Relation of Sufficiency Ratings, Tolerable Standards, and Priorities

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THE NATION’S heavy backlog of highway needs, the search for means of coping with it, and the present complexity of the situation, all have brought sharply into focus the need for more scientific methods of highway evaluation.

Gradual assembly of facts and research continually places more tools for that purpose in the hands of engineers and administrators. As in the building of a machine, no one tool is the universal implement. A variety is required with each one designed to accomplish its purpose most efficiently. Tolerable standards, design standards, sufficiency ratings, and a number of factors affecting priority of work are all important tools complementing each other in the job of building a sound highway program.

Any measurement of needs must be accomplished through the use of proper gauges, which set a target to be aimed at in the measurement process. Highway standards become the basic element in measurement methods. They are the engineering yardstick by which our evaluation of what is needed or desirable is determined.

Before going to the specific subject of tolerable standards, we must keep in mind a few of the more important objectives to be achieved in the measurement of highway needs:

First, it is essential that needs be accurately determined in order to establish the rate or level at which highway development should proceed. Second, the needs must be known in order that an adequate and equitable fiscal policy can be established. And third, the needs must be measured in order to place proper balance and priority into the execution of the program.

For purposes of measurement, the needs of the highway are broken up into three major components. First is the backlog of substandard facilities which must be improved to higher standards to meet ever increasing demands of traffic use, second are the requirements for replacement of facilities as they wear out, and third are the requirements for maintenance. Highway standards have a very direct bearing on each of those three basic elements of need, but in the measurement process they affect most directly the items of construction and replacement.

The standards of design for highways as developed by AASHO reflect the type of highways that are desirable, economical and most efficient in serving transportation needs. When roads are improved to standards lower than those prescribed in AASHO policies, some efficiency and safety is sacrificed.

But the sheer magnitude of bringing the whole highway plant up to such standards dictates that we be completely realistic in our statements of necessity. To do that we must say that will have to continue in use those facilities which will not provide completely modern service but yet will give reasonably satisfactory service. We must extract the greatest possible degree of service from existing facilities. The present investment must be used to maximum advantage.

Thus, recognizing the economic aspects, it becomes necessary to establish some cut-off point where it can be said that roads which do not meet certain standards for given conditions of traffic, terrain, service, and safety must be improved to a higher standard. It is this realistic, practical economic approach that brings into being the use of tolerable standards.

Fundamentally, the tolerable standard is a completely defensible criterion, every element of which is set at the lowest point on the yardstick permissible under today’s highway transportation requirements. It is not a point determined by funds available to a job but rather a point used as a means
of isolating and identifying these sections of the several systems which are so far below design standards that their need of improvement is unquestioned.

In setting the tolerable standards, past design practice and resulting investment must be evaluated. The service performance of existing facilities has to be examined in the light of maintenance costs, accident experience, capacity in terms of operating speeds, and other service characteristics. Traffic volumes and vehicle types in use must be considered. In the final analysis the tolerable standards are set by informed engineering judgment with the objective of defining the existing investment that we can continue in use without creating: (1) congestion detrimental to the public welfare, (2) uneconomical time losses because of low operating speeds, (3) unreasonable accident rates, (4) unreasonable maintenance costs, and (5) uneconomical operations resulting from improper surfaces, excessive grades, circuitous routes.

In the practical application of tolerable standards, consideration must be given to the economics of the state and the probable impact of its economic status upon highway development.

The economic influence extends to design standards as well as tolerable standards. It is most important with relation to systems other than major arteries. Uses and service importance of secondary systems where traffic volume is not significant pose the greatest problem. The mileage is large and most directly related to local economy.

Questions always arise, such as: (1) At what point is a dustless surface justifiable? (2) What minimum width will provide reasonable service - 16 feet, 18 feet, or maybe 12 feet? (3) What degree of improvement has the local economy been able to support in the past?

These and many other questions arise as design and tolerable standards are developed in the measurement of highway needs. They are finally resolved through the application of the best available engineering analysis and experience. The AASHO design policies form a solid base for determination where they are applicable. Decisions that have to be made for secondary and urban facilities do not rest on such a solid body of fact.

In many areas there is need for research which will give more positive guidance in the economics of highway development. Some of these areas are: (1) A better evaluation of the relation of design elements to safety of operation. What are the lowest standards of highway improvement we can accept without increasing the accident rate? (2) What are the lowest acceptable standards that can be used which will result in economical maintenance costs? (3) What is the optimum standard that can be used to produce the lowest overall transportation cost considering jointly the cost of vehicle operation and highway costs?

The sufficiency-rating procedures do not answer these questions. In their present stage of development rating procedures cannot in themselves determine what is tolerable and what is not. However, they are a valuable corollary to the tolerable standards in the measurement of needs. In their use on routes of considerable traffic significance they provide a measure of relativity which is badly needed.

It is to be hoped that, as research and study continue, it will become possible to correlate rating values and standards sufficiently to permit selection of a certain rating as a tolerable level for a particular system or for a given set of conditions.

How the ratings can now supplement the tolerable standards and aid in determining priority of work may be indicated by the chart on which are shown the basic elements of the measurement process. It represents a typical route or given system of roads. By the use of tolerable standards, the current backlog of substandard sections are measured. In this example, 50 percent of the mileage was found to be below tolerable standards as adopted. This sample is not typical of most highway routes in that it shows a poorer than average condition.

But as a program is developed to eliminate the measured backlog which must be carried out over a period of years, the other 50 percent now considered adequate will begin to wear out, become obsolete and otherwise have to be replaced. Thus the needs program must incorporate annual replacement costs. In addition, the annual maintenance requirements must be added
An impartial priority program requires a uniform approach which, in general, sufficiency ratings can help to obtain. Practical procedures must be established and adhered to except for most unusual causes. Yet final selections determined by such procedures still will be subject to tests of engineering judgment, financial feasibility, changing conditions, and emergency requirements.

It is doubtful whether any formula can ever satisfy automatically all conditions affecting priority determination by highway administrators. However, the improved guides represented by rating procedures are helpful in making a comparative analysis of the relative merits of needed work which has been determined through the application of tolerable standards. Thus final decisions on priority can be narrowed to remaining considerations of feasibility which cannot be reflected in techniques so far developed.

Our experience in cooperation with the Bureau of Public Roads and several states and in the application of rating procedures to priority analysis most recently in Virginia, leads us to the conclusion that among the considerations which affect priority, in addition to the sufficiency ratings themselves, are the following:

**Effect of Highway Classification**

The predominant functional classification of the highway must be considered in scheduling work. It is well known that traffic volumes alone do not determine the classification plan. It is clear that in many cases a sufficiency rating of 50, for example, on each of two routes having equal traffic volumes would not necessarily imply equal priority. One of these routes might be rendering most important interstate service between major cities and the other might be classified as a link between smaller local market centers. All other things being equal, it seems obvious that the former should have priority.

**Geographic Distribution**

The priority plan must provide for some measure of geographic distribution of annual work in order to have a reasonable
Balance of work load on available personnel and to provide for improvement of service in all parts of the state.

Continuity and Consistency of Route Development

Gaps in continuity of routes, development of a fully integrated system sometimes involving new mileages not now existing, and short sections of poor highway greatly inconsistent with the balance of the route are special factors which must be considered and for which current rating plans do not account.

Rural-Urban and Urban-Urban Relationships

There are fundamental problems of priority of fund allocations between rural and urban work which are not easily resolved. And when these decisions are reached, the cities themselves generally have the authority to alter them. For example, a top priority urban-state project may be deferred for many years pending financing of the city's share. Thus a state-wide determination of relative priorities of urban work among all cities may be largely academic in actual practice. Within a given jurisdiction, however, great benefits can accrue by careful priority determination of specific needs, in which process a good urban sufficiency rating plan can play its part.

Traffic congestion within a city will also have its effect on purely rural needs in cases where rural bypasses may be required or rural connections are needed for newly-located urban routes. Importance of such work would not necessarily be reflected in current rating techniques.

Benefit-Cost Ratio

The nature of the improvement required, rather than the section's present sufficiency, obviously controls its cost. Many methods of determining benefits have been worked out, and benefit-cost ratios determined.

Those projects having highest benefits per unit of cost should receive priority consideration. Perhaps one of the factors affecting priority, then, could be a sufficiency-rating point-cost ratio if it can be established that changes in rating values are commensurate with benefits.

One of the benefits to be obtained from a given expenditure is improvement of as large a mileage as possible. Consequently, low cost-per-mile work must be considered along with other factors.

Backlog, Future and Emergency needs

If a complete 10- to 20-year program is being proposed, those projects defined by tolerable standards as representing the backlog of need should generally receive higher priority than those which will accrue in the future. However, changing economic conditions, or unforeseen emergencies may force alteration of the picture, and the priority plan should remain flexible enough to include such conditions.

Time and Personnel

Time required to prepare plans, secure agreements, obtain rights-of-way and, currently, to obtain necessary materials and personnel will have an appreciable effect on selection of projects for annual programs. Presumably these are relatively short-range problems which more advance planning might overcome.

Over-Riding Importance of Certain Highway Elements

The elements of condition, service and safety making up the combined sufficiency rating are of course rated individually. The priority plan should make use of the ratings by some means of advancing the early scheduling of those sections with very low ratings in any one of the three general categories. While it is recognized that factors producing a low service rating also may produce a low safety rating, this is not always true, particularly in the element of condition. Again, such matters should be correlated with tolerable standards in order to insure early consideration of such very intolerable features as, for example, width of a two-lane pavement as much as 6 or 8 ft. below standard, or incipient failure of the surface even though all other road features may be satisfactory.

CONCLUSION

Highway needs must first be measured...
by reference to sound design standards and tolerable standards which seek to define the limits of elements below which highway service is intolerable. Sufficiency ratings greatly aid in this process, especially in borderline cases where combinations of conditions are difficult to define more precisely and individual judgment needs more scientific guidance.

But in a long-range program, the borderline case may soon move to the unquestioned backlog of need. The ratings are found, then, to be primarily a major tool in analyzing priority and developing schedules of work.

There are, however, a number of other factors which also affect the priority rating. They should have equal consideration with the sufficiency rating before annual priorities are set.

There is little to gain from making fine distinctions between the priorities of different highway projects, no matter how the relative merits may be derived. A complete 10- to 20-year program needs only to divide the work into perhaps three to 10 manageable groups. Within reasonable priority groupings, there is often small choice of one project over another.

With continuing research in economic evaluation and measurement of needs and in the job of putting first things first, the highway engineer is being given improved tools to do his job, and he will continually strive to use them properly.