

# Traffic Planning for Freeway Operations

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Our transportation picture seems to be constantly changing at an ever-increasing rate. The decade just past, that of the "fabulous fifties," witnessed jet travel come of age; and now, as we begin the "soaring sixties," space experts are talking about rocket trips to the moon. To return to earth, a similar transportation evolution is taking place in surface travel, the development of controlled access arterial highways, perhaps the greatest change in highway transportation since we took ourselves "out-of-the-mud" with paved roads.

This tremendous federal highway program, the greatest public works program ever conceived, is providing a network of integrated and coordinated highways that will make for expeditious and safe travel for the ever-increasing volume of traffic. With this splendid highway transportation system, we may travel over our entire country as easily as going across town, and be just as safe. But, this "picture" I have just described is "not yet completed." There can be many difficulties ahead if we tend to use the "broad brush" and overlook the problems of operating this network of controlled access highways.

## GROWING POPULATION AND USE OF AUTOMOBILES IN URBAN AREAS

While no one can be sure of what the traffic volumes on our highways will be by 1975, we need only to take a look back at our 1970 traffic estimates made in 1950 and to realize that even by 1955 they were exceeded. Improved methods of forecasting now in use should give more reliable results of traffic estimated for 1975. We can be sure that, taking into account the estimated population increase of another 50 million people in the USA by 1975, with over two-thirds of our population residing in urban areas, and the expected 110 million vehicles to be registered by then, the problems of adequately handling the daily traffic in another decade or two will be many times greater than they are today.

Transportation is a basic factor in the urban growth, its form, its prosperity, and its life. The flexibility and convenience of the automobile is seemingly an indispensable part of our daily life. Whether used for work, for shopping, to go to and from school or for social or recreational activities, the entire family relies on the automobile. Where there was an average of 4.5 persons per automobile a decade ago, today that average is less than 3 persons per car. This modern, swift and convenient mode of transportation is a major factor to increasing urbanization.

The economic impact of our national highway program will be far reaching. The growth in vehicle registrations and highway travel has corresponded with the increase in the nation's gross national product (GNP), a barometer of our country's economic growth and stability. The urban areas where the majority of the nation's population reside and work are the primary centers of the business and wealth. These people will own about 60 per cent of the 110 million vehicles expected to be on the streets and highways by 1975. As business and traffic generators, the urban areas will account for at least 50 per cent of the travel on the Interstate System, yet less than 15 per cent of the entire mileage of the interstate system will be within the urban areas.

## CHANGING CHARACTER OF URBAN AREA

The form and character of the urban areas in the United States are undergoing rapid and extensive changes characterized by less concentration of economic activities, increasing suburbanization and spacial growth far in excess of previous experience.

Forces influencing these changes can be identified with the technological advances in communication, power generation and transmission, transportation, and the improved economic growth and standard of living of our country.

Advances in manufacturing processes and in the distribution of goods, have brought forth new forms of industrial architecture, calling for large expanses of floor area using single-story buildings and making obsolete the older multi-storied factories in traffic congested areas. Similarly, retail shopping, which has been one of the characteristic economic activities of the central business district, has felt the impact of these decentralizing forces resulting in suburban shopping centers. Partly as a consequence of these technological factors and

partly because of the natural desire for increased amenities, available land is being extensively, as well as intensively, used for both residential and business purposes.

The dispersal of the increasing population is emphasized by the single family homes spreading out over the landscape. Consequently, the growing suburbs have had to provide more acres for the additional population than the older areas had to do. As an example, in the New York-New Jersey metropolitan area, comprising a total of 22 counties on both sides of the Hudson River, the 1820 population of 497,000 persons occupied 10 square miles; in 1860 with a population of 1,933,000—30 square miles were developed; in 1900 a population of 5,514,000 occupied 140 square miles; in 1940 with a population of 12,518,000, there were 640 square miles in use. By 1955 with the population of slightly over 15,000,000—1,100 square miles were developed. Thus, in a period of about 100 years, the area required for each additional million population has increased almost 13 times, or from 14 square miles per million in 1860 to over 180 square miles in 1955.

In this period of the so-called "urban sprawl," the population and employment in the central business district has tended to stabilize while its functions have been changing. These changes, a natural corollary to what has been observed in the suburban development, indicate a trend toward central-office type of business management, finance and professional business services, wholesale trade, specialty and quality retailing, and educational and cultural activity.

Furthermore, as a result of these changes in business practices there is a trend away from maintaining large inventories which is reflected in changing transportation requirements. The flexibility of truck transportation permits rapid delivery from manufacturer, to distribution center, to user.

While urbanization has expanded into metropolitan size and area, the central core or city has retained its general form since prior to the era of the motor vehicle and the airplane. Most street patterns today existed before the rubber tired vehicle; and as a result, are overcrowded and wholly inadequate to meet increasing demands of modern vehicle traffic, and the terminal needs for parking, loading and unloading. Similarly, many of the typical highways in use today, especially those lacking the controlled access feature of the interstate system, are poorly located and inefficient to serve the expanding urban development and changing land uses. We are faced with the need to operate modern equipment in a plant that was not designed for it.

## COORDINATION OF HIGHWAY AND LAND USE NEEDS

Highway facilities to serve this ever-increasing transportation load must be developed in balance with proper land use needs and service. The traffic circulation system requires maximum utilization of the existing and improved street systems as well as the modern freeways. New freeways alone will not be sufficient to handle the volume of traffic anticipated in the foreseeable future. Nor will maximum freeway capacity be obtained without adequate connecting arteries to crossroads and local streets, and to terminals, for parking. In the last analysis, a moving vehicle has a destination, a stopping place, whether at the curb or off-street.

The controlled access freeways, like major rivers, will branch off into smaller streams, the adjacent highway and street system. Any clogging at the entrances and exits will create back-up and congestion and threaten the major artery. There needs to be proper balance of capacity on the freeways, connecting highways, and streets to assure a fluid interchange of traffic movement. Adequate provision for the anticipated moving traffic demand. Off-street parking and unloading terminal facilities will assure maximum efficiency of the traffic circulation system and related land uses of the area.

A comprehensive highway and land use plan is essential to satisfy the fundamental questions of location, alignment, type and capacity of the expanded highway facilities. The traffic engineers' knowledge of traffic origins and destinations, travel patterns and traffic volumes that exist, and the planner's understanding of the effect of the various land uses on transportation, must all be considered in the estimates of future traffic needs.

An adequate highway system will not only provide indispensable traffic service, but it can also aid in the development of desirable land use arrangements. The interstate system, the freeways with controlled access can be a powerful tool for good city planning to permit the replacement of many slum areas and obsolete buildings and decadent areas with new facilities properly tied into efficient land usage. It can help preserve homogeneous areas on the one hand; and on the other, to divide residential sections from industrial sections, or to effect desirable separation of other dissimilar land uses. With proper coordination, the total highway system and the land use plan complement each other.

## FUTURE TRAFFIC NEEDS PRESENT A CHALLENGE

The expansion of urban areas, the growing population, the increasing use of the motor vehicle and other evolutionary processes add substantially to the complexities of our transportation problem. The steadily increasing traffic is not to be deplored. It is the result of a dynamic thriving economy. Urban areas are the sparkplug of this economy, and their transportation needs must be met if the objectives of the national highway program are to be achieved.

The interstate highway system is planned to connect all the major cities and metropolitan areas of the nation. Certainly, these highways cannot end on the fringe of the urban areas or merely bypass them. They must provide access to the traffic generating urban areas and have sufficient capacity to avoid hazardous bottlenecks and economic waste which the President specifically aimed at eliminating in formulating his highway program.

The current national highway program, initiated by Congress in 1956, to complete the 41,000 miles of the interstate system, has been progressing on schedule. As of January 1 of this year, the Bureau of Public Roads reports: 7,570 miles of the 41,000 mile national system of interstate and defense highways, open to traffic. Of this 7,570 miles in use, 2,790 were completed to the acceptable Interstate standards for 1975 traffic, and 2,520 miles are adequate for present traffic but will need additional improvement to bring them up to the Interstate standards. The remaining 2,260 miles are the toll roads, bridge and tunnels incorporated into the interstate system as permitted by law.

In addition to the sections open to traffic, 4,770 miles are under construction with Interstate funds, and preliminary engineering or right-of-way acquisition was in progress on another 18,370 miles. Thus, of the 41,000 miles, work was completed or under way on 30,710 miles.

While construction progress has been good so far, it is most important that planning be undertaken now for handling the increasing traffic as more miles of the system are placed in use. Already, in several areas throughout the country, an awareness of the traffic operations problems on the freeways is noted. Experience on existing freeways and the toll roads can be most useful toward an understanding of these problems and the challenge ahead.

## TRAFFIC OPERATIONS CONSIDERATIONS

The accelerated construction schedule that has made possible the progress to date on the interstate system, has of necessity required many sections or projects to be under construction simultaneously. Maintaining traffic operations during construction is a major problem and requires adequate advance planning to assure that necessary detours are properly signed and maintained. Unless carefully handled the natural conflict between traffic flow and construction activity can mean higher costs, a longer construction period and numerous job hazards.

The motorist's common complaint, when confronted with inconvenience and delay during construction, is poor signing and inadequate maintenance of the detour. Just as frequently, he will be annoyed by the lack of information concerning the construction project which he might well have avoided had he known.

Planning for the traffic operations during construction is equally as important as planning necessary for the completed facility. Existing routes to be used as detours must be adequate for the anticipated additional traffic and exits and entrances treated accordingly. Policing is no less necessary during construction and on detours, to handle accidents, abandoned vehicles, vandalism and other problems.

As longer continuous stretches of freeways are completed and placed in operation, increasing traffic volumes are using these sections of the Interstate. The design and construction of the highway does not complete the job. Unless adequate consideration has been given to the vehicle and to the driver, efficient operation of the facility will suffer. It becomes increasingly important to recognize a concept of public service to the traveling public, which the motorist expects and is paying for, and to provide proper operational environment for the full realization of adequate capacity, safety and convenience inherent in controlled access highways.

In the past few years there has developed a growing recognition of this problem and the need to think and to plan in terms of the dynamics of the traffic operation of the freeways, the interstate system. Forward thinking highway officials, traffic engineers, planners, legislators, and various groups concerned with highway transportation services for the motorist, have done much to develop an awareness of this broad problem. However, the full impact of the changes being indicated in our highway transportation system has not been fully appreciated.

Section 112 of the 1956 Federal Aid Highway Act prohibits service stations or other commercial establishments from serving the motorists, on the right-of-way of the interstate system. Such service facilities as gas stations, restaurants, and motels must necessarily be located off the interstate highway on crossroads and frontage roads accessible to the interstate traffic through interchanges. While the removal of these service facilities from the multi-lane freeway eliminates potential accident locations, it conceivably adds to the traffic leaving and entering the freeway and some delay and inconvenience to the motorist.

In seeking these services off the freeway, the motorist needs adequate advance information as to where he must go for the service desired. It is questionable whether the currently authorized AASHO standard signs that may be located along the roadway or within the rest areas of the interstate system, will provide sufficient information for the motorist leaving the freeway.

The location of these service facilities on crossroads or along frontage roads near the freeway interchange may very well aggravate local traffic problems and will certainly justify appropriate zoning and land use controls. While there may not be sufficient experience to date to indicate the magnitude of this problem, there is no doubt of its potential. One needs only to observe the land use development at existing intersections of major arterials to understand the need for early consideration of this problem. Steps should be taken now in the early planning of the interstate routes to examine critically the traffic data and other information used to establish interchange locations, and ascertain the availability of adequate zoning and other controls at these sites. Effective zoning, land use controls including enforceable regulations delineating driveways and service areas, and adequate capacity of the crossroad and frontage roads in the vicinity of the interchange should be provided. If these considerations are overlooked in the planning, it may be too late once the interchange is completed and in use.

The approved design standards for the interstate system are recognized as minimum standards. Under certain conditions in urban areas where anticipated high traffic volumes will exist, it will be necessary to exceed the minimum requirements to assure satisfactory operations of the adjacent and connecting highway and street system. The location and configuration of the interchanges should be based on comprehensive traffic and planning studies of the urban area and the forces

Good engineering practice warrants a field check of the plans for operating features. Is the topography such that an exit ramp may

and influences that may affect or be affected by the freeway development. surprise the motorist and be missed or become a hazard? Is it possible to effectively sign the interchange and to provide other traffic control features to assure safe and efficient operation? Are all ramps necessary and what about operating provisions under abnormal traffic conditions? What operating problems must be recognized in the freeway design by the travel pattern on the connecting and adjacent street system, resulting from one-way streets, channelization, parking regulations, "stop" or "yield" signs or traffic signals?

It is most important, therefore, to recognize the traffic operating features and place them in proper perspective, at the beginning of the design stage of the facility.

During the series of Freeway Operations seminars, conducted by the Institute of Traffic Engineers over the past two years, questions frequently discussed had to do with the emergency service needs of the highway user. On most highways, including toll roads, should an emergency develop such as running out of gas, or a breakdown due to tire or motor trouble, one is usually able to quickly summon aid from a nearby service station or telephone. Eliminating the facilities for food and fuel from the interstate system presents a problem for the motorist in need of emergency service, and for the highway officials responsible for the operation of the freeway. The problem is more acute on controlled access highways, because of the high-speed, high-traffic volumes and the absence of intersecting roads, service stations and the inaccessibility of dwellings and business along the roadway. Though service facilities will be available at most interchanges and the interchanges will be more frequent on the freeways than on toll roads, it may still be extremely difficult for the stranded motorist to obtain essential emergency service. It seems clear that the highway officials' responsibility for the operations of the freeway must include adequate provisions for such highway user services.

The kind of service that will be necessary include: automotive and towing services to take care of vehicle breakdowns and removal of the vehicle from the highway; ambulance and fire-fighting equipment that may be needed in serious emergency situations involving accidents, personal injury; policing for enforcement, protection and proper control of moving traffic; maintenance including the roadway, right-of-way and rest areas, signs and markings and snow removal. These services must be available at all times on a round-the-clock basis, be able to respond with minimum delay, be performed in a capable and efficient manner and at reasonable cost to the user for the personal services required.



Experience on the toll roads throughout the country has revealed this to be a very important part of the service to be provided for the highway traveler in order to maintain an efficient facility at maximum operating capacity. Past experience on the typical highways, unfortunately, offers no proper base for estimating the service needs to the motorist. An entirely new approach must be considered by the responsible public officials if we are to obtain the maximum operating efficiencies for the dollar spent.

Disabled vehicles on a freeway can also have a far reaching effect on the capacity. It is necessary to remove disabled vehicles from the traffic stream as quickly as possible for safety and to maintain the traffic flow and efficiency. Experience on toll roads and the extensive freeway system in California has indicated that effective traffic surveillance by police or maintenance patrols will help in finding and removing the disabled vehicles and thus prevent sudden back up in traffic and potential accident hazards. Consideration has already been given to ways and means to enable the motorist to communicate his need promptly; and while much research is still necessary, the use of electronic detection and control systems for monitoring traffic appears to be applicable particularly in areas of high traffic density.

There is no question that the current national highway program, and especially the accelerated schedule of construction of the interstate system will have a tremendous influence on the economic growth of our nation. Highway transportation is inextricably tied to the expanding urban development. Changes in land uses resulting from improved transportation facilities increase tax revenues; and in general, contribute to a healthier community financially. It is quite clear, however, that none of these advantages will accrue without a comprehensive transportation and land use plan to work from. It is equally important that without adequate planning for and execution of proper traffic operations, even the best plans can fail. Therefore, to assure the most efficient use of our highway transportation system, effective planning for the traffic operations on the new freeways, connectors, and adjacent street system must be undertaken as early as possible.