Arizona's Experience with Sufficiency Ratings

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THE METHOD of applying a sufficiency rating system to state highways was first developed and successfully applied by the Arizona Highway Department in 1946. Since the very first year the method has attracted considerable attention not only in the United States but also in many foreign countries as well. At the present time the principle of point ratings has been adopted, in one form or another, by some 22 states and the U.S. Bureau of Public Roads. The main reason for this acceptance has been the one fact that the system fills a need in a reasonable and logical manner. The basic idea is relatively simple and is merely a method of allocating funds for highway improvements on a priority basis whereby the greatest construction benefit can be realized for each dollar spent. The method assigns a point rating to each section of road based on the actual condition, or sufficiency, of the road and its ability or inability to carry the traffic load in a safe and efficient manner, as compared with a uniform set of standards. The ratings are tabulated by mechanical means and arranged in order of priority without regard to route number, geographical location in the state, or political influence.

Most systems currently in use follow the same general pattern and arrive at the same relative conclusions. In Arizona the breakdown is 35 points for Condition; 30 points for Safety and 35 points for Service. It is not too material how many points are assigned to each category, and it is well that each state design a system to fit its particular requirements. The thing that is important is that the ratings be assigned on a uniform, impartial, engineering basis, unbiased by outside influences. Each segment must be small enough to assure equality and to confine the elements of personal judgment to a very limited range of values.

During World War II, highway construction in many states was practically

stopped due to various causes, e.g., shortages of material, labor, equipment, brought about by the war emergency. Due to the federal policy of considering that highways were expendable, the nationwide network or roads was all but ruined during this period. Funds for highway purposes continued to build up, however, and at the end of 1945 many states, counties, and cities were favored with rather large postwar reserves. The problem confronting each highway administrator was how to use these funds to reconstruct the most urgently needed and most badly worn sections on the overall system. The highways were in such deplorable condition that there was not enough money for a complete rehabilitation program. Even if there had been, the contractors and their road building equipment were not geared, nor could they be geared economically, to such a gigantic undertaking within a short period of time. The public was clamoring for better roads, and sections of the State of Arizona began vying with other sections to have their projects constructed first. This led to many bitter fights between various cities, counties, and organizations interested in obtaining better roads. The thing that was needed was something that would reduce these many requests to a common denominator and then sift them down and arrange them in order of priority. It was realized clearly what the problem was, so research began. Arizona was very much aware that the solution would have to be founded on an impartial systematic basis in order to satisfy public demands and to convince all concerned that an equitable distribution of improvements was to be made.

A point rating was decided upon, and the various engineering elements, such as sight distance, alignment, super-elevation, maintenance were grouped into three new classifications. The terms chosen for this purpose and now in common useage are: Condition, Safety, Service. This

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meant that the condition of the road would be observed and given a point rating. Accident records and physical measurements, when compared with established standard criteria, would provide a safety figure, and whether or not traffic was getting over the road in an efficient and comfortable manner would be a measure of the service provided the motoring public. A field card was designed and the highway log was referred to so as to establish the length of each section to be rated.

By the second year most of the bugs had been eliminated from the system, and by 1948 it was considered nearly foolproof in performing the job it was designed to do. In the early stages each card contained only the data for one year. But it is now recommended that each card be designed to cover a period of at least three annual ratings, so all background data will be available to the field crew. Notes placed on the card from previous years can serve as a historical guide while the section is being investigated and a new rating applied. The present form used in Arizona provides space for ratings over a period of seven vears.

In rating a particular route it is well to alternate the direction of travel in order to observe the riding qualities and appearance of the highway in both lanes. In this manner the rating of the previous year can be correlated with the current rating and a true overall result can be obtained. A divided highway should be rated by direction of travel, and a separate tabulation listed for each roadway between the same termini. A compass designation has been adopted to identify each section of a divided highway, e.g., Route 84 east and Route 84 west.

Prior to the start of World War II, and principally during the 1930's, the public hearings on each annual Arizona highway construction budget were rather hectic affairs. The commission room was crowded and overflowed into the halls with people from all over the state. Each group was primarily concerned with the political aspect of the road they were demanding, and their thoughts were generally along the lines of local pressure at the expense of the state as a whole. Many stories were circulated at that time as to how the highway commission decided where to spend its money. There were five commissioners, so it was said that they divided the money five ways and each spent his share in his respective district. Another version was that since there were 14 counties, the funds were equally divided into 14 parts. Still another related how the projects were drawn from a hat, and if a certain group did not get in line their particular improvement would not even reach the hat.

Since the sufficiency-rating method was established, these same public hearings on the budget have lost all their old fight and glamour, along with the abolition of political bitterness between local sections within the state. The hearings are now very brief and orderly with only a few people in attendance, and these individuals are usually present to express some word of appreciation for the businesslike and equitable manner in which the state highway funds are allocated. This very desirable change in public attitude came about principally because of the intelligent use of the rating system.

In order to definitely determine the extent to which the commission has used the system, a computation was made of the point ratings of the projects budgeted for reconstruction since 1946. The results disclosed that an average of over 80 percent has been achieved in allotting funds to the most critical projects. The remaining 20 percent went for many improvements that were a matter of state policy and only a very small percentage went for so-called purely political expedients. One of the policies worthy of mention is the matter of paving gaps in the state highway system. A gravel surface road for instance may be straight, level and in good condition and have a rating of 75 points. On the other hand it is dusty and expensive to maintain, so the policy is to bring the state system up to a paved standard at the earliest possible date. Money is therefore programmed and the section is improved. The result is only a slight point value gain; however, the project was worthwhile and had to be done at one time or another.

At this point it would be well to mention that, like other mathematical formulas, the sufficiency rating system must not be used blindly. It is a guide, or an engineering tool, to assist the highway administrator in doing a better job. For instance it is not practical or desirable to build only the inexpensive sections of a highway system. The costly mountainous sections, or bridge structures, must also be constructed, so an integrated highway network will be the result. It is also impossible from a public relations standpoint to place all funds for improvement on any one route or in any particular portion of the state simply because the roads have a low point rating. The problem being dealt with is a state highway system, badly in need of funds for improvement; in the final analysis all sections of the state must receive an equitable distribution.

Knowing these limitations, it is still possible to use the system to good advantage by analyzing all sections with a critical rating of 60 points or less. In this manner the responsible executives can be sure that they are not overlooking a single item that needs to be improved and a priority list for programming can be established. After these facts are pointed out, the results then obtained will depend upon experience and sound administrative judgment.

An important by-product of the sufficiency rating system is its ability to disclose the degree of progress being made in improving the state highway system. It will show whether or not construction expenditures on a particular route are keeping pace with traffic demands, together with wear and tear on the highway. To go further, the average of all the route ratings, taken by highway systems, can inform the state engineer, the highway commission, and other highway administrators how the overall picture changes from year to year. If the rating goes up it shows that progress is being made and everything is well under control. The administration is good. The public is satisfied. Money is being spent where the needs are greatest. Everything is fine.

Now, on the other hand, if the rating stays the same, you are just barely holding your own, and every available means of further improvement must be sought. The final possibility is to be confronted with the stark realization that the rating is going down in spite of the best that can be done. This has been the experience in Arizona during the past year. In other words, the highways are wearing out at a rate faster than they are being reconstructed. Without the sufficiency-rating tabulations this statement would be guess work, and the subject of a great difference of opinion. The results are calculated from factual data, however, and the reasons for this downward trend are known. The principal reasons for this decline are twofold: a great increase in traffic and the tremendous rise in construction costs. With this information the highway department is in a good position to give a satisfactory explanation to the public as to why the highways are not keeping abreast of the demands.

Experience has disclosed that roadsystem classification must be considered in establishing a sufficiency-rating procedure. There should be a separate rating tabulation for the primary system; the federal-aid secondary system and the urban system. The urban mileage has reached the point in Arizona where a separate tabulation soon will be justified. At present it is combined with the report showing the status of the primary system. In order to assist the 14 Arizona counties in doing a better job of programming and because each county supplies the matching funds on county roads, a field investigation, together with a sufficiency rating report on all county federal-aid secondary routes in the state, has been made.

As a new development just added this year, we believe the continuity of improvement of a highway has a value in a sufficiency-rating tabulation. That is to say, it is better to have a continuous good section of road than to have the same mileage in several intermittent good sections separated by poor segments. For this reason we have arbitrarily applied a two point adjustment to a poor highway with a rating of less than 60 points if it joins a better section with a rating of 80 points or more. If a low-rating section is located between two improved projects, the overall rating is lowered 4 points in the same manner that the traffic volume adjustment is made.

In view of the wide acceptance that this system has received, it is apparent that some method of sufficiency rating is considered absolutely essential for intelligent and successful highway administration, planning and programming. It is believed that any state that does not have such a system in the years to come will be as out of date as a new automobile without

an automatic transmission. To those states not yet using a rating method, it is highly recommended that they adopt one and give 'it a trial.

General Comments on Sufficiency-Rating Procedures

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IN DISCUSSING this topic, remarks will be directed toward giving a general summary of the principal characteristics of the procedures in use in various states. Areas of similarity and areas of difference will be noted together with comments on features of particular interest adopted by certain states.

The "Review and Digest of Sufficiency Rating Formula Procedures' published by the Highway Research Board last June makes certain significant comparisons between the various formulas in use. As those comparisons were rather abstract, it was thought of interest to apply the formulas outlined to a few typical road sections. The road sections were rated by all formulas, except those for Kentucky, Nebraska, and Virginia, for which the descriptive data were incomplete in one or more respects. The uniform sufficiency rating plan of the Bureau of Public Roads, currently being applied nation-wide to federal-aid primary, interstate, and forest highway systems, in connection with the regular maintenance inspections, is likewise not included in the following analysis.

Following is a brief description of the four road sections selected, all of which are in Minnesota:

Section A is located on the interstate system on TH152 extending southeasterly from the north Hennepin County line. It is 12.67 mi. in length and was a county road prior to its addition to the state highway system in 1934. The roadway width is 30 ft. with a bituminous surface course 2 in. in depth and 24 ft. in width placed on an unstable subgrade. The sight distance is restricted to less than 1,500 ft. on 76 percent of its length. There are four substandard curves on the section. The 1950 annual average daily traffic was 947, with a very substantial increase expected when the route and its extensions are improved to adequate standards.

<u>Section B</u> is a federal-aid primary route located on US 12 extending westerly from Long Lake in Hennepin County for 8.79 mi. It was graded in 1928 and a 20-ft. portland-cement concrete pavement with 8-ft. shoulders was placed in 1930. The sight distance is restricted to less than 1,500 ft. on 55 percent of its length. There is one substandard curve. The average traffic volume is 3,426 vehicles daily, with normal increases expected.

Section C is an interstate route located on US 65 south of the Minnesota River in Dakota County and is 7.36 mi. in length. It was graded in 1921 and a 6-in. portland cement concrete base and a 2-in. asphalt surface, both 18 ft. in width, were placed in 1922. The current effective shoulder width is about 3 1/2 ft. The sight distance is restricted to less than 1,500 ft. on 59 percent of its length. There are no substandard curves. The average traffic volume is 3,105 vehicles daily, with a greater than normal increase expected when this section is reconstructed.

<u>Section D</u> is a federal-aid primary route extending south-westerly from Stillwater in Washington County for 11.17 mi. It was graded in 1924 and an 18-ft. portland cement concrete surface was placed in the same year. The shoulder width is 7 ft., 2 1/2 ft. of which is bituminous surfaced. The sight distance is restricted to less than 1,500 ft. on 60 percent of its length. There are seven substandard curves. The average traffic volume is 2,575 vehicles daily, with normal increases expected.

Each of these sections was rated by the