Basic Information Needed for Sound Capital Investment Planning

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Investment in highways, very much as in any other investment, should be based upon past experience and the projection of existing conditions into the future. In great part, the present investment in highways was begun with enactment of the Federal-Aid Highway Act in 1918. This period of investment continued into the 1930's, and it is this investment that comprises a great part of the existing network. That it was a sound investment and that the returns have been good is beyond dispute. However, in the period since World War II there has been a substantial change in road usage, weight limits, land use and land development. The old values and projections no longer apply and new and more complex factors have appeared. The move to the suburbs, combined with the great use of automobiles in the place of mass transportation vehicles has loaded the streets and highways in a way not envisaged by early planners. Also, much of the freight formerly carried by rail now is trucked over roads and streets. With all these changes a more complex system of roads and streets has developed.

There has also developed an interdependence between component routes of the system. Thus, the improvement of one route, giving it greater capacity and facility of movement diverts traffic from other routes. Road and street improvements change the competitive position of producing, marketing and consuming centers and thus traffic patterns. The changing developments due to scientific research cause traffic generators to develop in new locations. The needs for defense transportation capabilities have increased tremendously. The current tendancy to industry dispersal causes the development of new sources of traffic generation and changes in the traffic pattern.

The wise investment of the highway dollar has become a complex task. The administrator, therefore, has turned more to the engineer for assistance in the development of sound highway construction planning.

In the development of bases for decision, the orderly application of engineering facts is considered the first step. Once the facts have been developed, a projection of future conditions, must be made, from which an estimate of needs for an investment period can be made.

The physical needs having been developed, the question of financing arises. How large a budget should be adopted? How is a just and equitable taxation policy to be devised, and how can it be assured that the most efficient road system is being purchased with the budget adopted? Cost-benefit studies are of assistance. The Bureau of Public Roads is now completing a study on incremental cost factors for the various highway elements. Economic studies by the states and cities furnish bases for revenue estimates.

When the budget has been determined, a method of orderly programing which assures the development of most urgent projects first must be devised. All of the foregoing require the assembly of large amounts of information on all phases and facets of road and street development.

An inventory of the existing plant is considered the first basic step in sound construction planning. The engineer must know in detail with what he is dealing. This inventory should be obtained by a careful inspection and recording of every roadway feature, located accurately by log mile.

All project beginnings and ends should be carefully established and the location of all county lines, city limits and urban boundaries carefully determined. Road plans, where available, should be used to establish curvature, structure data, surface and base descriptions, right-of-way widths, and other critical data. However, all plans

descriptions should be field checked to eliminate errors due to faulty research or subsequent construction for which records were not available. A special check should be made for overlapping or gaps between projects. Sections for which plans are not available must be completed by field measurements of all critical features. Other items required in the field inventory are the description of the terrain; the type of cultural development, rural, suburban, urban; the width of available right-of-way; and the available passing and stopping sight distance. On completion of the inventory, the maintenance personnel should be consulted and a condition rating established for the surface, base, subbase and drainage. Sections having excessive maintenance costs should be identified. An estimate of remaining surface life should also be made.

When all the inventory data have been obtained it should be assembled in a readily usable form. Some type of straight line diagram appears a logical method of data assembly. Tennessee uses a Kardex System, with all data for a 10-mile section of rural road, or a 1-mile section of urban road assembled on a single Kardex form.

The standard county and city maps prepared by the highway planning survey division from highway inventory data are invaluable for all highway planning purposes in Tennessee and are considered a basic requirement.

In conjunction with the road inventory operation, a study should be made of road life and road cost. This consists of recording each project built and still in use as part of the existing road network. The original grading and drainage project, the bridge projects, subsequent surfacing, resurfacing, widening and other betterment projects are shown in chronological order. Thus, it is possible to obtain from these records actual construction information showing materials underlying the existing surface. Costs are obtained and the amount invested in the section is shown. By a study of surfaces built and subsequently rebuilt or resurfaced, estimates of average surface life for various road surfaces are obtained. This also furnishes information for location of projects not available without extensive research.

Traffic volumes should be measured each year on each section of highway having appreciable variations in volume. These volumes, obtained by portable counters and adjusted to year-ground counts obtained at permanent representative counters furnish information as to the average daily traffic. Traffic counts are also used to establish the peak-hour volumes; classification counts show the type of road usage and the number and percentage of commercial vehicles using the road. Weighing stations are operated periodically to determine the axle loadings and gross weight of trucks on the various sections.

From this information a traffic flow map is prepared each year for the entire state highway system. This map is especially useful in that it readily shows the relative traffic volumes of the system and also the volumes at specific locations.

In Tennessee the traffic volume and the percent of commercial vehicles is also posted on the Kardex system each year for each section of road. Volumes for each intersecting road or street are also posted. Location and type of all traffic control devices must also be shown, and special traffic regulation measures noted.

Varying degrees of congestion and delay occur on highways. Some sections are so overloaded with vehicles that resulting delays approach intolerability. The establishment of a yardstick for measuring and comparing these delays has been aided by the publication of the Highway Capacity Manual. This manual gives basic data from which the capacity of highways and signalized intersections can be computed. Capacity tables have been prepared for varying conditions such as percent of available sight distance, design speed, percent of commercial vehicles, type of terrain, and operating speed for rural highways. Capacity tables for urban intersections may also be prepared for various signal timings, parking conditions, direction of flow and percent of commercial vehicles.

These capacities can be compared with existing traffic volumes to establish the amount of congestion existing on any section.

In Tennessee and a number of other states, these conditions affecting capacity have been further arrayed so as to show the effect in reduced operating speed which can be rated against the tolerable operating speed as a measure of road or street adequacy.

Another basic tool for sound planning is a road classification system. This system

classification does not refer to existing legal systems necessarily. This is for study purposes, to ascertain the general system to which the road should belong, as state trunkline, county or city arterial or feeder road.

State primary routes are routes that are of primary interest to the state as a whole. They connect the principal communities of the state and those of neighboring states. They are identified by the greater volume of traffic; by their superior service to natural resources, industry, agriculture and the national defense; and by the state's obligation to provide an interconnected system of highways to all sections of the state, while doing so with the least mileage which will achieve these objectives.

County arterials connect towns, communities, shipping points and markets within a county or adjacent counties; they provide access to schools and churches; they connect with state highways to form a complete network of main feeder roads; they carry appreciable volumes of traffic and act as collectors of traffic from several local roads.

City arterials are the streets that provide for the heavy traffic movements to and from the downtown business area as well as heavy traffic on crosstown routes; they include heavily traveled routes serving business or industrial areas.

Feeder roads, business or residential access streets serve relatively small local areas or provide adjacent land, residential or business access.

The requirements and standards generally vary for these systems. It is important that the approach in planning be based upon the type of use and the standards expected from these systems. System classification narrows the field in which each type of development must be studied and channels the appropriate type of improvement to its correct place.

When the foregoing data have been assembled the engineer is prepared to evaluate the existing highway system. He has the information on the existing investment and may now proceed to evaluate it and make preparations for the future.

In preparing for the future he must use any available data of past performance, present conditions, and anticipated trends. Using past and present experience as a guide and adjusting to foreseeable events, projections may be made. These projections should be tempered by comparisons with projections in other but comparable fields and a rational determination made for the future. In this way, sound forecasts may be made of numbers of vehicles, changes in traffic volume, estimates of revenue and other developments.

Having assembled all this information for inspection, the time has come to separate the good from the bad. To do this some standard of comparison is required. We must decide on the geometrics and quality in roads which will give the best and longest service for the investment. Therefore, standards must be established.

To be economically sound these standards should be based on the terrain where the road is located and on the traffic volume. Obviously it is not economically sound to attempt to build roads in mountainous terrain to the same design and operating speed standards as for flat terrain. By the same token, it is not justifiable or even desirable to build roads to the same standards for low volume roads as for high volume roads.

Two types of standards should be developed. For existing roads, there will be many roads that, although not quite up to the desired standards for new construction, do approach the new construction standards sufficiently so as not to justify rebuilding. To remedy this situation, a set of tolerable standards for judging existing roads should be developed.

The design standards for new construction should incorporate the best design features consistent with terrain type and traffic volume.

In judging tolerable and deficient sections of highway each section of road must be examined and compared with tolerability standards. Sections meeting tolerable design standards are judged presently adequate. These sections should also be judged for future inadequacies. Thus, a section that may meet all standards of tolerability at the present time might be expected to have an increase in traffic (from traffic projection) so as to become inadequate for traffic capacity at a future date. Sound planning would schedule improvement for that time. Estimates of remaining surface life might similarly show that a resurfacing or reconstruction project should be scheduled for the future.

In applying tolerability standards, examination should also be made of existing conditions to ascertain if some spot improvements might make the section tolerable. The addition of truck climbing lanes at certain points, for example, might remedy a capacity deficiency. At times one or more minor relocations to eliminate hazards may make a section tolerable. In cities, traffic remedies such as removal of parking, one-way street operation or other traffic control measures often furnish needed relief. These possibilities should be explored before declaring a section deficient.

Having examined each section and determined the deficient sections, a listing of deficient sections for each division or district of the Department should be made.

This listing, the maps, and the Kardex containing assembled data should be studied with design and location engineers of the field divisions and projects established and cost estimates made for each present or future deficient project. At this time, it may become apparent that field surveys, traffic studies, or the establishment of a transportation plan for an urban area are needed. Projects proposed should be the result of the application of sound engineering principles and investigation.

Origin and destination studies are of much help in planning, especially in determining justification for rerouting, new routes and bypasses and also the determination of the amount of relief which might be expected from such projects.

Each urban area should have an established transportation plan. The plan should be based on thorough traffic and engineering studies and provide for future growth. In this connection studies of future land use and projections of urban growth should be made. The best traffic engineering should be incorporated into the plan. It should be based on the thorough study of local conditions, be economically feasible and acceptable to the public. The transportation plan should be adopted as official and be used as a guide in issuing planning and zoning permits. Construction projects proposed in the area should be consistent with the official transportation plan.

When each deficient section has been established and the remedial projects and their cost developed, a highway needs study has been made. The projects may be divided into groups, such as, needed now; needed in 5 years; and needed in 10 years. Adding the cost for projects within the group, a total cost for each group may be obtained.

At this time, a study of fiscal capabilities is required. A study of past revenues and existing revenues can be made and these amounts projected to give estimates of future revenue available from present sources. These revenues compared with physical needs, over the study period will show if additional funds are needed. If there is a discrepancy, studies may be made of alternate methods of financing as by a 10-year catch-up program with funds augmented by bond issue to be paid from future revenues in various time periods, or new sources of revenue may be explored. Another and less desirable alternative is the construction of only those projects for which current revenues provide each year.

In embarking on any of these programs it is recognized that, even with a short catch-up period, a decision must be made as to which projects should be buit first. And certainly where revenues are insufficient to provide for needs, a method of equitable distribution of construction of the most urgent projects should be used.

Establishment of a system of priorities based on sound engineering principles is recommended. There are a number of methods in use, all of which have something to commend them. In Tennessee, we use an urgency rating based on structural condition, facility of movement and accident record, adjusted for traffic volume. Available funds are divided among field divisions on the basis of total needs of division against total needs of the state and by Federal-aid system. Then, priority arrays for the Federal-aid primary system, the Federal-aid urban system and the state system are used to establish a 5-year construction program for each system within the division. This 5-year program is used as a basis for surveys, design, right-of-way procurement and contract letting.

The adoption of some similar method is recommended for any department charged with the responsibility of sound investment of highway funds. A further note of caution is that the method adopted should assure that lower volume roads and remote areas will recieve attention in proportion to their needs. This can generally be accomplished by allocation of funds by Federal-aid systems to smaller department sub-divisions with the sub-division of funds based on the proportion of total needs.

The foregoing outlines the basic data we have found of use in capital investment planning in Tennessee. We have profited greatly by the assistance of the Automobile Safety Foundation in a highway needs study and also in a subsequent programing study. Other sources of information include published papers of the Highway Research Board and the manuals and publications of the American Association of State Highway Officials.

Discussion

Babcock. — If you find that your needs are greater than the probable revenues, do you change your tolerability standards?

Donnell. — No, when we build a road, we hope to build it to a standard.

Hall. — You referred to removal of parking and other measures. Sometimes it is much more costly to take the immediate action, the obvious palliative, than to carry out some major construction to eliminate the critical section.

Donnell. — We make a study of an urban area, and we usually resolve these problems with the city planning and engineering departments before making recommendations. These departments usually tell us what can and what cannot be done operationally. Unfortunately, we do not have an expert operational man, and often we depend on the city to advise us as to the possibility of one-way streets, removing parking, the operational plan, and if that is not feasible, we try to work out with them a by-pass or new route.

Hall. — It seems to me that in general, it will cost much less money in the long run to build the by-pass because the cost of rights-of-way, construction, and other developments are increasing.

Donnell. — If operational improvements would only add one year or two years to the existing street system, we would advise, "Go ahead with your by-pass." But if they think they can get ten years out of an operational plan without a major improvement, then we would not go into an expensive by-pass at the present time.

Hall. — You referred to a transportation plan, and I certainly concur that we must have transportation plans — except I do not know what a transportation plan is.

Donnell. — Currently plans are being made in Nashville and Chattanooga. Our idea of a transportation plan is the one that was recommended by the committee that worked for about two years on highway transportation plans for urban areas.

We hope, when we get through, to have a plan that shows what the state highway system should be, what the city arterial system should be, and what the county arterial system should be in the metropolitan area; also what each one of these systems will cost, what should be built, whether it should be built to two or four or six lanes, and an over-all plan agreed upon by the city, the county, and the state highway department. That is what we hope to have — a transportation plan.

And when we make our assignment of traffic, it is made to this arterial street system, county system, state system, as we hope it to be some 20 years hence.

Hall. — You have said that there are two elements, first of all a map of the whole state, city, or county, and second, standards to reconcile the various elements of the system. Would it include anything as to planning or programing the financial aspects?

Donnell. — No, the over-all transportation plan will not, as far as the published report. As far as the state highway system, or the state highway department, is concerned, we will make a 5-year construction program, and we are encouraging the city and county to do the same thing. But that is, of course, out of our jurisdiction, and we can only hope that they will cooperate.

They are in a position that they are going to have to do something, because the Interstate System is dumping tremendous loads of traffic on to streets that will not handle

the volume of traffic that they are going to receive. And we are recommending to them that they not wait until the Interstate System is completed, but start now acquiring and building those streets that need to be improved first, and thereby establish a construction program of five or ten years.

Swanson. — I think that we need a complete understanding, particularly in the northeastern part of the United States, of the mass transportation system and what is going to happen to it. Anything that occurs in mass transportation is going to influence the highway program. Therefore, it is necessary to make a complete study of mass transportation as part of these major transportation plans.

From a statewide viewpoint, it is necessary to study the state's economy, trends in state legislation, shifts in the type of industry, and movements from one state to another.

That kind of basic information is essential, if we are going to do the kind of a capital investment planning that needs to be done.

Donnell. — Of course, we are making a study of the transit system. In our area there has been decline for a number of years. However, Nashville is one of the cities that shows a profit in its mass transportation and has a good system.

Swanson. — Whether it goes up or down, it is certainly a factor to be considered.

Tacke. — You stated that transportation studies were being made in Nashville and Chattanooga. I presume these are being made by the state highway commission. If so, what portion of the cost of that study is being paid for by the two cities?

Donnell. — We set up an agreement with the city and county that if they would make all the correlated studies recommended for a highway urban transportation study, and would pay for them, that we and the Bureau of Public Roads would pay for the origin-destination and parking study. They would furnish the information to make the other reports.

This has not been reduced to a percentage. We are in full control of the origin-destination parking study. They make the correlated studies.

Walker. — Were there definite reasons why you did not make your 5-year program public?

Donnell. — Frankly, we do not want the state legislature to adopt it. That is the best reason I can think of for not making it public, that we do not want to be strait-jacketed that severely if we can help it.

There are problems. There are bridges knocked out. For one reason or another, things go all to pieces in a winter. This occurred last year in the mountains, and you just have to make repairs. That automatically drops some projects into the second year instead of the first year. And that is one of the main reasons why we do not have it approved by the legislature.

Martin. — We find that the development of the highway system tends to alter the economy, so that a projection of past trends simply will not work in some cases.

There are other factors. The development of secondary roads sometimes opens up new market areas that make a difference in the economy that affects traffic volume materially. Other things, for example state and Federal public works, alter the requirements for traffic. Does your plan take into account the changes that are brought about by such developments?

Donnell. — Yes, in our land-use studies, they have the benefit of the arterial system as planned.

Now, we know that you cannot always say that this area is going to develop and this one is not. We are going to have to take the land-use people's word for it. We get the best people to work on it that we can, and we try to get them to tell us their best forecast.

I believe they make a statement similar to the one that Mr. Lang made, that they cannot tell you what it is going to be next year, but they think they can do a fairly good job in telling you what it will be 20 years from now, because it goes up and down.

Morf. — You said you had this 5-year program which you did not publish. Do you have a 1-year program that you do publish?

Donnell. — No. We put it out in a 5-year program. We publish it, but we only give it to the staff engineers of the highway department. It is not given to the general public.

Morf. — My question relates to the amount of money that you have in your program. Let us assume that for a period of a year, or a period of five years, you can make a fair estimate of what your income is going to be. Do you have trouble determining how many jobs you are going to list against that income?

If you have $100 million, do you list $90 million worth of work against that, or do you list $110 million?

Donnell. — We started out listing $110 million. We found out that we got in trouble. So now we are listing about $90 million.

Morf. — I could see where if it is a restricted publication, this might not be too critical, because nobody sees it in total. You say that the people discuss it as individual improvements?

Donnell. — That is right. If a county man comes in, we show him anything that is in his county. We show a state legislator anything in his district.

Morf. — But no one has a chance to see the whole array that is in your five-year total?

Donnell. — That is right.

Morf. — We are in a different position, because our publication lists the money and the work. And we are torn between whether to list more jobs on the chance that all of the jobs listed will not come to the contract stage, or, on the other hand, less than we have, because we may have jobs that should be done, which could not have been foreseen at the time the program was compiled. I think that this is one of the real problems in making a program among those who have actually done it.

Donnell. — We ran into trouble with a 125 percent program, so now we make a 90 percent program of the money that we think will be available.

The first year is very secure. The second year is fairly secure. And if we get all projects in the first year program done, we just reach over in the second year for a contract and go ahead with it.

Our program is revamped every year. We make a new 5-year program every year. We get our money on a 2-year basis, and are fairly certain of what the money is going to be those first two years. Our bond issues have been set by the legislature. There is not going to be much change in the money.

But if the legislature, which meets next year, gives us an additional $15 million a year, then the 5-year program will reflect that for the period of time they set the bond issue up.

Babcock. — Who does your land development planning? Do you do it yourself, or do you have experts do it?

Donnell. — Nashville and Chattanooga both had land development programs, and they furnished that as part of their agreement.