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FRANCIS C. TURNER was born in Texas and received his civil engineering degree from Texas A&M University. He started his professional career with the U.S. Bureau of Public Roads as a junior highway engineer, and since that time he has served continuously in various capacities throughout the United States and in Canada, the Yukon, the Northwest Territories, and the Philippines.

He was a member of the task force established in 1967 to set up the U.S. Department of Transportation. Earlier that year he was appointed director of the Bureau of Public Roads by President Johnson. In 1969 he was appointed to his present post as Federal Highway Administrator by President Nixon.

Mr. Turner is a Registered Professional Engineer in the State of Texas and is a member of the American Society of Civil Engineers, American Association of State Highway Officials, Society of American Military Engineers, American Road Builders' Association, Highway Research Board, and many other semiprofessional and official groups in the road-building fraternity.

To set forth realistically what transportation is likely to be 10 and 20 years into the future is not a new or special task for highway engineers and administrators. This is exactly what we do every day on every project that we undertake, and we start about 30 or 40 projects every working day. By law, we are required to design all interstate projects for the type and volume of traffic that is forecast to use the project 20 years from the time construction begins. Moreover, a 6- to 10-year and sometimes longer lead time between programming the project and beginning the construction compels us to be realistic in forecasting specific dimensions and numbers for more than 20 years into the future.

Although the law specifically requires it only for interstate projects, the same procedure is customarily followed in all federal-aid projects. For a number of years, we have made 20-year or longer forecasts of highway needs in response to congressional directives as well as in support of our own responsibilities for general management of highway programs in this country. Characteristically, then, by the exercise of appropriate administrative leadership in the profession, we have been regularly doing exactly what this panel was asked to do.

In making forecasts, we have had to consider many things. What will be the shape of the urban areas? How will land be used in both urban and rural areas? How can the transportation objective best be interwoven with the attainment of other objectives of society? How will people want to travel and where, when, and in what volumes? At what rate will new technology provide other options to them? What will be their capability to fund the indicated needs, and what will be their willingness to do so? What will be the trend in vehicle design? What will be the performance characteristics of

new vehicles? How can we organize to attain the types and the quantity of highways that are finally determined to be needed? Indeed this is a large order, but it is exactly what the highway administrator is faced with every day. Looking into the future, therefore, is not a new experience; he is always doing it.

Being realistic, we do not rule out the possibility of revolutionary developments in transportation technology, although these may be unforeseen now. Even revolutionary breakthroughs in transportation knowledge are almost certain to be evolutionary in their development and application. This was true of railroads, motor vehicles, and airplanes. Transportation is an enormous industry, and heavy investments in money and time are necessary to bring about even small evolutionary changes. We can be almost certain, then, that the foreseeable requirements for highway facilities in the 1970's and 1980's will not be seriously altered by technological developments in other modes. Within the highway mode itself, the vehicle is most susceptible to change, but it takes more than a decade to phase in technical innovations in the rolling stock. That stock today numbers more than a hundred million vehicles.

Widespread change in the physical highway plant is even more difficult to achieve. Less than half of the nation's 3.7 million miles of roads and streets are classified as paved. Roughly half of the paved mileage is on the federal-aid system, which we have been building and rebuilding for more than a half a century. Since 1956, when we launched the accelerated federal-aid program, federal-aid projects have involved only about one-third of the total federal-aid system. In other words, it takes about 40 years just to go around the cycle one time.

Many projects to be built or completed in the decade of the 70's are already in the plan or design stage because the lead time is 8 to 10 years on urban projects and 4 to 8 years on major rural projects. As a result, I think there will be little outward change in the physical design of highways before 1980. This does not mean that we discourage innovation or that we are standing still. We do need to cope with the growing challenges of transportation in this country through innovation, but we need to be aware of the practical obstacles to any fast and sweeping changes in our transportation system or, for that matter, in any other parts of our society. To be realistic, we must start with what people want of the transportation system rather than what public officials think is the most efficient system in terms of dollars expended. It is apparent that people want the nearly infinite flexibility of the automobile and highway network that permits each individual to program his own movement rather than to be forced to conform to some rigid schedule of time and routing that may suit some of his trip needs but will not suit all or even a majority of them. People also want to control the places where they live and the circumstances under which they will raise their families. A majority of people have shown a preference for living in the typical spread development in suburban areas.

To some transportation experts, this sprawl type of arrangement is very inefficient. However, they measure efficiency only in terms of dollars expended for transportation, while the urban sprawler uses an entirely different set of numerators and denominators in which the factors are his personal desires as to how he wants to live. In calculating efficiency, he includes in his formula a whole series of plus and minus factors in both the numerator and the denominator as he makes trade-offs for this or that feature.

To argue, therefore, as some critics do, that the automobile-highway system is responsible for suburban sprawl is beside the point. The real point is that motor vehicle transportation has greatly expanded choices available to individuals for developing land into various uses that range from houses to hamburger stands. It is this exercise of individual choice, within some restraints set by public policy, that has brought about the pattern of development on the edges of cities. In a free society, we should hardly expect otherwise. To Americans, generally, this is what America is all about, and this is why they rightly think it is the best country in the world.

Certainly other factors are also involved in suburban land development, such as economic incentive and encouragement from various public policies. I am convinced, however, that the primary factor is individual preference and particularly the desire of a great majority for private homes with a little green around them and private transportation by automobiles. Coupled with this, of course, is the financial ability of large numbers of people to realize and achieve these preferences.

In their appraisal of the transportation desires of the public, highway administrators are supported by an impressive collection of facts—facts about the actions of individuals collectively measured by traffic flow counts, facts about individual travel preferences and practices gathered from tens of millions of personal interviews, facts about land use that determines transportation, and facts about public attitude.

We need to be rather clear eyed about suburbanization and the transportation demands associated with it because this is where the action is. During the past quarter of a century, almost the entire net growth in population occurred in the expanding suburbs. At the same time, the central cities decreased in average population density and, in some cases, in absolute numbers of residents. By 1990, we expect the population of urban areas to grow by 40 to 50 percent, and it seems altogether likely that this growth will continue along the present pattern of spread development. I can see nothing to reverse this pattern short of a fundamental shift in public policy, which would certainly require rather general public approval. Because it is hard to see how such a reversal could be accomplished without eliminating or reducing the choices available to individuals with regard either to personal mobility or to housing preferences or both, it is hard to see how such a reversal could win voluntary acceptance. In fact, housing authorities are now forecasting a further swing to single-family housing as a result of the life cycle and desires of many new families being founded.

Spread development, as we now know it, is characterized not only by low or average population densities but also by dispersal of many urban activities once concentrated in the central cities. These include commercial, industrial, educational, cultural, and recreational activities. This also means dispersal for employment and travel as well. No longer are the majority of transportation lines in urban areas to and from the central city. In fact, this travel is now only a small fraction of the total, about 5 to 15 percent. This fact is also the most important and elemental piece of information often overlooked or disbelieved by those who glibly talk about the urban transportation problem.

The result for transportation is that, in urban areas today, from 85 to 95 percent of all person trips take place outside the central business district. They are spread throughout the urban areas simply because of the wide dispersal of origins and destinations and the great variety of trip purposes. They are dependent almost entirely on highways, primarily by the private automobile with some supplementary assistance from buses and other public transit modes. Certainly none but highway modes could begin to handle most of these trips within the next 20 years. Nor could any other mode handle the enormously diverse and large volume of movement of goods and services that are essential to the life and vitality of urban areas.

The continuation of spread development, therefore, will create huge demands for highway transportation in the 1970's and 1980's. Given an urban population increase of about 50 percent by 1990, we can expect an urban travel increase of about 75 percent or more.

Even though urban areas account for 70 to 80 percent of the population, they account for only part of the demand for highway transportation. There are also rural and intercity transportation demands for both passengers and goods movement, and these demands too are met by heavy reliance on highways.

These, then, are the real demands to which the highway program must respond in the 1970's and 1980's. I have dwelled at length on the spread-development concept because it is what shapes transportation. We must understand it in order to prepare for the

future and to make forecasts for what it will be like. We can conclude, therefore, that, while all modes will be substantially upgraded and expanded to keep pace with national growth, highways, because of their personalized transportation aspects, will continue to be the dominant transportation mode for the movement of people and goods except for the long haul of passengers that will be by air and the long haul and medium haul of heavy freight that certainly will continue to be by rail.

Precisely because highways are the dominant mode and the only mode that ties all the other modes together, they must play the key role as we strive to coordinate the transportation system and achieve an overall transportation policy. The highway program has, in fact, been a pioneering effort in this coordination through sponsorship of the comprehensive and continuing urban transportation planning process that is now operating in every urban area in the nation. Because most of the interaction among modes actually takes place in the urban area, the urban transportation planning process provides the basic data essential to the coordination and planning for all modes.

Although much progress has been made during the past decade or so in this activity, we can look for continued improvement, refinement, and more effectiveness in this total transportation planning endeavor during the 1970's and 1980's, especially if planning assistance from the other modes can be channeled into the organizations that are already carrying on this basic, comprehensive highway planning function. The greatest immediate challenge to the intermodal planning and to the highway program lies in what most people refer to as the urban transportation crisis, that is, the daily morning and evening rush-hour movement. This is actually, however, a relatively minor portion of total urban travel, comprising not more than 15 percent of total urban-area trips.

Nevertheless, it is a problem, separate and distinct to a large degree from the other urban transportation needs, and a problem that we must resolve. The immediate practical solution to this problem is to increase the people-moving efficiency, sometimes referred to as productivity, of the existing urban highway system by using higher capacity vehicles (which translates, certainly, into buses) and by making better use of the back seats and the right side of the front seat of most passenger automobiles that are now lightly loaded.

Because buses can make use of existing and planned urban highways, the material increase in the use of bus transit can be accommodated without the heavy capital outlays that would be needed to provide some totally new system and that would strain financial resources and capabilities. Such a goal can also be achieved in the very near future—within 2, 3, or 4 years, rather than 15, 25, or 30 years into the future. Buses on highways, therefore, offer the only realistic and immediate answer to the need for improved public transportation in almost all urban areas, and this is going to continue to hold true through the 1970's and into the 1980's.

Fortunately, we obtained during the past year new legislation that is needed to make this kind of a solution work. First, the Urban Mass Transportation Assistance Act contains the authority to assist in acquisition of transit vehicles and their servicing facilities. Second, the Federal-Aid Highway Act of 1970 contains authority to construct the required roadway facilities and many other necessary appurtenances. The two acts, in combination, are complementary to each other. It is my opinion that they will essentially meet the vast majority of center-city transportation needs both immediately and 20 years from now. I am convinced that we will look back on this 1970 legislation as a landmark in the development of modern urban transit, just as we now look back on the 1956 Federal-Aid Highway Act with its program for interstate system construction as a landmark in highway development.

In addition to increased uses of buses to cope with the downtown congestion problem, I believe we can expect other measures to be adopted such as placing greater emphasis on car pools, using the unused back and right-front seats that I mentioned, and instituting staggered work hours or even staggered workdays and workweeks (and I suspect, in some cases, even staggered months as well). There will probably be some vertical separation of pedestrians from automobile traffic in the downtown areas by putting side-

walks on a second-floor level or underground in a few limited cases, such as in Montreal and New York. There will also be time separation of commercial vehicles using streets to deliver and pickup at stores in the central business district. These measures, simple in themselves, will improve vehicle and pedestrian flow and produce substantial relief from present congestion and safety hazards.

Most cities, however, will not see much increase in volumes of rush-hour traffic to and from the central business district because the center-city work force will not be growing at a rate parallel to that in the remainder of the urban area. Because most of the growth will occur in suburban areas and in medium-sized cities, there will be little increase in the need for additional major transportation arteries into the central business district beyond those now planned or under construction. This situation will obtain for highways and freeways as well as for rail and other public transit lines.

In the future there will be better coordination under the auspices of the U.S. Department of Transportation in such areas as the development of airports and their access facilities in relationship with other modes of transportation. We will be considering ways to coordinate heavy-freight movements between trucks and available railroad facilities to reduce the number of highway vehicles and heavy axle-load passages in order to possibly increase traffic safety, present roadway lane capacity, and the life of the roadbeds and structures while at the same time increasing railroad revenues without increasing total transportation costs. We also will be considering the possibility of increased use of rail to carry passengers making medium-length trips to reduce congestion on highways, in airways, and at airports. Congestion relief is particularly desirable for some air services such as the Washington-New York-Boston air shuttle service.

In a number of cities, we will be exploring the possibilities of consolidating railroad trackage and terminal facilities to permit abandonment. Some currently used rights-of-way could then be made available for improvement as public transit arteries for either rail or bus transit and, thus, reduce rail taxation burdens and operating costs and permit the construction of needed transit facilities or new roadways without major displacement of people.

Highway program administrators will be active partners in community development. Our overall transportation planning process will be broadened to encompass even more of the community goals and objectives and to bring citizens into the planning process, if means can be found to make their contributions useful and effective. It is gratifying that, at its Fiftieth Annual Meeting, the Highway Research Board devoted an entire day to consideration of the problem of more citizen participation and how it might be effectively accomplished.

Environmental factors will be spread throughout the total planning and development processes from the very beginning and will be properly weighed in relation to other factors.

Housing and relocation provisions in the highway program already provide a positive commitment to alleviate any adverse impact on citizens who must be relocated to provide the transportation facilities that are needed for total societal goals. In fact, our authority now permits and has already brought about considerable upgrading of the housing of many low-income families that have been displaced by the highway program. This concern for social objectives and the well-being of individuals will increasingly characterize the highway program of the future. It indicates a direction in which highway research should be heading—toward greater emphasis on the human rather than on the material or the technical side, although the latter will still be needed.

On the operational side, we are dealing with people, and it is this aspect of our assignment that is most difficult to plan and design for. On the technical side, we will have more electronic gadgetry of all kinds to vastly increase our engineering capability and to improve the end product.

Highway design will not change radically by 1990 in its visible aspects. Reconstruction, mostly the addition of lanes and resurfacing will have occurred on a considerable mileage of the present interstate routes as a result of normal traffic growth and required heavy maintenance. I think there will be some limited application in both vehicles and roadways of automation and other glamorized items such as dual mode. There will be substantial gains in the capability of signaling to and communicating with drivers by audio means to increase safety, volume of flow, and the overall efficiency of the present highway and street network.

There will be major improvements in highway safety through better roads, drivers, and vehicles, as we force the pace of the evolutionary process I mentioned earlier. We are today receiving substantial benefits from safety improvements made recently to the highway plant, and we will see even greater emphasis on safety in the future. Vehicles, like highways, probably will not change radically in outward appearance, but they will have improved crashworthiness, increased reliability, simplified maintenance, and, I hope, substantially decreased or no engine emissions that pollute the air.

The attention being devoted to safety and pollution reflects a concern for people and for the quality of life in the United States. The inclusion of a broad range of social responsibilities in the highway program, together with the transportation responsibilities, implies a major commitment of resources and makes adequate funding a necessity. I believe financing will continue to lean toward general user charges because of their demonstrated success, but these may possibly be supplemented by general funds, for example, some form of a readiness-to-serve charge. Administration of the highway program will continue to be reasonably similar to the present administration through the federal-state relationship. However, counties and metropolitan areas, or their equivalents under some other kind of a name, will increase, especially as area-wide planning, public works, and service agencies; these could have an important role in urban transportation and development planning in the future.

The highway of the 1970's and 1980's, I believe, will outwardly look much like the present ones, but the planning and administrative processes by which these highways are produced will focus substantially increased attention on the social and environmental factors. The lack of outward change certainly does not imply any shortage of technological development or capability. Rather, we will shift our emphasis toward the intangible factors related to the humanities.

People will continue to rely heavily and principally on the personalized mode of transportation because this is what they want. It will best serve their needs, and they can afford it. I do not visualize this country without automobiles or their equivalent, whether they are called by that name or not. Therefore, we had better learn how best we can live with rather than without the automobile, the truck, the bus, the highway, and the street network. The points of social and humanitarian emphasis in the highway field will be the same as those in other transportation modes, so that what we learn and use for highways can be equally applicable to other modes without the need for duplicative research. In this regard, we should encourage cooperative research programs, such as those of the Highway Research Board; and, in doing so, we will supply our abundant capability and resources to others as well as to ourselves with little or no additional cost to the public.

I believe we in highway transportation are already the leaders in these areas. I suggest that we broaden our interest sufficiently to cover the similar needs of our other modal neighbors. We fully recognize that the provision of highway transportation is for the purpose of helping communities, from the neighborhood to the nation, to meet their goals and objectives. That also is our goal. As understanding of how to establish community goals and of how transportation can aid in achieving those goals advances, our efforts toward meeting our goal will become increasingly more effective. We must never forget that mobility is itself a community goal, perhaps more important than any other single goal. We can never accept that our concern or the concern

of society is for transportation only without regard for other community goals. Our concern must be for transportation in relation to these other community goals.

To me, the future looks bright for a better America that, I believe, will be immensely aided by our efforts in the highway field. I am an optimist in this. I think the future of America is intimately tied in with the things that we are doing and that it will be better than the past, whether yesterday, 50 years ago, or 100 years ago.