulled over the road;
and the question of safety did not enter into the discussion
as to how much a hill should be cut down. Now we find
that although many of these roads have been improved by
a gravel surface, no attention has been given to the safety
which is so necessary with our modern vehicles and rates of
speed. We hesitate to destroy this gravel surface by cutting
down the hill and raising the fill through hollows.

These situations have been corrected on our main state
highways; and the average motorist, upon leaving the state
highway, forgets to reduce his speed and in too many cases
provides work for the county coroner. By the use of vertical
curves, it is often possible greatly to improve the safety of
the road with only slight expense. The approach grades
to bridges should be given consideration not only to prevent
undue strain on the bridge but also as a matter of safety.
The approach grades to railway crossings should be made so
that a level space will be provided on which the motor vehicle
may be stopped before crossing the railroad. Approach
grades to heavily traveled highways should be treated in
the same manner, as the hazard at such crossings is greater
than that at the railroad crossings. The grades of connect­
ing or cross-roads should be given consideration, and any
changes which can be made in the road to be improved that
will improve sight-distance on these roads should be made.
Again, if time and funds permit, we think that a profile
showing elevations on the road at each 100 feet will be worth
much more than it costs and will make it possible to improve
the appearance of the road greatly.

RIGHT-OF-WAY

The general width of the right-of-way on the county roads
in our county, which were formerly township roads, is about
thirty feet. This is hardly wide enough to provide for an improved road with proper drainage, and we have secured an additional five feet on each side where any extensive improvements have been made. As it is highly desirable that some one keep the weeds mowed on the roadsides, we do not think it advisable to take any more right-of-way than is absolutely necessary for the proper maintenance of the road. During the time that we have had relief workers on the roads, we have moved the road fences back with no expense to the landowners for labor. The landowner either furnishes new posts and fence, or we move the existing fences back to the new line. It is usually possible to secure the consent of the landowners to make these changes without paying for the land. If they insist on being paid, we skip this part of the road and go ahead and improve the other parts. Before the rest is completed, we have always been requested to come back and complete the road; and we get the right-of-way without further trouble. While it may not seem that the right-of-way has much bearing on the resurfacing, we do not think that it is of any use to resurface a road unless the right-of-way is such that the road can be efficiently and economically maintained.

GENERAL DRAINAGE

Many of our roads have been drained by digging a ditch of a certain width and of uniform depth below the surface of the road without any provision being made for the water to get out of these standard ditches. The result is that the water lies in these low points in the side ditch for a long time after the remainder of the road has dried out. This frequently results in permanent damage to such surface as may be on the road, and such conditions should certainly be remedied before any resurfacing is done. We believe that the width of the road from shoulder to shoulder should be kept uniform, but the width and depth of the side ditch should be such that the water will all move to a permanent outlet without damage to the road. If it is not thought possible to have levels set for these ditches, it is a good practice to drive over the roads either during or immediately after a heavy rain, when the defects in the drainage will be very noticeable. Then notes can be made of the points to be improved by drainage. After the drainage has been completed, it is a good idea to drive over the road again after a heavy rain and see if any further improvements can be made. If any wet spots remain in the road in dry weather, the cause should be investigated and either French drains or perforated pipe installed if necessary.
Before any resurfacing is done, we believe that all drainage structures should be examined and that, if it seems probable that all or part of these structures will have to be replaced before the surface which it is proposed to apply is worn out, the replacement should be made before the surface is applied. Under a CWA project we had a survey made of the drainage structures under our county roads. We found that on the 717 miles of county highways, we had about 3,400 structures. This includes all openings under the highways from four-inch pipes to three-span bridges. Many of the older pipes are of vitrified clay and have been badly cracked by the modern heavy loads.

It is only a question of time until all of these must be replaced. This replacement will necessitate the digging of a trench across any road surface which may be on the road at that time. It is very difficult to fill this trench so that there will not be a rough spot in the road surface for some time after the pipe has been installed and the trench refilled. Many of our larger bridges should be replaced with stronger structures in the near future. This will require changes in the road surface on the approaches. We feel that a road is no better than its poorest sections and that a rough spot caused by the replacement of a structure largely offsets any advantages that may be gained by its resurfacing. The inlets and outlets of drainage structures should be given attention. In many instances the cleaning away of rubbish from the inlet and the deepening of the outlet will cause a pipe culvert to carry all the water which normally flows to it with no damage to the road surface; while if the same pipe is neglected, serious damage will result.

PRESENT SUBGRADE AND SURFACE

The present condition of the road surface will largely determine the kind and quantity of resurfacing to be added. As we have a great many gravel pits in Wayne County, it is the common opinion that all a road needs when it becomes rough is to have some gravel added to its surface. The greater part of our roads are on the section lines; consequently, we have a corner stone in the middle of the road each half mile. I say "have" but should say "had," for it was the practice for some years to remove these stones whenever they interfered with any road equipment. During the past five years we have adopted a different plan. Whenever one of these stones interferes with any construction or maintenance work which is being done on the road, it is reported to our office. We then send one man from the surveyor's office and a light truck and driver from the highway department and lower the stone
if it is too high or set an iron pin on top of it if the road is to be raised. The method used is first to set four reference stakes from the stone in its original position. If the stone is too high, enough gravel and dirt is removed from around the stone so that it can be pulled out with the truck. A hole is then dug and the stone placed deep enough to prevent any interference with road work, using the reference stakes to replace the markings in exactly the same position as before. If a fill is to be made so that it will be difficult to get at the original stone, reference stones are placed as described above, and when the fill is completed an iron pin or pipe is driven directly over the mark on the corner stone.

In laying concrete and brick pavements some years ago, no attention was given to these corner stones. This causes a lot of extra work on land surveys in these locations. In recent years all corner stones have been carefully referenced before any pavement of a permanent nature was laid, and permanent marks made in the completed pavement. In pavements laid by the state we have co-operated with the state highway engineers in having these marks set. In the past five years we have lowered nearly 100 corner stones as described above.

In doing this work we noted the depth of the gravel, and were somewhat surprised to find that in nearly all instances the gravel was eight inches or more in thickness. As these stones were always near the center of the graveled part of the road, we decided to dig some test holes on each side of the center line to determine whether this thickness was the same for the entire width of the road. About this time the road department decided to resurface one and three-fourths miles of gravel road by adding a bituminous course with rock-asphalt wearing course. It was decided to dig test holes in this road to determine the exact thickness of the gravel surface then on the road. Accordingly holes were dug through the gravel on the center line of the road and at points five and ten feet each side of the center line. Along the center line these holes were about 100 feet apart, with closer spacing where there were any indications that there might be a change in conditions. It was found that on the center line and at the points five feet on each side of the center line the gravel was from eight to ten inches thick. At the points 10 feet on each side of the center line the thickness of the gravel averaged about 4 inches. We decided that this was due to the widening of the gravel to fit modern traffic conditions after it had been dumped in the middle of the road. By digging a few trenches entirely across the road it was found that a strip in the middle of the road about 12 feet in width was graveled with the greater depth of gravel mentioned above and the remaining four feet on each side was graveled only to the lesser depth. By inquiry from the residents along the
road, we found that the road was sometimes cut through during the spring thaws; and by investigating the points where we were told that the road did cut through, we found that the defect was one of drainage rather than of depth of gravel. Observations on other roads during spring thaws have led us to believe that stability is not so much a question of thickness of gravel as of the proper placing of the gravel after the road has been properly drained.

By digging some test holes in roads which were badly corrugated and at other points in the same road where the surface was comparatively smooth, we were led to believe that this corrugation is quite often due to the oversize material in the gravel. Properly graded gravel added in thin layers over these corrugations does not seem to help much. In fact, we think that this new material is practically wasted when applied to any road that has not been thoroughly smoothed and brought to uniform texture and proper cross-section before the new material is applied. Where this oversize material exists, we think that it would pay to scarify the road to a depth of six inches and then remove the oversize by hand raking if necessary. If this material could be crushed and put back on the road without too much expense, this would be a fine way to dispose of it. If this is not possible, we think we would be justified in wasting it on the widening of narrow fills.

In applying gravel during the winter, provisions should be made for spreading the gravel each evening. If the gravel becomes frozen before it is brought to proper cross-section, it is very difficult ever to get it in shape, and a large part of the benefit of the new material is lost, as it is much easier to prevent a road from becoming rough than it is to make it smooth again after it has become rough.

Our entire resurfacing work could be much more efficiently and economically done if a definite program for a period of years could be adopted and made a matter of record and then carried out by whoever might be in charge of road work. Under our present system one person maps out a program and gets certain roads in shape for resurfacing the following year. The following year some other person is appointed to take charge of the road maintenance and does not resurface the roads already selected but starts on another list of roads. The net result is a loss to the taxpayer.

In conclusion we would like to emphasize these points on resurfacing:

1. Keep within your budget. You do not get much of a thrill out of paying back bills, either your own or someone else’s.
2. Spend all the time you can in riding over the roads so that you may know what roads need resurfacing the most.
3. Select materials for resurfacing that will make maintenance easier and cheaper.
4. Don't resurface until you are sure that the drainage has been well taken care of.
5. Don't resurface until the old road surface has been properly prepared to receive the new material.
6. Don't expect that the new surface will not require maintenance.

THE INDIANA SECONDARY ROAD PROGRAM

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What is the secondary road system in Indiana? Can the state system now be divided into a primary and a secondary system; and if so, on what basis should such a division be made? On the basis of surface types, the system cannot be so divided, for on some of our most heavily traveled roads, there now exist secondary-type surfaces. On studying our traffic records it soon becomes apparent that one cannot divide the existing system into primary and secondary roads on the basis of traffic. On many roads one section will be carrying light traffic, say 100 to 150 vehicles per day, while on another adjoining section the count may run from 750 to 1,000 per day or even higher.

The highways in the state system have never been classified into primary or secondary roads, as was done in many of the states. In several of the states of the Mississippi Valley, the law establishing a state highway system designated a primary and a secondary system of roads and provided for the sequence of improvement of the two systems.

The first Indiana Highway Act passed in 1917 provided that the commission should designate the main roads of the state, which were to be known as "Main Market Highways," and that a report thereon should be made to the governor. In designating these main roads, the commission was obligated to take into consideration the lines of travel connecting main market centers, as well as the kind and volume of traffic.

This law was declared unconstitutional, and at the session of 1919 the legislature passed a new law with changed provisions for laying out a system of state roads. The "Main Market Highways" as selected under the 1917 act were to remain in the system, and in addition it was provided that the state system of highways was to reach every county seat and every city or town having a population of 5,000 or more, as well as to connect with all improved trunk highways of adjoining states. This selection of a state highway system was to be completed by the highway commission before April