New Concepts and Goals in Highway Planning

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• IN TERMS OF definitions given previously in this conference, planning is the process by which administration determines the method of achieving its aims.

A GAME OF HIGHWAY STRATEGY

As a prelude to discussing new concepts and goals in highway planning, the aims and objectives of highway administration or of a highway program should be examined. Theodore F. Morf, Engineer of Research and Planning, Illinois Division of Highways, has invented a game of highway strategy. In this game the player is asked to imagine himself to be the top policy-making authority—governor, legislature, highway commission, director, or chief highway engineer—all in one person. This person has complete and unrestrained authority to follow any strategy or sequence of strategies appearing justifiable to him; the only limit upon his action is the amount of funds available. The player must review the possible strategies which he may follow in spending his money, and he must make a series of choices. The strategy which appears to be most justifiable to him must be considered his first choice. On this, he may spend money until he reaches the point where the benefit of his first-choice strategy is not as great as could be yielded by his second choice. He continues making successive choices until all his money is spent.

In this game there is a sharp distinction between strategies and tactics. Strategy is defined as involving the question of what objectives are selected, and tactics are the means of attaining them. On the basis of these definitions, the strategies in the game of Highway Strategy are the administrative aim and tactics constitute the planning process.

Upon the basis of Morf's game of Highway Strategy, what are the aims and objectives of highway administration, at least in the opinion of those who have played the game?

To start with, the game lists nine strategies in no particular order of importance, and the player is given the opportunity to add one of his own. The strategies are as follows:

Safety

Each year, in the United States, automotive transportation is taking a toll of nearly 40,000 lives and results in injuries to more than a million persons. The annual economic cost of motor vehicle accidents approximates the annual capital investment in highway facilities. Investments in highway improvements, such as roads of freeway design and, less dramatically, wider surfaced shoulders, widened bridges, easier curves, and longer sight distances, can effect a substantial reduction in the number of deaths and injuries. Expenditures should be directed to maximizing the benefits of increased safety.

Existing Responsibilities

All highway departments are assigned the responsibility for a road system, in being, and have developed a technique of sufficiency rating to compare the relative deficiencies of the several parts. The needs for the continued maintenance and reconstruction of this system, in being, should be a claim on the funds of the State before any new additions supported from the same financial sources can be undertaken.

Least Freight Cost

Every article used has some element of motor freight cost in its price. It is well known that the unit cost of motor freight declines as the size of the transportation unit increases. It follows that motor freight costs would be much less than their current level if highways were provided which would withstand much heavier unit loads than are now permitted. The highway construction program should be directed to provide

for much stronger pavements and bridges than at present, and structure clearances should be revised to accommodate much larger freight vehicles than are now lawful in order that motor freight costs may be minimized.

Economic Redevelopment

While some areas of the State are flourishing and their populations and economy are booming, other areas appear to be declining or in a condition of chronic depression. In such areas the depression may stem from a depletion of a natural resource, such as exhausted soils, mines, or forests; or to technological changes similar to those which have blighted the buggy whip industry. The economic redevelopment of these areas is an important objective of the State's long-range planning, and the State's highway construction program should be directed to furthering this purpose.

Industrial.—It appears that the best ways to stimulate the economic recovery of the area are to retain the industrial workers and, through increased highway transportation facilities, make the area more inviting as a site for new industries. Or, in the case of extractive industries, to build roads to serve new mines or logging sites, connecting them with refineries, sawmills, and shipping points.

Recreational.—It appears that the best way to stimulate the economic recovery of the area is to develop its recreational potential. Large artificial lakes are to be created (by dams formed of massive roadway embankments) and roads need to be built, or rebuilt across them as well as to serve their new margins. An outstanding skiing area could be developed to sustain the winter economy by the construction of a new highway capable of serving large volumes of weekend traffic under the most adverse weather conditions.

Maximum Motor User Benefits

Practically all of the State-collected highway revenues, and all of the Federal-aid revenues, have their source in special and burdensome taxes levied upon motor users in connection with their use of the highways. Motorists generally expect to receive benefits, at least as great as the amount of these special taxes which they pay. Road improvements create demonstrable benefits, although the ratio of benefits to the cost of the improvements may vary considerably as among a number of alternative choices to be made. Not only do these advantages result to the motorists themselves, but they also affect the economy at large, through savings in transportation charges. Highway administrators should feel impelled to spend the highway funds in such a way that the greatest motorist benefits will result.

Urban Redevelopment

In every State there have been shifts of population during recent years. Metropolitan area populations have increased greatly, while those of many rural areas have diminished. Not only has this shift in population created new needs for highway facilities, but changing modes of transportation have reinforced and magnified this need. Changing modes of transportation have made possible new patterns of urban living and new forms of industrial and commercial activities. The satisfaction of the requirement for rebuilding cities into newer forms should be a first claim on the financial resources available for State highway purposes.

Unemployment Relief

Government has accepted the responsibility for minimizing the effect of periodic unemployment, with its cyclical impact upon indigency in general, through a number of publicly financed programs. The scope of these tax-supported programs might be reduced by a time-wise scheduling of highway improvements so that the effect of highway construction generated employment would have the greatest beneficial result. The reinforcing action of unemployment relief and highway construction should not be overlooked, but instead be recognized as companion efforts, and the highway program should be held in schedule accordingly.

Least Governmental Cost

Someone, perhaps it was Thomas Jefferson, said that the least governed nation was the best governed nation. Others have said that the least taxes are the best taxes. Public highway expenditures are now running at a rate in excess of $10 billion. Benefits which might be realized from time and distance savings or through accident reductions are illusory statistical concepts which have nothing to do with governmental highway finance. States could spend themselves and their taxpayers into bankruptcy creating these so-called benefits. A highway program should be devised which will result in the least governmental cost for the total governmental function of maintaining and operating a road system.

Geographic Distribution

Generally speaking, automotive travel is local rather than long distance. If road construction does create benefits as a result of the motor vehicle imposts that motorists pay, it then follows that highway expenditures should be made on projects geographically close to the source of the taxes collected. In almost all States, the public mind has created definite geographical boundaries, such as between a large metropolitan area and the agricultural remainder; between those areas east and west of a chain of mountains; or north and south of a major river. Lacking other well-defined geographical boundaries, a breakdown of expenditures by counties might be used. If the benefits of road construction are to be made most available to the motorists who make them possible through their taxes, a geographical distribution should override every other consideration in devising a program.

The game has been played by a class of graduate students in highway economics and by about an equal number of highway administrators and educators. It is of interest to examine their scores to see if there is any uniformity in opinion as to the objectives of a highway program. Table 1 lists the way in which these two groups scored the various strategies.

In determining the objectives of a highway program, it is significant to note how closely these two groups compare in their evaluations. The three most important strategies, as agreed upon by the group of graduate students and by an equal number of highway administrators and educators, are:

1. Maximum motor user benefits,
2. Safety, and
3. Existing responsibilities.

It is of passing significance that although both groups agreed that providing maximum motor user benefits was first in importance, the highway administrators ranked the meeting of responsibilities on the existing highway system slightly ahead of safety while the students thought safety to be more

TABLE 1

ORDER OF IMPORTANCE OF OBJECTIVES OF A HIGHWAY PROGRAM DETERMINED BY MORF'S GAME OF HIGHWAY STRATEGY

Order of Importance	Graduate Students	Highway Administrators and Educators	Both Groups
1	Maximum motor user benefits	Maximum motor user benefits	Maximum motor user benefits
2	Safety	Existing responsibilities	Safety
3	Existing responsibilities	Safety	Existing responsibilities
4	Economic redevelopment	Geographic distribution	Economic redevelopment
5	Urban redevelopment	Urban redevelopment	Urban redevelopment
6	Least freight cost	Economic redevelopment	Geographic distribution
7	Geographic distribution	Least government cost[1]	Other
8	Other	Other[1]	Least government cost
9	Least government cost	Unemployment relief	Least freight cost
10	Unemployment relief	Least freight cost	Unemployment relief

[1] Equal weight.

important. The two groups were fairly well agreed in their evaluation of the relative importance of economic redevelopment and urban redevelopment, placing these about midway in the scale.

There was a wider divergence as to the relative importance of providing a program that provided less freight cost; the students placed this sixth in the scale, but the highway administrators placed it last. Geographic distribution and least government cost were other objectives on which there also was a divergence of opinion as to relative importance. Both groups scored unemployment relief very low in priority. Finally, each group had about the same number of "other" suggestions.

MAJOR CONTROLS OF HIGHWAY DESIGN

At this point, it may be wondered what this has to do with "new concepts and goals in highway planning." None of these concepts is new, but then the objectives and goals of highway administration are not new. The strategies remain substantially the same today as they were 20, 30, or more years ago. However, it is the tactics that change or that must be continually reevaluated. The manner in which the tactics or the planning changes—the new goals and concepts which must be adopted in highway planning—is directly dependent upon the objectives of highway administration and the relative importance accorded any particular objective at any given time.

Is there a common denominator in the three main objectives previously determined and can this denominator be used with respect to any of the other objectives?

One factor that appears to be common to these three objectives and to a number of other objectives, such as least government cost, urban redevelopment, and economic redevelopment, is the type of service that is to be furnished the motorist. The type of service furnished the motorist is determined by the geometrics of design used in the construction of the highway.

In the AASHO Policy on Geometric Design of Rural Highways it is stated that in a broad sense there are three major controls—traffic volume, character or composition of traffic, and design speed—that determine the principal geometric features of a highway. Other design controls and criteria, such as topography, physical features, capacity, safety, and economics, are of primary concern but are either reflected in the three major controls or have to do with the more detailed features of design which are not considered necessary for inclusion in a concise and simple design designation.

Traffic volume, the first major control in the expression for highway design designation, should include the pertinent traffic information relating to both current and future traffic volumes. This is best expressed in terms of ADT, with the current year and the future (design) year noted. Most significant is the design hour volume, a two-way value. Also of importance, particularly on multilane facilities, is the directional distribution of traffic during the design hour.

Character or composition of traffic, the second major control, should indicate the proportion of trucks (excluding light delivery trucks) in the traffic stream. Since design hour volume is the controlling volume in geometric design, it follows that trucks should be expressed as a percentage of this volume.

Design speed, the third major control for highway design designation, is basic to the over-all standards, and together with the traffic volume and percent of trucks is indicative of speeds and type of operation to be expected.

In summary, then, the factors which determine the design of any particular section of highway are the traffic volume, percent of trucks, and the design speed.

However, if maximum road user benefits are to be furnished, existing responsibilities met, and future urban and economic redevelopment provided for—all at the least government cost—

there is a more important criterion that must be considered: the determination of the level of service that is to be furnished to the road user by any particular highway.

Traditionally, highways have been classified on a functional basis (primary, secondary, or local) or by some similar category. Responsibility for the various systems has been delegated to the different governmental agencies on a financial basis, with little attention given to the type of service to be furnished by each system.

LEVEL OF SERVICE

The term "level of service" has been used by various groups and, dependent upon the group, has been given various definitions. In discussing advance planning operations by the North Carolina State Highway Commission, W. F. Babcock, Director of Highways of the North Carolina Highway Department, defines level of service as the defining of the average operating speeds which each system should provide and includes capacity recommendations and the degree of control of access to be used on the various systems.

What does this mean in terms of operation and design? How would the level of service criterion be applied and what would be the results? An example of a specific situation in Illinois will illustrate the point.

Interstate 74 has been constructed on a new location and is open to traffic between Danville (population 42,000) and Champaign-Urbana (population 77,000), a distance of about 35 mi. It is under construction from Danville east to the Indiana State line, and its construction from Champaign northwest is contemplated within a few years. Before the construction of the Interstate highway, this corridor was served by US 150. The two routes —Interstate 74, a 4-lane divided highway, with full control of access; and US 150, an old, resurfaced concrete highway, 20 to 22 feet wide with no control of access—parallel each other. There are four small communities served by US 150 in the 35-mi stretch between Champaign-Urbana and Danville, with populations of 1,210, 515, 494, and 861, respectively. Although all of these communities have access to the Interstate route by adjacent interchanges, there will still be a substantial amount of traffic from these towns using the old route. Northwest of Champaign the situation is similar. In the first 24 mi there are three communities served by US 150 with populations of 1,367, 743, and 1,883. Again, each of these towns will have access to Interstate 74 by adjacent interchanges. But even so, estimates of future traffic indicate that the old route will continue to carry a substantial number of vehicles after the Interstate route is completed.

Upon the basis of present design concepts and in conformance with the existing system of classifying highways, the old route would warrant reconstruction to the geometrics indicated by the ADT. If the traffic is sufficient, this could mean 70-mph design speeds, 12-ft traffic lanes, 10-ft shoulders, 5 percent grades, stopping sight-distances of 600 ft, passing sight-distances of 2,500 ft, and other geometrics of design dependent upon the number of vehicles remaining on the old road.

The example cited is duplicated many times, not only with respect to Interstate construction, but also in other situations wherever the need for the construction or reconstruction of a highway occurs.

One of the concepts planning engineers should recognize is the concept of the level of service to be provided the motorist by the highways now being constructed and which will be constructed in the future. If the maximum in road user benefits is to be provided, and if the existing responsibilities are to be met—all at the least possible cost —this new concept in highway classification and design is required.

Referring again to Babcock's definition of level of service as defining the average operating speeds which each highway system should provide, and including capacity recommendations and the degree of control of access to be used on the various systems, several questions arise. First of all, there must be some criteria on which to base the decision as to the level of service to be provided by any given route.

Table 2 gives a number of factors to be considered in determining the level of service that a proposed route should provide. Obviously, these are not all of the factors to be considered, and it is possible that some of the factors included in the list should not have been included. However, Table 2 does sug-

TABLE 2

FACTORS TO BE CONSIDERED IN DETERMINING LEVEL OF SERVICE

1. Other highway service in corridor:
   (a) Number of routes serving essentially same origins and destinations.
   (b) Proximity of other routes to subject route.
   (c) Stage of development of other routes in corridor.
   (d) Mileage and motor user cost by other routes
   (e) Potential development of other routes in corridor in comparison with subject route.
2. Land use in area served·
   (a) Present land use.
   (b) Size and spacing of municipalities.
   (c) Potential economic development within corridor.
3. Characteristics of traffic served:
   (a) Average trip lengths.
   (b) Volume of traffic and percent commercial.
   (c) Potential increase in traffic.
4. Economic effects of developing various routes to different levels of service:
   (a) Comparison of cost of development of various routes in corridor to desirable levels of service.
   (b) Computation of benefit-cost analysis on basis of developing various routes in corridor to desired level of service
   (c) Effect of construction on value and use of property abutting highway

gest a basis for the development of criteria for determining various levels of service.

Although it is beyond the scope of this paper to attempt to evaluate these various factors or to assign values which would determine comparative levels of service, a review of several of the factors will illustrate the procedures involved.

One factor of importance is the average trip length on the segment of route under consideration. If the average trip is 75 mi in length, the difference in travel time between a design that will permit an operating speed of 30 mph and a design that will permit an operating speed of 50 mph is approximately 1-hr travel time to a motorist. However, if the average trip is but 15 mph, then the difference in travel time is but 12 min. Another factor to be considered is the presence of other routes in the corridor being served and the level of service already being furnished by such routes. Referring to the example given, there should be no obligation to furnish more than one route in the corridor described providing a level of service affording 70-mph design speeds, 12-ft traffic lanes, full or partial control of access and, such other features. Other routes in such a corridor should be constructed to lesser design standards—even though on the basis of traffic volumes a higher design would be warranted.

The question also arises as to the features of design that will be embodied by each level of service. How will the highway in the highest level differ from the one in the lowest level? Table 3 gives five different levels of service to be provided and gives the pertinent design features for each level. Again, this table cannot possibly include all the features that must be considered, nor does it purport to be precise policy in each item. It is a guide to what it is hoped will be constructive thinking on this subject.

Perhaps the best way to summarize this premise is by reference to present practices. The level of service furnished by the Interstate Highway System has been determined by Federal policy, *i.e.*, a fully controlled-access highway system. The method of achieving this objective—by grade separating all intersections (highway and railroad), providing access to the through traffic lanes only by carefully designed interchange facilities, regulating the frequency of interchanges, separating the directional flow of traffic by medians, and by other carefully prescribed details of design—has been set forth in memoranda issued by the U. S. Bureau of Public Roads and has been adopted by the several States. The relative level of service of any highway constructed to such standards would be at the top of the list.

Second on the scale would be those routes designed to provide a level of service slightly below that provided by fully controlled-access highways but considerably better than that provided by the ordinary non-access controlled highway. Such routes are commonly referred to as partial (or limited) access controlled highways.

Third on the scale would be routes which would not be access controlled and which would provide slightly lower operating speeds. These highways would

furnish more service to abutting landowners and not quite as much service to the motorist.

At the bottom of the scale would be those highways which will carry local traffic and which will be designed to provide a service commensurate with such usage.

In the discussion of this concept, the problem has been oversimplified. There are many facets that were not discussed. A complete re-evaluation of the existing highway systems is involved—not in the classic primary-, secondary-, tertiary- or State-, county-, city-, local-tradition but instead from a viewpoint of level of service to be provided. It cannot be done piecemeal. No one part of a highway system operates independently of the other segments. The classification of a route with respect to the service to be provided by such route is dependent upon all the other highways in the corridor.

This concept will require the development of standards for the determination of the appropriate levels of service to be furnished and the manner in which they are to be applied. It also will require changes in the application of design standards since the prime question will not be one of traffic volume, percent of trucks and operating speeds, but instead it will be one pertaining to the service to be furnished by the facility.

Finally, it will require careful consideration and complete planning of entire highway networks instead of routes or segments of routes.

The classification of highway systems from a level of service viewpoint, whether it is recognized as such or not, has already taken place. The authorization of the 41,000-mi of Interstate Highway System by Congress in 1944, the designation of the actual system by the States, and the enactment of legislation by the Congress in 1956 insuring the means of financing its construction constituted such a classification. Similar prior action by the Federal government and by the several States in designating and providing for the financing of the construction of primary and secondary systems have been milestones in the road to progress in the highway field. However, after each such action there has been a lull, and during this lull more ground has been lost in meeting the highway needs than has been gained, it sometimes seems.

During the last half century, there have been vast changes in the highway networks and in the services offered the motorists.

For example, in 1905 the mileage of Illinois roads in rural areas was much the same as it is today. Of 94,000 mi of roads reported for that year, only about 7,860 mi were surfaced. On a state-wide basis, the roads of 1905 were almost uniformly unsurfaced dirt roads. In 1913 the passage of a State-aid act provided for a specialized system of county highways. This system, constituting about 25 percent of all rural roads (to be financed by the counties with State aid), was to be the backbone of the rural road network. By 1917 the need for an even better road system, of more specialized hard-surfaced roads, was recognized by the adoption of a State bond issue act. The system to be constructed with this bond issue totaled about 4,800 mi of rural highways. So immediate was the public recognition of the need for a modern system of hard-surfaced roads that, before the highways of that first bond issue had been completed, a second bond issue authorizing an additional 5,200 mi was adopted. The bond issue systems were completed during the early 1930's, and for the next 15 years, or until after World War II, road building consisted mostly of reconstructing older sections of the basic system and constructing a limited mileage of beltlines.

Although the dates may be different and the means of financing and the type of legislation enacted varied, the same sort of pattern can be traced throughout the United States. Each time a bond issue is authorized or a legislative act adopted, there is a feeling that the highway problem is solved. In highway planning this is not true. Increases in motor vehicle registrations, in traffic volumes, and in miles of travel, together with technological improvements in the motor vehicle, combine to require the

TABLE 3

CLASSIFICATION AND CHARACTERISTICS OF VARIOUS LEVELS OF SERVICE

Dependent on Level of Service									Dependent on Level of Service and Traffic Volume							
	Access Control									Traffic Lanes			Shoulders		Median	
Degree	RR Crossings	Highway Crossings	Entrances to Travelway	Frontage Roads	Design Speed (mph)	Max Grades (%)	Sight Distance Stopping (ft)	Sight Distance Passing (ft)	DHV	No	Width (ft)	Surf Type	Width (ft)	Surf	Min Width (ft)	
Full	Grade separate	Grade separate Close minor roads or connect to frontage roads	At interchanges, interference to traffic kept to minimum. No private entrances	As required	70	3 – 4	1,000	2,300	Over 2,700	2	36	High	12 R 10 L	Paved	46	
									800 to 2,700	2	24	High	12 R 10 L	Paved	42	
									Less than 800	—	24	High	12	Paved		
Partial	Grade separate, major crossings Protect others with automatic signals	Grade separate, major highways Minor roads intersect at grade	Private entrances No commercial or industrial entrances	As required	70	3 – 4	1,000	2,300	Over 2,700	2	36	High	12 R 8 L	Stabil.	42	
									800 to 2,700	2	24	High	12 R 8 L	Stabil.	42	
									Less than 800	—	24	High	12	Stabil		
None	Grade separate, major crossings Protect other crossings with automatic signals	Channelize major intersections and control with signals	Private, commercial and industrial entrances permitted Type, size and spacing controlled	None	60	5	600	2,000	Over 2,700	2	33	High	10 R 6 L	Stabil.	16 Desirable	
									800 to 2,700	2	22	High	10 R 6 L	Stabil.	16 Desirable	
									Less than 800	—	22	High	10	Stabil		
None	Protect by automatic signals or reflectorized cross-bucks Only most hazardous crossings separated	Channelize major intersections and control with signals	Entrances of all types permitted Type and spacing regulated	None	50	6	475	1,700	Over 2,700	6	60	High	10	Stone	Directional traffic divider desirable	
									800 to 2,700	4	40	High	10	Stone	Directional traffic divider desirable	
									Less than 800	2	20	High	8	Earth		
None	Protect by automatic signal or reflectorized cross-bucks	Highways intersect at grade Traffic controlled by signals as necessary	Entrances of all types permitted Type and spacing regulated	None	30	8	275	800	Over 2,700	6	54	High	6	Stone	None	
									800 to 2,700	4	36	High	6	Stone	None	
									Less than 800	2	18	Gravel or stone	6	Earth		

continued construction or reconstruction of the highway system.

It is imperative to examine closely the highway needs today so that preparation for the motorists' demands of tomorrow can be made. The fully controlled-access roads being constructed as Interstate Highways are as far in advance of the conventional highway of today as the hard roads constructed in the 1930's were in advance of the dirt roads of earlier days. A new level of highway service has been established. As portions of these new roads are opened, their attraction for long-distance travel has been astonishing. The shape of communities is changed, and new industrial patterns are being developed.

What will be the course when the Interstate System is complete? Will the next 20 years be spent patching that system or will progress be made?

As these Interstate Highways are being constructed, many of the States are now planning a supplemental system of freeways. However, as in the case of the Interstate System, more than State-by-State planning is required. Trips by motor vehicle are not confined to State boundaries. The pattern of highways required to meet the road user demands of tomorrow (and even today) cannot be planned on a State basis. Planning concepts must cross State boundaries—they must be nationwide in scope. As construction of the Interstate System proceeds and other highways are built within the State, it is imperative that such systems be extended so that progress will continue.

URBAN TRANSPORTATION

Within the past few years, those in the highway field have become very conscious of the need for more specialized planning in urban highway construction. Again, traditionally the role of the State highway administrator had been largely devoted to the construction, maintenance and operation of a rural highway system. The streets inside urban areas were the responsibility of the municipal officials and were largely financed by property taxes levied on the abutting owner. Initially, the State's role was to construct a system of hard-surfaced roads connecting the municipalities and enabling the farmer or other resident of the rural area to reach the cities. The State's task stopped at the city limits—in some instances there were State laws which prohibited State highway department activities within municipalities. The increase in urban population, the growth of suburbia, and the increased reliance on the motor vehicle have made the limitation of the State highway department to the rural field archaic.

There is general awareness of the urban transportation problem, but no solution. When new problems arise, new people are attracted to the field and sometimes people already in the field see an opportunity for the solution of some of the problems they have had for many years. The influx of the city planner and the many other specialists in this field is an example. Another example is the renewed activities on behalf of the mass transit interests to enter the financial side of the highway field. Because the highway administrator and planner has been dilatory in entering the urban highway planning field, solutions offered by other experts in the field, or the solutions to some of the old problems that have been reoffered, have been overemphasized.

What part should the highway planner take in urban planning? Certainly refuge can no longer be taken in the belief that responsibility ends at the city limits. The problem today is not merely to afford highway connections between cities or to make it possible for the rural resident to reach the city. Provision must be made for handling the traffic after it enters the metropolitan area. There must be ample ways for through traffic to either traverse or bypass the area. Traffic wishing to stop must be furnished a place for storage—no longer can planning be limited to moving traffic—the parking of vehicles is as much a part of the transportation problem as is the movement of vehicles. Neither can the effects of other aspects of urban development on highway planning be ignored. Mass transportation,

where it exists, and where it can be economically justified, must be taken into consideration.

In all these phases the highway planner must work with other experts in the field. He should not endeavor to become an expert city planner or an expert in mass transportation. Neither should the highway departments assume the role of consultants in city planning. Instead, the role of the highway planner should be to coordinate highway planning activities with other urban planning so that the highway system in the urban areas will conform to the over-all plan of urban development. This is a long-range objective as well as an immediate objective and involves careful preparation and complete coordination between the city planners and the highway planners. Too often the highway planner loses sight of the basic fact that highway systems exist to serve people and in such sense also to serve communities. All too often there is a tendency to feel that a city plan should be based entirely on the highway plan. Although it is the prime purpose of the highway planner to lay out the best possible highway system at the most economical cost, it is also imperative that every consideration be given to existing and future development in urban areas so that all interests will be served to the maximum possible degree.

HIGHWAY COSTS

The need for additional freeways, the need for construction in urban areas, the need to meet the responsibilities on the existing highway system, and the cost of maintaining and operating the highway system of today all require the expenditure of vast sums of money. Without reciting statistics or without referring to any of the many studies that have been made, everyone is well aware of the rate at which highway maintenance and operation costs have increased during the past 15 years. Everyone is fully cognizant of the tremendous backlog of construction needs that exists on the highway systems of the nation today and of the needs that will occur in the future. The enactment of the 1956 Federal-Aid Highway Act, with its provision for financing the construction of the Interstate Highway System within a fixed time period and with its promise of nominal future increases in Federal aid, has created an impression on the general public that the financial problem in the highway field has been solved. It has also tended to create an impression in many circles that Federal funds are available—at no cost to the local or State governments—to finance any and all highway (and in many cases even some very distantly related) improvements.

Prior to World War I, practically all highways were land service roads and the only source of funds for highway construction, maintenance, and operation was from property taxes. Residents living on a road desirous of improvements were expected to bear the cost of such improvements by special assessments or some other form of special taxation. The advent of the motor vehicle changed the pattern. Although the change was slow in taking place at its inception, it increased rapidly until during the 1930's a new pattern was established. Certain roads and streets were still primarily land use highways, and in general the work on such roads was financed from property taxes. Other roads were financed partly from property taxes and partly from road user taxes. Still other roads—usually termed the primary system—were financed completely from road user taxes.

Since World War II the pattern has changed. Almost all public highways are now financed at least in part from road user taxes. The distinction between road usage or service has become less pronounced as each year passes. The fact that motor vehicle user imposts, particularly the motor fuel tax, are easy taxes to collect and, once the initial shock of an increase passes, easy to levy, has led State legislatures to use them not only to finance work on all the highways within the State but also in some instances for nonhighway purposes.

The 1956 Federal-Aid Highway Act directed the Secretary of Commerce, in cooperation with the several States, to

make a study of the proportionate share of the design, construction and maintenance costs of Federal-aid highways attributable to each class of person using the highways, based on the benefits derived from the use of such highways. In keeping with the current and future needs and trends in highway usage, consideration should be given to the benefits derived from highway improvements, not only by the highway user, but also by property owners and others, and a determination should be made of the proportionate share of the cost of highway improvements that should be made by each class involved.

OTHER PROBLEMS

There are many other problems confronting the field of highway planning. There are many other concepts which must be adopted—new goals, any of which may be more important than the few discussed. There are opportunities in the use of computers in the design of roadways and structures, in the utilization of manpower and equipment, in accounting and fiscal control, and in many other ways. There are fields to be explored in the control of traffic by electronic devices and by the installation of systems of signalization that will regulate the flow of traffic so that maximum use can be made of the capacity of the highways. Work must be done in the field of highway safety—not merely in highway design but also in driver behavior and education. These are but a few; there are many others. But the three basic goals in highway planning were named by the players in Morf's game of Highway Strategy—maximum road user benefits, safety, and meeting existing responsibilities.

DISCUSSION

Holmes.—One of the points that was raised at the Sagamore Conference by one of the planners who was there was this: "If the highway administrator could find that for $1 expenditure of highway funds he would produce a benefit of $2 of community benefits, would he spend that dollar?"

There was not one of the seven chief administrative officers present who would say "yes" to that. I expect I would have not said "yes," either.

But they did ask a question, in turn: "How do you figure the $2 benefit?" The planner could not answer that, and he knew he could not. We all recognized that that is a great area of uncertainty.

But the point you make here so strongly, Mr. Carley, about regional community benefits of all sorts, as to a desirable product of the highway system, does not exactly jibe with the point that the first strategy of the highway administrator is to produce maximum highway user benefits.

Carley.—This is right. I would like to go back to a point that you made before I spoke, when you mentioned that the highway administrator, as diligent as he might be about planning requisites and planning needs, nevertheless was involved in carrying out the responsibilities of the job that he had to do. What I am saying is that we have a great responsibility to go beyond that which is prescribed by law and by the legislature in terms of what our responsibilities are.

You say "existing responsibilities." That is black letter law. That is what the program calls for. I would say that you people are shaping our lives, and that responsibility is far greater than any black letter law or statutory prescribed law that we have.

Highway administrators are not worrying as much as I think they have in the past about geographic distribution and about where the highway is, but of serving the needs apart from what the legislature says the needs are, or what the people think they need. There can be a difference.

If the administration today became close to what the Sagamore Conference called for, you could not ask for anything more in the world. But they have gone home and retreated to the oldest refuge, the status quo.

Bill Haas was here from the Wisconsin Highway Commission, and I watched him fight for years, talking about a larger perspective than that served by engineers, by mechanics, in

terms of a highway program: a plan, a development, for a community-wide, region-wide, state-wide program.

I think that slowly but surely even the public is becoming interested and will back programs that are more than laying out ribbons of concrete.

When I see highways laid out, beautifully designed, engineered perfectly, but serving no other function than to get a car from point A to point C, it distresses me because there are far more functions than moving that car from one point to another. There are abutting land uses, the social needs, and all the other things that are there.

Highway administrators are beginning to believe that this is necessary, that they have a community responsibility, and I do not mean to a specific number of people in a local geographic spot, but to the entire region. I think this is indicative of the fact that you recognize you have a larger measure of responsibility. I don't think there is that much difference between the engineer's and Mr. Shaneman's statement.

Shaneman.—First of all, I will have to admit that this approach was made by graduate students in highway economy and by administrators. I feel quite sure if it had been made by planners, there would have been a difference. But again, we are talking about the goals and objectives of highway administration; within that framework.

There is another question, here, the use of highway funds. I know that in Illinois and most other States highway funds are earmarked. At least a good portion of them are earmarked for highway purposes.

Now, granted that earmarking is good and is correct, then how should we use those funds? I still think this is a good array for that purpose.

Telford.—Many of the thoughts expressed there have been expressed by people in my office at various times. I think, however, that the highway engineer has tended to be too apologetic. He has been to a great extent taking the lead and trying to get the planner to do some planning, and he has been shaping the future. He has been shaping it with the tools that he was given within the legislative and financial framework. He has been building systems because, beginning with the Pennsylvania Turnpike, people demonstrated that they wanted and would pay for a better means of more vehicle transportation, and if one group did not get it for them, they would fire them and get someone that would.

I believe that we need to take the broad view, but the implication that the highway engineer alone is narrow in his point of view is all too prevalent, even among the apologetic members of our own profession.

One of our problems is that although we have many kinds of planners, very few of them have a responsibility for accomplishment; however, many of them give us the strongest and most effective support that they can.

But each of them, in the hundreds of cities that we have to deal with, has not only to plan and develop ideas, but to get them over with his own legislative organization. Many of our problems lie in the fact that the planning concept of their own people and their staff is not acceptable to the legislative group controlling it, and it is completely different from that of the next community adjacent to it, that wants some other type of service.

We have the responsibility of coordinating those things. We meet some of them head on, and somebody has to make the decision. I believe that that is where much of the conflict between the engineer and the planner lies. The engineer is very conscious of public service, but he has to get a job done. About nine planners will agree with him, and the tenth one will object and insist that a line should be swung widely afield from where it should be to meet his concept of some zone, which in five years may be completely different.

Then we have a difference—public meetings, dubious remarks in the press; and the highway engineer is the defender. I think it is high time the highway engineer pointed out that he is trying to get some sound planning, and we have, I think, supported the concept of regional development.

Certainly regional and State broadgage planning is essential to the integrated motor vehicle transportation system that we are endeavoring to develop. You cannot take one piece of it without considering all of the rest of the pieces and the way they fit together.

St. Clair.—I think perhaps there is not as great a conflict between what Mr. Shaneman presented and what Mr. Carley spoke of. I am not shocked by the fact that responding to user needs, or conferring benefits on the user is the first item of attention of both the student engineers and the administrators, and I think even that is not in conflict with the broader view because we cannot get community benefits or regional benefits from highways other than by highway use. Practically all, stem from some form of motor vehicle use.

There is no real conflict between the broad benefits to the economy and the benefits to the motor vehicle user. Where it appears that there is, there is some wrong planning or some wrong engineering, such as putting an elevated expressway in a place where all the esthetics, all the needs of the local community, call for a depressed highway.

So I think in serving the motor vehicle, we will serve the community. It is a question of really looking deeply into the matter and making certain that the level of service to both motor vehicle and community is reconciled and worked out intelligently.

If there is a conflict or antithesis, and we say that we must follow this plan because of community needs, whereas the narrow or pure concept of user needs would follow another plan—then perhaps we do need to salt the highway revenues with a little something in the way of community contributions. However, I am not quite certain that intelligent planning can completely reconcile these two concepts.

Carley.—I am afraid that in talking about planners and engineers we raise up a dichotomy that we don't want to exist. Mr. Holmes said that planners did not have to implement their plans—that is true. But the highway engineer, who is responsible for implementing the program and thereby takes most of the blame and very little credit, goes ahead and builds it. Inherent, here, we have a problem of a man who has to stand up and be responsible for what he has built.

I am afraid, though, that the next jump is not saying that the planner ought to be more responsible and the engineer ought to have more considerations other than just being able to show a good job per se. Why cannot highway departments incorporate both planning and engineering?

I don't want to see planners established as a profession without any responsibility for building, nor highway departments concerned about only meeting the engineering design specifications, traffic counts, projected design traffic carrying capacity of a road. Why not inculcate into the job descriptions if need be, or into at least the job description of the total performance budget, that a highway be more than just a finely engineered tool and finely attuned to engineering standards—that it be planned?

Why not hire planners with engineering degrees, if you have to hold up your profession, maybe without them, even?

Even the creation by label of an Office of Planning in the Bureau of Public Roads is a big step. I heard people say the other day: "That doesn't mean much. They are just doing that to accommodate the Congress and the President, and other people are asking for it."

So what? Labels are a good beginning, and I am sure you people plan to carry it out.

Oliver.—I am not sure where we failed in all this. I helped, from 1936 on, to collect a lot of planning information; and for the last several years I have been using a lot of planning information. Frankly, I do not think the highway engineer has done such a bad job.

Shaneman.—At the risk of being a traitor to my cause, I would like to more or less second what Mr. Carley said.

To go back to this term, "level of service," by way of illustration, I am thinking of the construction project that has just been completed in Spring-

field, Illinois. There was an existing street that was 20 or 22 ft wide, 12,000 to 14,000 vehicles a day, on a 60- to 70-ft right-of-way. Something had to be done, but all my designers could say was that we have to build to geometrics that will accommodate a DHV-20, which will be, perhaps, a 1,000, 1,500, or 1,800. And if you have to have 200-ft right-of-way, you have to have service roads, interchanges, and other things. We didn't do that.

Finally we either had a consultant do the actual design or designers looked at it again. There was a corridor here where something had to be done. But what should be done in that corridor? Certainly if we had gone in and built that to what are existing design policies, that we would adopt as engineers, it would have destroyed the entire service in that corridor. So we had to do something different. We had to build something else there; we had to adopt a different level of service.

I think that is one of the things that we miss when we start to locate routes and when we start to pick geometrics of design and that sort of thing.

The location should be examined, not with just an idea of how much traffic is going to be there in 20 years, or how many lanes are needed, or how wide those lanes will be, and how many trucks. Other factors must be considered, such as the economic development within the corridor, or as Mr. Carley said, on a regional basis, or even a statewide basis. Another thing was the stage of development of the highways in the area.

Those things have to be taken into account, and we are just opening the door to planners and other kinds of people coming in and doing our job.

Hitchcock.—In consideration of goals, what is the position of providing some facilities for bus stops, bus operations, on expressways? A separate lane, perhaps, or a bus stop off the traveled way?

Shaneman.—Speaking again of level of service, I do not think you can permit bus stops or any kind of stopping on the freeway. Off that system, a bus stop or bus transportation is a part of the transportation picture, and it all should be taken into consideration. It is not compatible with the features of freeway design, though.

Hitchcock.—Should we use highway user revenues to build the bus stops?

Shaneman.—I indicated that I thought the whole question of financing should be examined to ascertain what portions of the system should be paid with other revenue. I am begging the question, I know.

Carley.—I would propose that bicycle trails adjacent to expressways and interchanges be developed for recreational use and paid for out of motor vehicle fees. Or rather, I do not care if they are paid for out of these fees or not, but paid for some way or another, as a national and State policy in recreation development, that is not inconsistent with national highway planning and State highway planning activity.

This is consistent with safety, I mean. I do not know how you would do that. These areas in the 20 years ahead may represent the only areas that are stretching out into the suburban and even beyond the peripheral area of the suburbs. I think this could be paid for first of all out of public funds, and it would not hurt at all to have the payment out of motor vehicle use fees.

Granum.—It struck me while you were discussing that group of highway administrator and user decision-making gains, that really so many of the things we do in highway planning and design ought to be directed to as much multiple purpose objectives as possible. True, when you design and build a freeway, you have essentially a single purpose of moving traffic, but at the same time many of the other objectives that you outlined are being served. It seems to me that as many as possible of each one of these objectives that can be incorporated into a highway plan is a desirable thing to do.

For example, we want safety. We also want speed, and preservation of the investment. We take care of existing responsibilities.

At the same time, the multiple purpose characteristics here are served by all of the discussion that has been held about planning of a city freeway system

for the best urban development and the best concepts of city planning.

Quinnell.—The bus situation in Montana is rather bad. We have a very sparse population, large areas, and because of the sparsity of population there are not the parallel routes there are in some other States.

We take one of the primary roads and change it to an interstate route, and probably it is 20 or 25 miles to any other road. What are you going to do with buses, including the school buses? You are going to have to provide a facility in some way to take care of them. Who is going to pay for it?

Hitchcock.—The point I was leading up to is that with the same amount of money perhaps we can move more people by providing a lane for buses only, or providing bus stops on primary roads, than by building an additional lane of highway for mixed use of vehicles, particularly during peak hours.

This question has come up in a few instances, and it is going to come up more in the future. If it has come up in Montana, it is even more of a problem in some of the other States that are more highly urbanized. Perhaps, it is a new concept in the use of highway user funds.

Quinnell.—Our population being like it is, there is not really enough traffic using any one area so that you can afford an interchange or anything of that kind. There should be some other way of treating it.

Babcock.—We had that same problem, where we were converting certain existing roads into the Interstate System. This showed me that there cannot be one rigid pattern for the Interstate System. There has to be a little give and take.

Wiley.—I feel I cannot help but come to the rescue of the State highway planners to this extent: There has been some comment here to the effect that by providing highways that do the most for road users, we might be in some measure slighting other needs. I submit that when we as State highway planners do the best we can to find out what travel people are doing, where they are going, and for what reasons, then project this as best we know how to take into account expected future development and future activities, and then attempt to provide a roadway that will carry the people to these things in the most economical and safest way, we are not only meeting the best needs of road users, which is not a foreign crowd of some kind, but it is all of us, you and me and every other person of the millions who own automobiles—then we will in effect also be taking care of these other needs.

In other words, if we properly project and provide the best facility for road users, we will have already taken into account the things that Mr. Carley was mentioning. This is what we are attempting to do, not on a local basis, but on a regional or statewide basis.

Carley.—How are you finding out, for example, 20 miles out, how fast Albuquerque is going to grow, and what future land uses are going to be, and where you need additional belt lines, etc.? How are you doing that today?

Wiley.—We are taking the best estimates we can get from city planners, in that particular instance, who are rather active in land use inventory and projection.

Carley.—They have developed a comprehensive plan?

Wiley.—They have a plan, which isn't as thorough as it should be, but in the process of doing our new urban transportation study, they are obligated to provide this for us.

Schwender.—If you undertook to hit the projected land use within that particular area, I expect you would find that about 90 percent of what goes on in an area is non-conformity to the plan that was laid down.

I think it is essential that the plan be a plan that can be put into effect, and some assurance that it will be put into effect, so that you do not find that you have made a special effort to meet a land use that is gone when the time comes to serve that area.

Wiley.—That is an important point. We are trying to make plans in advance so that this can be a continuing study, one that can constantly be up-dated, be-

cause we all know that we can sit here with city planners or any kind of planners you want to name and project land use, and it is not always going to conform. You cannot have a plan now for 1980 and know that every respect of that is going to turn out to be just exactly the thing it is going to be today. It should be flexible enough so that it can be up-dated, we believe.

Schwender.—After you have built beyond a certain point, then, there is no flexibility. You have very often bypassed land uses that have not developed, yet they were planned. And if that is changed entirely, you may have a different concept of the whole thing. But you have passed the point where you can do anything about it, even though it is a continuing study.

So the land use plan is going to have to be something that is realistic and does lead to requirements. After you go to the point of no return, you had better stick to it, if you are not going to foul it up again like it has been.

Wiley.—Of course, when you go to a certain point, beyond which you cannot make a change, you just have to incorporate that into your next plan. And that may be any phase of the development of the community.

Whitcomb.—In the planning carried on in some of our urban areas and now being carried on in the Boston area, we have published reports, and this has happened in at least a dozen different reports, each one of them incorporating three or four urban areas.

These books have been published, distributed, outlining what the plans of the highway department have been or are, and what the programing of the construction is.

In the Boston metropolitan area, we are taking into consideration now over a hundred cities and towns in developing a land use in a socio-economic report done by Professor Nash of Harvard.

Now, the development of the land use has got to be based on something. Either the development of the land has got to come first, or a highway system has got to come first. And I think it is an accepted fact that if an area has adequate transportation facilities, it will develop. If it does not have adequate transportation facilities, it will stay just as it is.

The development of the area, as planned in the Boston metropolitan area, is based on a highway plan. Now, if this highway plan is built, and if it is built within a certain number of years, then a certain thing will happen, as to the development of the area and the land use.

If any part of the plan is delayed, for a period of five years or longer, then that area will not develop. It will be a sick area as far as the whole metropolitan area is concerned. It will not get to develop along with the rest because it does not have adequate transportation.

In regard to some of the other areas, we have published our report, showing what we believe is the solution. We have talked with some of the urban planners in the various areas, and the gentleman from Pennsylvania asked me earlier this morning if their highway engineer would be accepted as a partner or as an equal or as a leader. He will be accepted as a leader, just as a horse is accepted as a leader of a buggy. He can pull the buggy, but somebody else will direct it.

We have found with some of the meetings that we have had with city planners that as long as we will accept their plan, we are cooperating with them. But the minute we deviate from any acceptance of their plan, there is no cooperation. And as an example of this, in one of our cities, the planning engineer felt that a modern housing development was located in the wrong place in the city, and as far as his plan was concerned, it was in the wrong place.

His idea of the highway location was that it should go through this development for the purpose of removing it; so then he could take it and put it where he believes it should be put. And we would not do that; so we were not cooperating.

I think that cooperation is a two-way street, and certainly I think the Highway Department of Massachusetts has

shown that it will cooperate with any reasonable suggestion or plan of the city planner.

Titus.—I would like to get into this question of "level of service" unless you intend to return to that later. Just what is "level of service"? I think some of these terms we have used to describe it, such as controlled access, number of lanes, and so on, are things that contribute to a level of service but do not exactly describe what the level of service is. And I think that two of the terms that Mr. Granum used, speed or travel time, and safety, tend to describe the level of service to me.

Steele.—There is one thing that has not been mentioned that we have thought of as being extremely important in that area, and that is the level of service that can be afforded. Now, we have not talked yet about physical ability. I will probably get into that in my discussion a little later. But it seems that fiscal ability certainly has to be considered in determining the level of service that we can expect to provide in any given highway facility.

Shaneman.—What you are saying is that you do not have to buy a Cadillac every time. There will be some places where you will need a Ford. And we do not have that now in our present concept. If you want to buy a highway improvement, you have to buy this model, because the traffic says so.

Steele.—I would even go further. There are some roads where the only kind of service we can provide is a Jeep.

Shaneman.—That is exactly it. And all these other things, the design speed, the access control, are just parts of the picture. You put them together this way, and they make a Cadillac, put them together another way and they make a Ford, or maybe you just repair the car you have got.

Schwender.—I think the level of service has to be like a system. It has to be a system of level of service. Some highways should have more money spent on them in order not to spend money on some facility that can divert traffic and put it on there.

I think there should be a system analysis of what the level of service is going to be for the whole State system, not in each individual road, and then spend some additional money on the principal arterial systems that can furnish this higher level of service, and grade down from that to other systems that are feeders.

Shaneman.—Certainly the analysis has to be made on a system-wide basis.

Schwender.—It cannot be made on each individual road when on each end there is a fairly high facility, and it may cost you twice as much to get the same type of service on some parallel facility, where this particular highway may act as the main arterial for that type of use.

Froehlich.—Let us put in the level of service that is required, and not settle for something less merely because we do not have the funds to do it at that particular time.

Wiley.—That would be real fine, except that there will be a lot of sections of the system we will never get to—that will do that.

Froehlich.—There you come into another phase of planning, and that is getting the funds.

Shaneman.—The point you made is exactly the reason we started to think about it so seriously; because we are not confronted with the improvement of a system that is 30 or more years old. The primary system of Illinois was built in the 1930's, and the late 1920's. We have primary highways now that are carrying 3, 4, or 5 thousand vehicles a day, and we are going to have to rebuild those.

Now, we build just what we have funds for, then we are committing ourselves to that improvement for another 30 years. On the other hand, perhaps on this corridor we should be building a freeway.

Well, even though we cannot build four lanes, or six lanes, and even though we cannot build all the interchanges, we should at least be making provision for the acquisition of right-of-way and the development, so that when we put the chassis there, we can put the body on later.