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Iowa County Maintenance Practices: A 20-Year Update

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In the late 1950s, the National Association of County Engineers was just getting started as an organization. In an effort to provide guidance to county engineers throughout the United States, they were working on a manual of maintenance procedures. In conjunction with these efforts and with a need for more information, a questionnaire on county maintenance practices was sent to the 99 counties of Iowa; 94 counties responded. In 1980, the same questionnaire was again sent to the countires in Iowa so that the practices of today could be compared with those in 1960. There are similarities and differences in that time span. There is less county highway mileage today. There is a change in the spread of population; however, the mode of county population is the same: 15 000 to 20 000. Safety has made an impact on operations. The physical evidence is shown by the greater number of signs, wider shoulders, and more center-line striping. Bridges were a concern 20 years ago. They are no less a concern today. Economic concerns are indicated by less emphasis on roadside maintenance (mowing and spraying).

In 1959, in cooperation with the Maintenance Committee of the National Association of County Engineers (NACE), a questionnaire was sent to the 99 counties in Iowa to obtain information relative to maintenance practices on county roads; 94 counties completed the questionnaire. These data became the basis for a paper (1) that was one of the first efforts to explore county highway maintenance practices. It was presented to a committee on highway administration. The discussion pointed out that there was a dearth of information regarding highway practices at the county level. There was praise for the newly established NACE, which was barely four years old, and the excellent progress it had made in providing guidance through manuals and instructions to county engineers across the nation. The paper on Iowa county maintenance practices and the questionnaire used were sent by NACE to counties in all states and used in preparation of a manual on county maintenance practices.

In an effort to determine what has happened in the intervening time, the same questionnaire was sent to the counties in Iowa in 1980, approximately 20 years later; 89 counties responded to the questionnaire. Comparison of information from the two questionnaires is the basis for this paper.

A tabulation of the answers to a majority of the questions was a part of the original paper. The 1960 questionnaire answers are not available now. Some of the information received on this questionnaire will be reported for today's knowledge even though there is no comparison with the information obtained 20 years ago.

The original paper outlined the administrative structure in Iowa. As a backdrop to this paper, certain administrative information is essential for better understanding.

The 99 counties of Iowa have jurisdiction for maintenance of approximately 89 000 miles of secondary roads. There are certain Iowa Department of Transportation (IDOT) approvals of design plans and contracts in the construction of these roads. The selection, design, and initiation of the projects as well as maintenance are the responsibility of the local county officials.

Highway policy for the counties is vested in an elected board of supervisors. Such policies are guided by statutes that give authority and limitations to the county board. The board of supervisors is elected at large or by district within each county and consists of three to seven members.

Statutes require that the board of supervisors employ one or more registered civil engineers, who are known as county engineers. The term of the county engineer is one to three years. However, the tenure of this office may be terminated at any time by the board. The statutes require that the county engineers, in the performance of their duties, work under the direction of the board. However, another section of the law states that all construction and maintenance work shall be performed under the direct and immediate supervision of the county engineer, who shall be deemed responsible for the efficient, economical, and good-faith performance of that work.

Some counties are divided and run by supervisory districts. In such instances, there is some evidence that the maintenance operation is controlled to some degree by the supervisor in that district. These counties are in the minority.

An annual secondary road budget must be submitted by each county to IDOT. It provides a fiscal picture of the counties' operations. There is good evidence that progress depends a great deal on the level of road management. Good management provides a high level of service and safe transportation with the revenues available.

Although each county is required to submit an annual report to IDOT, there is no requirement for a uniform accounting system. A system of accounts is used to provide information for the annual report. However, the fact that there is no required uniform accounting system may explain the wide range of answers to the maintenance questionnaire. There may be different interpretations and ways of keeping records as well as different levels of service that are used in the 99 counties. However, a majority of the county engineers have many years of experience, which lends authority to the information received and documented in this paper. This information

should be valuable in the formulation of future maintenance practices.

Iowa is one of the nation's leading agricultural states, located in the Midwest between the Mississippi and Missouri Rivers. It has one of the most dense road systems in the United States, approximately 1.7 miles of highway per square mile of area. Although growing modestly in the area of industry, it depends largely on its agricultural base for economic resources.

Agriculture, on which Iowa depends so much, requires an extensive highway system to fully utilize its potential. This is shown by several aspects: (a) an early county engineer law (1913); (b) three major areas of highway responsibility: state, 10 000 miles; municipal, 12 000 miles; and county, 89 000 miles; and (c) the dense road system mentioned above.

The extensive mileage has become the subject of much discussion, especially whether it is needed and ways to reduce it. This has led to the only significant change in the administration of county highways, which now permits county boards to designate certain roads as primitive roads. As yet, no such designations have been made.

There has been some mileage change statewide, however. On January 1, 1960, there were 91 500 miles in the secondary road system; 82 percent was loose surfaced; 5 percent was hard surfaced; and 13 percent was earth. As of January 1, 1980, the statistics were as follows: The total mileage was 89 027, of which 79 percent was loose surfaced; 14.5 percent was hard surfaced; and 6.5 percent was earth. That is a reduction of 2.2 percent in total mileage in 20 years.

During that time, however, there has been a concerted effort to transfer lower-classified state highways to the secondary system. The significant change is in the surface category. Essentially, the change has been a reduction of earth and an increase in hard surface. The earth has decreased by approximately 6.5 percent and the hard surface has increased approximately 8.5 percent.

It is interesting to note the change in population. Of 87 counties reporting, 5 counties are larger than 100 000 compared with only three 20 years ago. Today, there are 16 counties with less than 10 000 population, whereas 20 years ago there were 4 with less than 10 000 population. The mode today is 15 000 to 20 000 population; 20 counties are in this range. The mode is the same as that 20 years ago; however, 37 counties were in this range then. The disparity between smaller and larger counties has increased.

The earlier questionnaire dealt with earth roads, loose-surfaced aggregate roads (crushed stone or gravel, not stabilized), and bituminous- or asphalt-surfaced roads. There was only one question regarding roads surfaced with portland cement concrete (PCC) pavement. In the intervening time, Iowa counties have used the slip-form paving process to pave hundreds of miles with PCC pavement.

Beginning with maintenance management, the questionnaire asked who was in charge of maintenance: county engineer, county board, superintendent, or a foreman. Of the 89 counties reporting, 52 indicated the county engineer was in charge, 15 reported that either a superintendent or foreman was in charge, and 22 indicated a combination of the engineer, board, foreman, and supervisor. Only one indicated that the board was in direct charge of maintenance. If you add the combination of engineer, foreman, and supervisor to those who answered that the engineer was in charge, it shows that in 69 (78 percent) of the counties, the county engineer is in charge. This is slightly less than the 84 percent indicated in the earlier questionnaire. The information is interesting, since the statutes indicate that the county engineer is responsible for such activities.

In 1959, 29 counties used mobile radios for their maintenance and construction operations. Today, of 89 counties reporting, 87 indicated that they used mobile radios. This is a modern tool, and it is surprising that even two counties indicated that they did not use them. We have no indication as to other means of communication such as car telephones.

A statistic that affects maintenance operations and level of service is the number of bladings on unsurfaced and/or loose-surfaced highways. In 1959, county engineers indicated a range of bladings on earth roads from 3 to 80 per year. The range today was from 1 to 36. The average was 7 times a year, whereas 20 years ago the average was 21 bladings. Economics and/or better records indicate that the number of bladings on earth roads has been cut by two-thirds. Other reasons may be more expertise (better techniques and training) and better equipment.

The bladings on loose-surfaced roads averaged 29 per year compared with 37 per year 20 years ago. The range was also much less, 1-60 compared with 3-110. The questionnaire asked for a desirable number of bladings per year. Twenty years ago, the average number of desirable bladings was 42. Today, the desirable average is 30, which is the same as today's operational average. The county engineers must feel that their existing blading practices are adequate.

The paper 20 years ago noted that the Hamilton County engineer, after answering the questionnaire and not being sure of the number of bladings, kept track and found that his actual blading average was 30. As noted, there is little difference in his average of 20 years ago and the existing average.

Twenty years ago, about half the counties used crushed limestone and the other half used gravel for the loose surface on roads. Today, approximately 50 percent of those reporting use limestone exclusively and only 30 percent use gravel exclusively; 17 counties (19 percent) indicated that they use both stone and gravel. This indicates that natural deposits of gravel are being depleted and counties are now using limestone or limestone with gravel. This could become an economic factor in the future.

Sixteen counties indicated that they used chemicals to treat their loose surfaces. The average number of bladings for chemically treated surfaces is 14 per year, which is the same as it was 20 years ago. This is considerably less than that required for a loose-gravel surface (29), which shows a cost savings as well as an energy savings. There has been no change in the bladings in 20 years, which might indicate that the technology for this type of surface has been better.

Seventy-seven counties reported on the number of passes made to remove snow on loose-surfaced roads. Today, the average is 11 bladings annually as compared with 8 per year 20 years ago. Within the 20 years, it appears that the public demands and gets almost 50 percent more bladings for snow than they used to. There are indications in discussions that there is now a turn toward less bladings or a lower service level due to economics. This may have happened since the questionnaire was solicited.

Each county indicated an estimate of the annual loss of loose surfacing material. Twenty years ago, two-thirds of the counties indicated a loss of 0.5 in or more per year. In 1980, 72 percent indicated a loss of 0.5 in or more per year. Twenty years ago, it was felt that this was greater than the actual loss, but the current information helps validate that annual loss. As noted in the earlier paper, there is great variation in the results of

the questionnaire. This can be justified by the fact that it is an average for roads carrying anywhere from 10 vehicles to more than 1000 vehicles/day. The best estimate for the loss of 0.5 in of material would be approximately 240 tons/year. The average of all 87 counties reporting is almost 0.5 in. The cost of this operational loss ought to spur more research into ways of reducing the tremendous outlays each year.

Mowing road right-of-way shows some definite trends in the last 20 years. The trend is away from mowing on the lower-traveled and less sophisticated roads to an increase in mowing on the higher-type roads. Twenty years ago, 28 counties did some mowing on unsurfaced roads. Now, only 16 counties are mowing on these roads. Almost exactly the same number of counties were mowing on loose-surfaced highways--48 as compared with 47. On the paved roads, 77 counties showed mowing being done, whereas 20 years ago only 47 did. In all but one or two instances, the amount of mowing was essentially just the shoulders rather than all of the right-of-way. This is a significant change, since 20 years ago 16 counties indicated that they mowed all of the right-of-way on the paved surfaces, and 8 counties mowed the entire right-of-way on loose-surfaced highways. Thus we can say that there is a trend toward more mowing on paved roads, but the mowing is limited in scope on these roads.

Although the majority of counties use chemicals for weed and brush control, the number is slightly less than those who used chemicals in 1960. There is more spot treatment today rather than spraying the full right-of-way. This would indicate a more efficient use of chemicals, or it may be possible that over the years there has developed less need for chemicals for weed and brush control than there was 20 years ago. Also, environmental pressures may have limited the use of chemicals for roadside control.

As noted originally, it is difficult to gather information about ditch cleaning from just a few questions. There is very little difference in the information received today as compared with that 20 years ago. There is the same amount of ditch cleaning on the roads today (five to six years is the average between cleanouts). However, it was noted that the cleanout on bituminous or paved surfaces is slightly more frequent than that on loose-surfaced highways. It was just the reverse 20 years ago. The questionnaire also requested information on the type of equipment used. There was a spread of all types, but the gradall type was indicated by approximately two-thirds of the counties reporting. This type of equipment appears to have been an aid and improvement to side-ditch cleanout in the last several years.

Signing has become a very important part of maintenance operations in the last few years due to liability and concern for driver safety. That importance is indicated by the considerable change from that reported 20 years ago. Twenty years ago, the average number of signs on a mile of earth road was 1; on a loose-surfaced road, the average was 2; and on a bituminous or paved surface, it was 4. This compares today with 3 on a mile of unsurfaced highway, 6 on a loose-surfaced road, and 8 on a bituminous or paved surface. This gives an idea of the added cost in operation of county highways. The average life of a sign 20 years ago was 6.5 years, whereas it is 8.5 now. Perhaps we have better signs today or have learned to maintain them better.

The questionnaire attempted to determine the amount of bituminous patch material used on various thicknesses of road surface. The questionnaire requested respondents to categorize their roads into two basic areas, first with a bituminous surface thickness of 1 in or less and the other with 1 in or more. These two categories were further divided into two groups, which indicated those with less than 4 in of base and those with more than 4 in of base. The questionnaire requested information on the amount of patch material used in each of these categories.

Thirty-five counties reported 1565 miles of road that had a bituminous surface 1 in or less thick. Of these, 22 counties indicated that 1103 miles had less today than 4 in of base and required 15 tons of patching per mile per year. Another 19 counties reported 462 miles with more than 4 in of granular base and an average of 27 tons of patching per mile per year.

The number of miles with less than 1 in surfacing is only slightly higher today than 20 years ago. However, the number of counties with that mileage is less than it was 20 years ago. Of significance is that it takes less tons of patching per mile per year on roads with less than 4 in of base as compared with those with more than 4 in of base. These figures do not bear out the expected situation; i.e., with more base the patching should be less. It is also exactly the opposite of 20 years ago, when the average was 49 tons of patching per mile per year for those with less than 4 in of base and 25 tons of patching per mile for those with more than 4 in of base. Whether this is due to estimating on the part of the county engineer or an actual fact needs to be explored. In addition, we have no information on the traffic using these roads.

Forty-six counties reported 4466 miles of road with more than 1 in of bituminous surfacing, all of which indicated bases of more than 4 in. The average patching on these roads was 41 tons per mile per year. The number of counties showing roads with more than 1 in of bituminous surface is about the same, but the mileage has doubled. It should be noted that those roads in Iowa where there is more than 1 in of surfacing require at least an equivalent of 8 in of base. The amount of 41 tons per mile per year of patching compares with 17 tons shown 20 years ago. These are perplexing statistics and seem to require further study or checking with the respondents.

When Iowa began building paved surfaces, little attention was paid to the width of the shoulder. In fact, 20 years ago, 33 counties reported that 70 percent of their bituminous-surfaced roads had no shoulders at all. Forty counties reported that 70 percent of their roads had shoulders 2 ft wide and only 22 counties indicated that 60 percent of their roads had shoulder widths of 4 ft or more. This has changed drastically, most likely due to safety design criteria. Only 8 counties showed 70 percent of their paved roads with no shoulders and another 14 showed 70 percent of their bituminous-surfaced highways with 2-ft shoulders; 51 showed that 60 percent of their pavements have shoulders of 4 ft or more. Sixty-two counties reported that they use earth shoulders on the majority of their paved roads; 16 showed other material on the majority of their paved roads.

Yet another sign of the times has to do with the center-line striping of paved highways. In 1960, only 54 out of 94 counties reporting indicated that they used a center-line stripe on their bituminous-surfaced roads. In 1980, 74 of 83 counties used a center-line stripe. Twenty years ago, 29 out of 45 counties used a center-line stripe on concrete-paved surfaces. In 1980, 83 of 84 counties reporting used a center-line stripe. It is significant to note that with the exception of one county, all concrete

pavements have center-line stripes, whereas only about 90 percent of those paved with asphalt use a center-line stripe. The average life of the center-line stripe on country roads is 2.5 years. This compares with 2.2 years in 1960.

Sealing joints and cracks on PCC pavement has been somewhat controversial over the years. Of the 42 counties reporting, all of them sealed their cracks and joints. The average sealing rate is approximately every 3.5 years as compared with every 2 years 20 years ago. This rate change may be due to progress made in types of material used for that purpose or it may be evidence of today's economic situation.

The questionnaire requested information on the major problems on different types of roads. On earth roads, the major problem was that the roads were built to poor standards (62 of 85 counties). Perhaps one could even say that some had not been built to any standards at all. There was a scattering of other subjects such as narrow right-of-way and insufficient and too small drainage culverts.

The major problem on loose-surfaced roads was too much traffic for the type of surface, which is the same as it was 20 years ago. The preponderance of this problem was not quite so large as 20 years ago. The second and third problems dealt with poor granular surfacing material and poor grades. This follows closely the comments of 20 years ago.

Fifty-five of 80 counties reported that frost action was their major problem on bituminous-surfaced or paved roads. This also was the leading problem 20 years ago. The second major problem listed 20 years ago was too heavy traffic, and this is true today also. The third major problem was numerous breakups due to insufficient base, and this concurs with 20 years ago. One item mentioned frequently that was not a problem 20 years ago was insufficient funds. Surprisingly, it was the major problem today.

The counties were asked whether they had sufficient equipment to clear the snow from the highways. Ninety to ninety-five percent indicated that they did not have an equipment problem. This has improved, since 20 years ago 25 percent indicated a need for additional equipment.

Bridges were a problem 20 years ago but have certainly had the spotlight for the last 10 years or so because of the national emphasis. There was an increase in the concern that there was not an adequate bridge-replacement program. Twenty years ago, 32 counties stated that they had an adequate bridge-replacement program, whereas only 24 counties did this time. Fifty-three counties stated that they did not have adequate bridge-replacement programs 20 years ago; today, 65 counties reported that they did not.

The average number of bridges per county is 259. This figure is significant, since 20 years ago the average number of bridges per county was 390; there are 131 less bridges per county today. Approximately 13 000 bridges have been eliminated. Part of this problem may be explained by the criteria used in 1960, which were to identify bridges more than 12 ft in length. Today, one of the significant factors is the definition of a bridge by federal criteria as 20 ft in length. This can affect considerably the number of bridges reported. In addition, there has been an effort to eliminate bridges that were not needed, and many bridges have been replaced by culverts that are less than 20 ft in span. In 20 years, the number of bridges has been reduced by approximately one-third.

The major problem with bridges is a deficiency in width. Eighty-five of 90 counties reporting indicated that an average of 60 percent were deficient in width. Eighty-three counties reported that approximately 50 percent of their bridges were deficient in load capacity.

There are some significant statistics in these questionnaires. Some of the answers are not explainable. The questions that arise are the same questions as 20 years ago. Are we planning our maintenance as we should? Are we keeping records of what we are doing for an efficient maintenance operation? There appears to be little change in the problems of 20 years ago. There is still much room for improvement. The new terms for today are "maintenance management system" or "pavement management system." That sophistication is probably not applicable to the type of roads we are talking about. The process may not be one that can be readily utilized by those who operate the low-volume roads, but the concept and the needs are still there. Perhaps with time we will find and arrive at practical and simpler processes to aid in improving maintenance operations for the operators of low-volume road systems.

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Simplified Design Approach to Surface Treatments for Low-Volume Roads

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The use of surface treatment as an economical maintenance technique to preserve the service life of the existing pavements has increased substantially in recent years. Although many surface treatment design methods have been developed in the past on a rational basis, a vast majority of highway agencies, in both developed and developing countries, still use the quantities of binder and cover aggregate determined by experience and/or precedent and this often results in surface treatments that have poor performance characteristics. This is due primarily to the fact that most of these design methods involve time-consuming or complex test procedures and/or computations. A need was felt to develop a simplified rational design method especially for the low-volume, low-cost roads that could be used at the local level by the county maintenance managers and contractors. This has been accomplished in four phases: (a) literature review of the existing design procedures, (b) construction of field research projects, (c) laboratory experiments to correlate the complex and simple test properties of the materials, and (d) analysis of field and laboratory data to develop a simple nomographic design method. This design method has been used extensively for low-volume roads by the contractors and county maintenance forces in Pennsylvania during the 1980 and 1981 construction seasons with apparent success.