Transportation Systems in the Future Development of Metropolitan Areas

The Permanent Corridor Concept

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It is expected that 85 percent or more of the population will reside in urban areas by the turn of the century, and it is mandatory that transportation networks in metropolitan regions be established and the land for them be reserved now in order to serve the travel requirements in the future. This cannot be effectively accomplished on the basis of current practice. This paper develops a concept of permanent transportation corridors and network configurations that allow for long-range planning. It indicates that an optimum network of major transportation facilities, initially spaced at 4 to 6 miles and eventually spaced at 2 to 3 miles in built-up areas, can function into the future at reasonable levels of service for any predicted rates of population growth, urban area expansion, and increased travel demand. The concept provides for major transportation corridors that form the framework for all urban development. The corridors are permanent, but the facilities within the corridors are not. The corridors are established at sufficient width and appropriate spacing so that they are (a) capable of accommodating travel generated by likely future population densities and of allowing balanced transportation service, (b) adaptable to design or redesign to carry a freeway, a rapid transit facility, or a combination of the two, and (c) capable of conversion in the future to meet the design requirements of new technological developments. The application of this concept could resolve the urban planning dilemma that seems insurmountable.

•LONG-RANGE planning for expansion and redevelopment of cities has been carried out to various degrees, but there is little evidence that such plans are being successfully implemented. In the North American society, positive or restrictive controls needed to implement long-range planning are not apt to be imposed. The most widespread controls—zoning laws—are frequently changed in response to new requirements and unforeseen pressures for development. Opportunities for attractive short-range land development projects that can be readily programmed and financed frequently set the planning pattern. Therefore, the long-range aspects of master plans are seldom retained.

As a result, long-range city planning is often not even attempted. In practice, relatively short planning periods are used, generally 20 years. This appears to be logical in terms of programming and financing, both for public and private development projects, and is widely accepted as the period within which future growth can be predicted with some degree of confidence.

For individual transportation improvements, such as a freeway, a rapid transit line, or a terminal facility, the 20-year planning period is generally considered to be appropriate. The implementation process, which includes planning studies, design and plan preparation, procurement of land, relocation of residents, clearing of the site, and construction, normally takes 5 to 10 years before the facility is placed in operation. Staging procedures and programming or financing difficulties may cause large-scale facilities and area-wide systems to take more than 20 years to complete.

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For the broader aspects of transportation planning—the planning of total systems, including various modes of transportation—planning periods considerably longer than 20 years are required. Unlike detailed land use designations and individual land development projects, which are confined to relatively compact areas, major transportation facilities are parts of a highly interrelated system that encompasses the whole of the metropolitan area. In the past, portions of transportation systems have been destroyed or badly distorted by land development that blocks one or more corridors in the system.

On the basis of current practice, planning beyond 20 years is difficult and cannot be accomplished effectively. Moreover, few authorities are able to reserve or protect land in advance for transportation facilities within a 20-year period. Reservation and procurement of rights-of-way normally are not instituted until the project has been programmed and funds earmarked for construction. Sometimes exact locations are not determined until public hearings have been held. Under this procedure, sections of major transportation facilities designated for completion at the end of a 20-year planning period or those considered essential beyond 20 years may fall by the wayside.

Fully effective legislation for the protection of future rights-of-way is nonexistent. Another difficulty is that funds normally are not available for the purchase of land that may not be required for construction until 10, 15, or 20 years later. Municipalities in particular lack the necessary funds, and even the current programs must be carefully budgeted.

The problem of reserving rights-of-way for transportation facilities needed within a 20-year planning period is difficult enough, but what is even more discouraging is that there are practically no means of protecting locations of routes that are based on needs beyond 20 years. In the interim, large development projects and multistory buildings can destroy the continuity of routes and cause an imbalance in a carefully worked out network. One philosophy holds that if certain facilities are negated by development, other locations will be found and, besides, some of the planned facilities may not be required after all, or may be required somewhere else. This is a negative attitude but, unfortunately, it is widely held in the absence of a positive solution.

Another discouraging note is the disagreement among certain planners, and between highway and public transit interests, as to what modes of transportation should be provided in the future. Some are looking to a significant shift from travel by private automobile to travel by public transit with reduction or elimination of freeway development. Some stress that freeway development must be accelerated if cities and their core areas are to thrive. Others claim it is useless to construct additional freeways because they will continue to be congested and, if freeway expansion is not stopped, cities will be stifled and come to ruin because too much space will be taken over by freeway facilities. Anticipated technological improvements and possible future changes in transportation modes are used as additional excuses for not currently planning for the long-range future.

These conflicting philosophies and points of view are detrimental to sound transportation planning and to redevelopment and expansion of urban areas, and frequently they are used as the rationale for doing nothing or doing little in terms of long-range planning. This apparent dilemma must be resolved so that future cities and their transportation systems can be properly planned and development programs implemented. A completely new and bold approach is necessary.

One way of resolving the problem is first to break down the following notions and contentions (referred to here as deterrents) that are holding back progress and, in the process, to develop a positive approach.

PLANNING DETERRENT 1

> Deterring Attitude: Development of freeways will have to be minimized, and future travel must be taken over by public transit, if cities are to survive.

Travel in every city is accommodated by some combination of private automobiles and public transit. The proportion handled by each mode varies from one urban area

to another. It is suggested here that the prevailing modal split in a particular city is an inherent characteristic of that city and is a by-product of its historical development, land use arrangement, and population density.

Cities that matured before the advent of the automobile tend to be oriented more heavily toward public transit, whereas cities that grew up afterward are more likely to depend on private motor vehicles. Thus, the ratio of public transit to private vehicle usage is not necessarily a function of city size alone.

The fact that it would seem logical and economical to have travel in urban areas accommodated predominantly by public transportation is no indication that this actually could take place in the future. The personal mobility provided by the motor vehicle has become a way of life, and the public expects reasonable freedom in the use of the automobile. Denial of this mobility by withholding transportation improvements can stunt the growth of a community, change the pattern of its growth, or cause that growth to take place somewhere else. The dramatic example of the relative decline of the CBD reflects in part the lack of personal mobility in the transportation service to the city core as compared to the outer areas. Development of facilities to serve the natural desire of the motorist and transit user must keep pace with expanding population and commercial and industrial activity.

Urban transportation is not an either-or situation—either rapid transit or freeways. (Rapid transit is defined as any form of efficient, high-speed public transportation.) Freeways do not obviate the need for transit, nor do rapid transit facilities serve as a substitute for freeways. Highways and public transit are complementary and not competing facilities. Both must be developed to a proper balance of service according to the characteristics of the particular city.

In large metropolitan areas, certain predominant transportation corridors are now served, and others will eventually need to be served, by both rapid transit and freeways. This trend is clearly evident in many North American cities. Thus, to build a rapid transit facility rather than a freeway is normally valid only as a stage in the long-range development of transportation facilities. Although this may defer freeway construction, which may be desirable in some cases, eventually both will be needed.

The ratio of public transit to private vehicle usage is generally decreasing. There is evidence, however, that in certain corridors that serve high-density areas, a significant increase in the number of transit riders can be effected where modern and highly attractive transit service is provided for travel to and from the downtown area. In terms of the total metropolitan area, several such corridors would not have a pronounced effect on the modal split for the metropolitan area as a whole. One reason is that the ratio decreases in parts of the metropolitan area where development is too dispersed to be effectively served by transit. Another reason is in the normal makeup of trip purposes and their origins and destinations. Even if all logical trips were assigned to public transit, it would not cause the modal split to be greatly increased.

In view of these conditions and trends, it would be considered highly successful if, in the particular city, the current overall modal split could be maintained in the future, and this should be the objective. To accomplish this would require significant improvement and expansion of public transit facilities as the city grows. In many cities, provision of a balanced transportation plan would call for comparable expenditures for public transit and highway facilities. However, the proportion of the system to be served by transit in the future need not affect the long-range planning of transportation networks if a concept of permanent major transportation corridors is adopted. (Major transportation corridor is defined here, in its narrow sense, as the actual strip of land or right-of-way for the purpose of accommodating a major ground transportation facility.)

The accommodation of both a highway and a public transit facility in one right-of-way is not new. If this treatment is extended to a total network of major routes, each link or segment of the system could provide, in the long-range plan, for any one of several types of development—a highway facility, a public transit facility, or a combination of the two (Fig. 1). Certain functional relationships would favor one or the other mode in the early planning stages. In later stages the other mode could be added to the same corridor.

Figure 1. A major transportation corridor containing (a) a freeway, (b) a rapid transit facility, and (c) a combination of the two.

Where the combined types of facilities are called for, they would generally be located in radial corridors outside the city core. In approaching the urban center, the freeway and the rapid transit line would separate a mile or so in advance of the CBD, with the transit going underground on a different alignment to provide direct service within the district. Transit service may be required to other points of concentration between the corridors. Here, again, such service would be a distribution function and not a direct function of the major transportation corridors and would be provided by a spur or distributor facility deviating from and returning to the major corridor.

By the time it is decided whether a given element of the system should be a freeway or a rapid transit line, or both, the right-of-way could have been reserved and one of the forms of transportation could have been in service for a decade or more and accommodating an important travel demand. Conversion or modification within the right-of-way could take place later. The question, therefore, of whether a freeway or a rapid transit facility is to be provided for should not deter long-range planning of transportation networks.

PLANNING DETERRENT 2

Deterring Attitude: Future transportation could change radically as a result of technological advances in the design of vehicles, means of propulsion, and electronic control.

Technological advances of the future are often used as reasons for not extending transportation plans to include "horizon-year" or long-range requirements. It should be recognized, however, that even if some of the revolutionary technology were available today, it would take many years, probably a generation or more, to replace present facilities. The gradual implementation of new developments in transportation, communication, and other public services is evident through history. Obviously, no government would scrap its highway or transit system overnight to provide radically different roadbeds, vehicles, and operating controls. Existing facilities would be gradually retired near the end of their useful lives.

For this reason, planning for the next 20 years should not be deterred, provided that the facilities can be transformed to new or different modes at the end of this period. Again, this may be accomplished through the application of the permanent corridor con-

Figure 2. A transformed facility within a major transportation corridor where a 12-lane facility replaced a 4-lane, 10-year-old freeway, generally within the original right-of-way.

cept. The permanence of major transportation corridors is one of the striking features of the history of cities. Many routes established more than a century ago have been retained and transformed, some many times over, to modern carriers of traffic. Today they accommodate freeways or rail facilities.

Several examples of railroad rights-of-way in their second generation of use are the Pennsylvania Turnpike, parts of the BARTD transit system in San Francisco, the GO commuter system in Toronto, and the high-speed rail system along the Eastern Seaboard between Washington and Boston.

Likewise, numerous early expressway rights-of-way are now being rehabilitated into modern freeway or freeway and transit facilities to incorporate new technology and accommodate changes in travel characteristics (Fig. 2). Outstanding examples of extensive transformation are the MacDonald-Cartier Freeway (Highway 401) in Toronto and the New Jersey Turnpike in the vicinity of Newark. There is a great need now to establish new major corridors to satisfy the ever-changing travel demands of the future.

The mode of ground transportation, the vehicles, and their characteristics of operation may be different in detail two decades from now, but the corridors would be essentially the same, particularly in relation to the other permanent features of urban development. If the corridors were established initially at sufficient width to accommodate future changes in vehicle characteristics and modes of operation, then long-range planning for transportation networks and corridor location would be realized automatically for periods well beyond 20 years.

PLANNING DETERRENT 3

> Deterring Attitude: Because freeways are filled with traffic and become congested as soon as they are built, it would be impractical to provide all the freeways needed in the future to serve an expanding metropolitan area.

This notion, expressed by many planners, is a further deterrent to the development of long-range transportation plans. Frequently new freeways have been fully loaded within a few years after they have been opened to traffic. It is expected that travel in urban areas will continue to grow in the foreseeable future, as the population and economic activity increase. Therefore, the crowding of new freeways can be expected for many years, until the travel demand is more nearly in balance with freeway construction and until the individual freeways are tied together to function as systems.

It is well known that heavy volumes on many urban freeways are the result of distorted traffic patterns caused by partial freeway systems constructed as parts of staged development programs. Eventually, when the freeway network is complete and the system is in balance, traffic volumes will stabilize or decrease on individual routes, even though the level of traffic over the whole city will have grown substantially.

The number and spacing of freeways required to give satisfactory service are dependent on (a) population densities in combination with type and intensity of urban development, (b) topography, land use structure, and makeup of supporting street systems, (c) continuity of routes within the overall system and extent of through travel, and (d) size of freeways (numbers of lanes) and their interrelation with public transit facilities. Studies have indicated that traffic in metropolitan areas requires an ultimate network of freeways spaced generally at 2- to 3-mile intervals in the central area, and 4 to 5 miles in the outer areas (1, 2, 3, 4). It can be shown that an optimum network of freeways properly spaced, and supported by appropriate street systems and public transit facilities, can be expected to function into the future at a reasonable level of service regardless of population growth, urban area expansion, and increasing travel demand. This phenomenon is evident from an analysis of various metropolitan area studies in which freeway spacing was found to be independent of city size.

The relationships in Figure 3 derived from proposed freeway systems (see Appendix) planned for various cities to satisfy travel requirements about 20 years in the future indicate that spacings of freeways are related primarily to population densities. For example, where the population density of the central city is an average of approximately

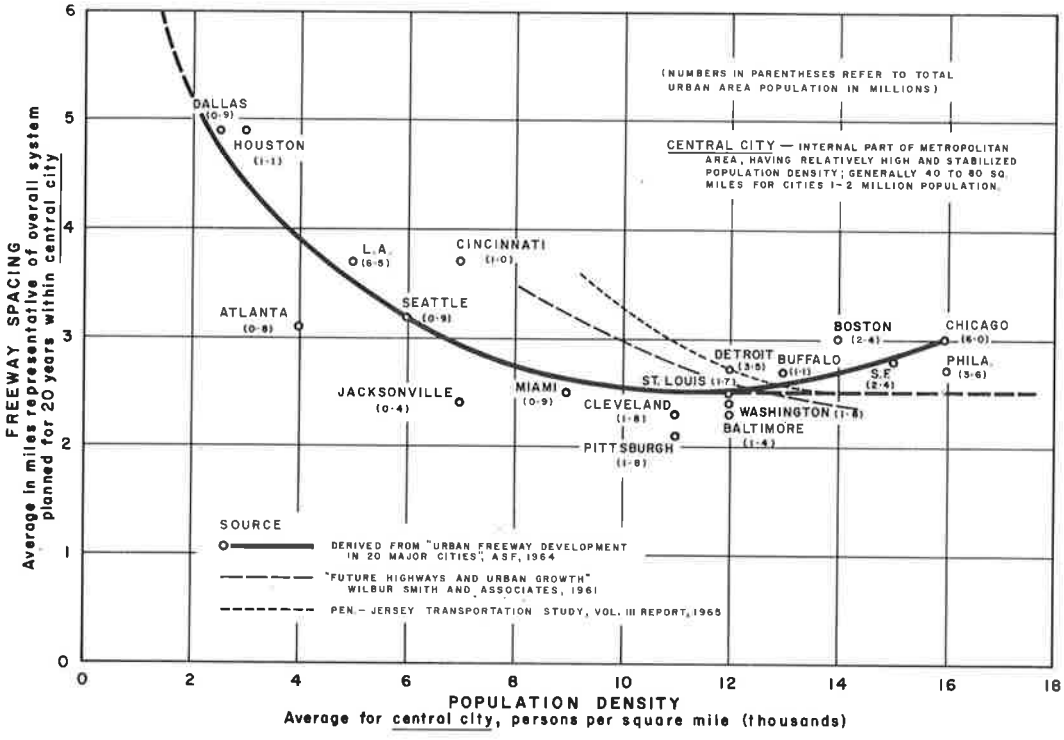

Figure 3. Freeway spacing requirements indicated by planning studies in 20 cities.

12,000 persons per square mile, seven cities show a need for freeways spaced at 2- to 3-mile intervals. Included among these are the cities of Buffalo, metropolitan area population of 1.1 million; Baltimore, 1.4 million; Pittsburgh, 1.8 million; and Detroit, 3.5 million. It can be seen that the spacing of freeways required in a stabilized built-up area tends to remain the same even though the population in the total metropolitan area may double or triple.

The analysis further reveals that cities with central area densities ranging from 7,000 to 16,000 persons per square mile also require an average spacing of internal freeways of 2 to 3 miles. These cases include metropolitan areas with populations of 0.5 to 6.0 million (Jacksonville, Florida, and Chicago, Illinois). Considering the wide range of metropolitan area sizes and population densities, such freeway spacing is extremely versatile and can be assumed to be optimum. This is in line with operational experience that generally points up that the minimum practical spacing of freeways is 2 to 3 miles. This average minimum spacing is capable of functioning well for a range of development and population densities because of the flexibility afforded through (a) variations in freeway size (capacity), and (b) distributional opportunities that are self-compensating in closely knit systems.

The 2- to 3-mile pattern of freeways in the central city can continue to function adequately in the future, provided that the freeway system is gradually expanded outward to serve the outer sectors of the metropolitan area as it continues to expand. This is illustrated in Figure 4. Once the population density is stabilized and the optimum freeway system is achieved in the central city, the volume of traffic on individual freeways would tend to be stabilized also.

In Figure 4, the designation and development of major transportation corridors to accommodate progressively the growing requirements for travel in an expanding metropolitan area are shown diagrammatically. Major transportation facilities in operation are indicated by heavy solid lines, and corridors designated for the future are shown by

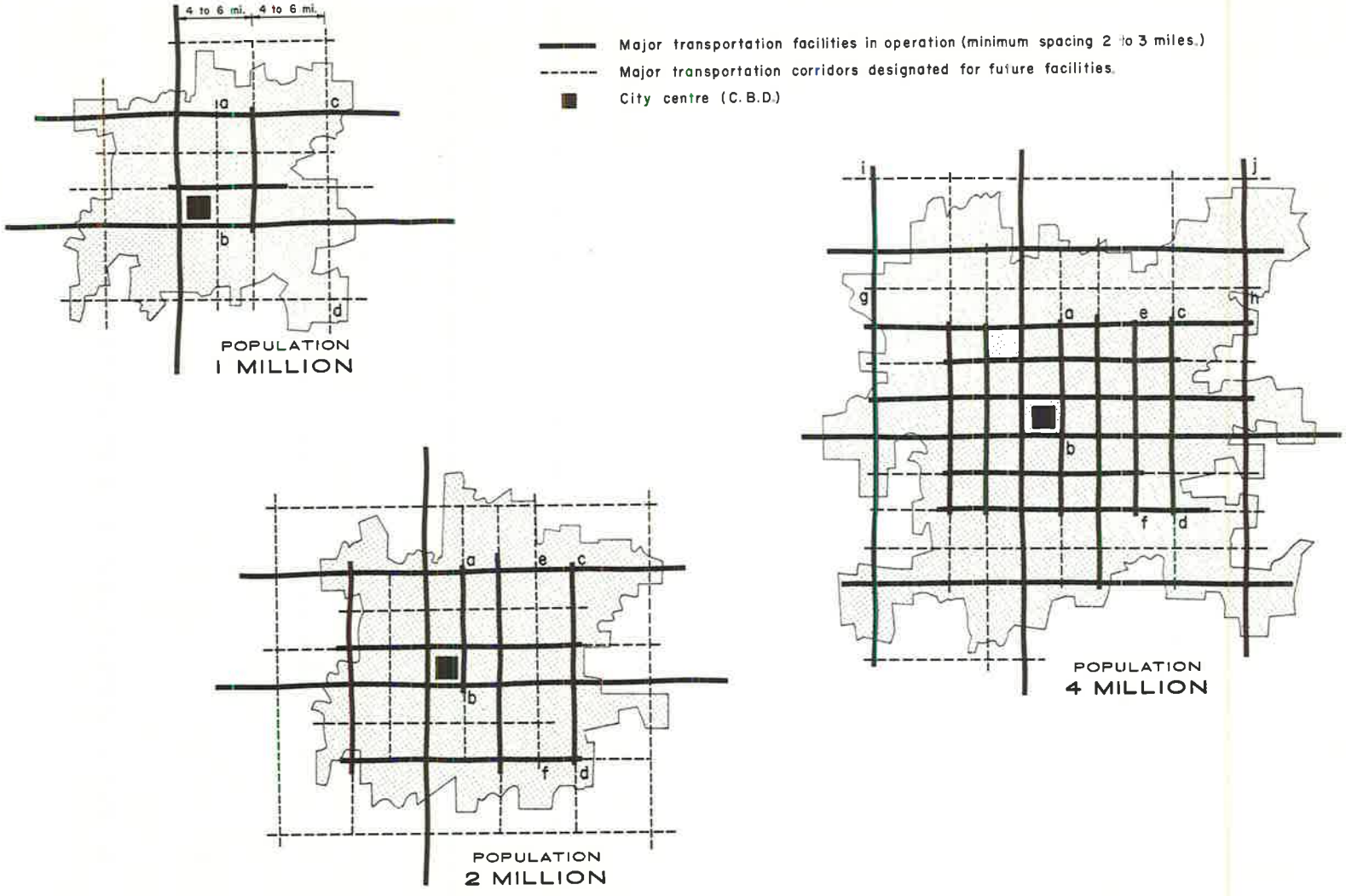

Figure 4. Formation and expansion of major transportation corridors as the metropolitan area grows.

dotted lines. The illustration represents a metropolitan area that has a present population of 1 million people and that doubles and redoubles its population in the future. In its growth from 1 to 2 million people, the reserved corridors are transformed to operating facilities as additional corridors are designated for further expansion. Such progressive designation of corridors and their development is further shown for the stage when the urban area reaches a population of 4 million.

At the stage when the population is 1 million, freeways are developed largely at 4- to 6-mile spacings. Additional facilities in the outer areas are designated for the future at 4- to 6-mile spacings, and several internal corridors are reserved at additional 2- to 3-mile intervals. Progressive development with city growth is indicated by the intermediate facility a-b, designated in the 1-million population stage. It is developed as an operating facility when the 2-million population is reached. Similarly, an outer facility, c-d, is constructed in the expanded area of the city. At this stage a new intermediate transportation corridor, e-f, is reserved for the future and is later shown as an operating facility when the urban area has reached a population of 4 million. Even at this stage, additional corridors would continue to be designated, such as g-h and i-j.

In this plan the ultimate freeway system is achieved first within the central portion of the urban area, prior to its completion in the partially developed outer districts. The built-up central area will continue to redevelop from time to time, but its level of activity, even with some increase in density, will tend to become stabilized and the outlying areas will tend to attract the additional activities of the region.

Further freeway segments are then introduced in the intermediate areas, completing that portion of the system. At the same time, freeways are extended and added in the outer areas (Fig. 5). This process continues: the transportation network expands outward as the metropolitan area grows, while the internal facilities, without basic change, continue to function. The established freeways within the city need not carry any more traffic because the internal system is progressively supplemented by additional freeways, which function as parallel routes providing bypass opportunities and further dispersion of traffic.

Figure 5. Freeways in the process of being extended and added within designated major transportation corridors, as urban development pushes outward from the city.

This analysis gives the answer to Planning Deterrent 3 and, recognizing what the optimum freeway system can accomplish in its stage development, suggests the basis for long-range planning of freeway networks. The application of the permanent corridor concept would provide ultimately for the full development of freeways at intervals of 2 to 3 miles in built-up areas and 4 to 6 miles in outlying areas. The 4- to 6-mile spacing would eventually reduce to 2 to 3 miles as the areas grow and additional outer facilities are introduced at the intermediate intervals of 4 to 6 miles. The plan makes it possible to serve the increasing traffic demands of the metropolitan area without limitations on its size, rate of growth, or period of expansion.

In this discussion a grid pattern was chosen to simplify the presentation. In actual practice there would be some degree of irregularity in the network, dictated by land use and development features and by topographic and other physical controls. The main point is that the indicated average corridor spacing would be generally achieved in the ultimate plan, even though there may be a lack of parallelism in the system, and the size of any one cell may be somewhat larger or smaller than the average indicated.

PLANNING DETERRENT 4

> Deterring Attitude: Transportation planning must be closely integrated with land use planning and, because specific land uses and detailed urban development cannot be predicted much beyond 20 years, transportation planning should not be carried out for periods greater than 20 years.

The interdependence of urban development and transportation demands joint consideration of the two in any long-range planning procedure. However, there is no assurance that any specific urban development for a period beyond 20 years will be implemented. Therefore, any long-range transportation plan will be, for the most part, ineffective if it is based on an urban plan developed by the usual short-range city planning procedures.

Another problem in current practice is the complexity associated with the determination of future transportation networks. When the basic system is established, an attempt is made to coordinate land uses and urban development with transportation, together with considerations of the modal split. This becomes an overwhelming ordeal. The procedure is further burdened by the present emphasis on data collection, research, mathematical models, statistical procedures, systems analysis techniques, and adaptation to computer processing. Such sophistication appears to be appropriate in resolving the more detailed features of the transportation plan after the basic system has been determined.

The crux of the problem is in the difficulty of handling the multitude of interacting variables and in predicting the future. To overcome this difficulty, it is necessary to break the process down into its component parts, the first of which is the network determination. Every part, then, would be contingent on a relatively small number of variables, allowing for simplification in each of the various study stages. Urban transportation planning concepts and techniques have been under intensive study and development, but they are relatively new and in a state of flux. There is a tendency here, as in other fields of endeavor, for the procedure to become unduly complex. As with any new development—whether it be a machine, a manufacturing process, or an analysis procedure—there comes a time when the number of moving parts must be reduced to achieve better results and greater dependability. The time for simplification in the transportation planning process has arrived, and more appropriate methods must now be established.

The procedure proposed here reduces the problem to three distinct steps or study stages: (a) long-range network determination of permanent major transportation corridors, (b) system determination including modes and combinations of modes for a 20-year planning period, and (c) design of a specific part of the system or an individual facility for a 20-year period or less. Each successive planning step is dependent upon the preceding step and is a progression of continuous planning and design. The degree of refinement and detail is increased with each succeeding study stage. At each step, there must be appropriate coordination with other relevant disciplines including city planning, economics, sociology, and architecture.

Planning stage 1, the determination of a long-range network of major transportation corridors, is comparable to basic structural design of a large office or apartment building. In the planning of the structure, the size and shape of the lot, number of occupants, parking spaces per occupant, size requirements for rooms, and perhaps several other general features provide sufficient information to design the framework of the building. The exterior finish and architectural touches and the type of window frames, wall coverings, elevators, plumbing fixtures, and managerial and operational considerations are all important but need not have any bearing on the location, size, and interrelationship of the columns, girders, and beams that form the framework. If designed to carry the likely ranges of loads, each floor or space in each bent or cell can be utilized in any of many different ways and developed or redeveloped as desired in the future within the basic structural framework of the building. Likewise, the framework of a transportation system, comprising the permanent major transportation corridors, can be established with respect to broad controls, and individual urban development plans can then be detailed, implemented, adjusted, or replaced in the future within this framework.

In actual application the major transportation framework is one of several frameworks that form the total urban structure. There are other urban features that have a fundamental and permanent significance. Some of these features are in the category of large capital improvements under government control, such as streets, schools, parks, sewers, and water supply. These features form additional frameworks and, together with transportation, may be planned jointly to shape the basic structure of tomorrow's metropolitan areas. Although this interrelationship is not specifically a part of this discussion, nevertheless its significance is stressed here to point out the necessity for coordinated effort in effective, long-range planning.

The establishment of the major transportation corridors would not limit the changes that may take place inside each cell or unit of land area between the corridors of the

Figure 6. Streets occupy 25 to 30 percent of usable land within cities; freeways at optimum spacing of 2 to 3 miles occupy only 7 to 8 percent of this land.

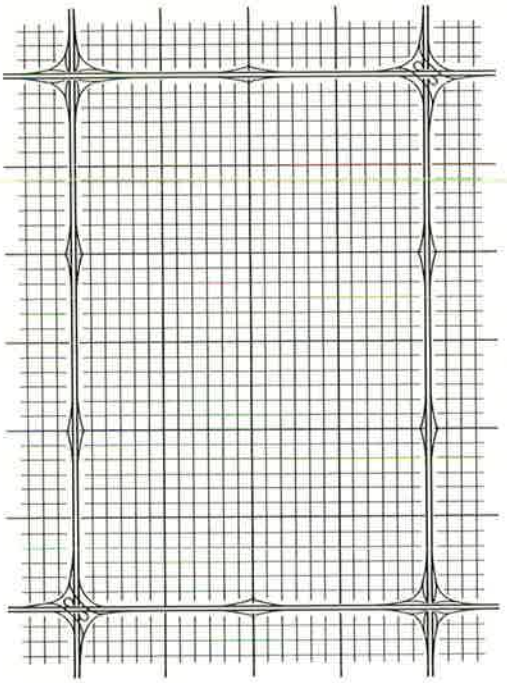

Figure 7. Spatial relations of freeways, streets, and urban area development for 2- x 3-mile major corridor module (diagrammatic configuration, but to proper scale).

system. The various segments of the corridor system would be sufficiently flexible and each facility sufficiently adjustable in mode and capacity within its corridor that all possible future changes in the magnitude and pattern of travel could be accommodated.

The establishment, therefore, of the major transportation corridors in coordination with other urban structure frameworks as everlasting features in the ultimate development of the city is the key to the solution. The system in this form is not limited to specific types of transportation facilities nor to specific land development plans. These other, more detailed considerations may be decided later in the process as part of planning stage 2. The corridors, supported by appropriate distribution facilities including an arterial street system, would assume an optimum average spacing of 2 to 3 miles in built-up areas and 4 to 6 miles in less dense or partially built-up areas.

The network would by no means take on a regular rectangular pattern, although arranged at optimum spacing as a whole. Land use forms, environmental areas and their interrelationship, major travel desire lines, topography, historic, and sociological aspects, and other basic features peculiar to the area would play a major role in shaping the final network.

The corridors and the cells within the corridor network produce the permanent configuration of the city, just as the major streets platted hundreds of years ago in the larger cities have remained as fixed elements of the city structure. The widths of the new major corridors would be of 1- or 1½-block units, or in the general range of 400 to 600 ft wide. Such corridors, assumed in their ultimate position to have average spacings of 2½ miles and to have an average width of 500 ft plus space for interchanges, would occupy 7 to 8 percent of the usable land area within the city. This is a small portion relative to the street system itself, which generally occupies 25 to 30 percent of the area within cities (Fig. 6). Figure 7 shows diagrammetically but to proper scale the proportionality among freeways, streets, and occupied space. It does not appear that major transportation corridors at an ultimate spacing of 2 to 3 miles would take over the city.

Another way of expressing the space eventually occupied by the major corridors would correspond to a plan without freeways but with all street reservations widened from an average of 70 ft to 85 ft. It is likely that the space given up to major transportation corridors could be compensated for by increasing the height of some buildings in the blocks adjacent to the corridors or through development of air rights or other joint land-use arrangements. As an example, a 15-story building placed over the corridor within every fourth block or three such buildings along each mile of the facility could compensate for the entire corridor right-of-way. There is a tendency in densely built-up areas for redevelopment to take place contiguous to freeways and rapid transit lines, not only in blocks adjacent to them but in those several blocks away. This, combined with increased property values and air-rights development, could compensate many times over for the tax rateables initially set aside by the reservation of the corridor (Fig. 8).

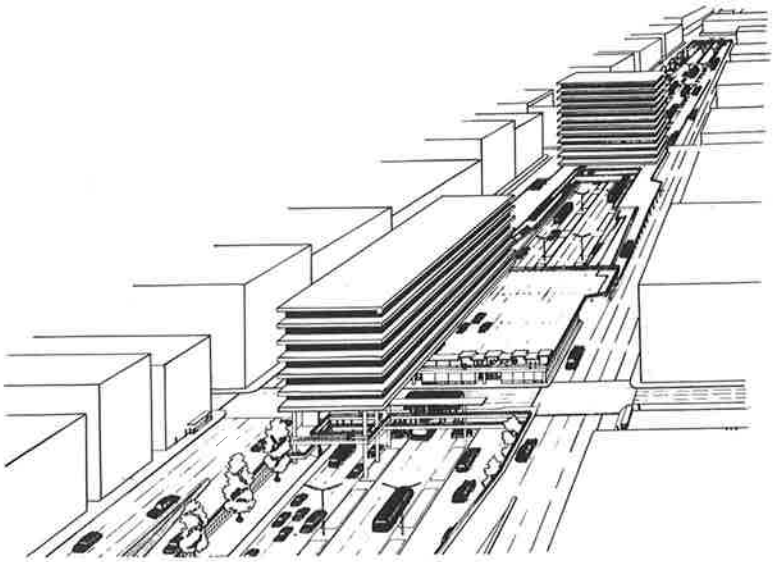

Figure 8. Increased property values of redevelopment in the vicinity of freeways and rapid transit facilities combined with development on air-rights tend to compensate for tax rateables removed by the transportation improvements.

The cellular urban form, framed by major transportation facilities, is a fundamental concept of city planning. For example, this is recognized as the basic planning principle in the Buchanan report (5) for the planning of new towns or the redevelopment of existing towns. The following quotation from this report emphasizes this principle:

> There must be areas of good environment—urban rooms—where people can live, work, shop, look about, and move around on foot in reasonable freedom from the hazards of motor traffic, and there must be a complementary network of roads—urban corridors—for effecting the primary distribution of traffic to the environmental areas. These areas are not free of traffic—they cannot be if they are to function—but the design would ensure that their traffic is related in character and volume to the environmental conditions being sought. If this concept is pursued it can easily be seen that it results in the whole of the town taking on a cellular structure consisting of environmental areas set within an interlacing network of distributory highways. It is a simple concept, but without it the whole subject of urban traffic remains confused, vague, and without comprehensive objectives. Once it is adopted, then everything begins to clarify.

It is precisely this simplicity and clarity that make the major transportation corridor concept a logical approach to future planning. The key, however, to practical and successful application of this principle is the establishment of permanent major transportation corridors to form an optimum network that could be achieved eventually.

From the point of view of community planning, the setting out of the major transportation corridors would evolve from the design of small environmental areas, the grouping of these areas into a unit cell or district, and then the establishing of major highways on the boundaries of the cell. Arranging the cells contiguous to each other in a logical and desirable pattern would form a network of major transportation facilities. In the process, the interconnection of the various segments of the network must provide continuous and direct routes for intracity travel.

This approach points out that the function of the network would be to serve the environmental areas and not the reverse. However, development within these areas would be affected by the service provided by the network. An environmental area consisting

of given land uses calls for a certain system of transportation facilities but, when this system is provided, it in turn affects land development and causes changes within it.

To account for the interaction between urban development and transportation and to resolve the total planning problem, it is essential to have a number of disciplines working together: city planners; highway, traffic, and transit engineers; architects; economists; sociologists; and political scientists. Together they would plan for an appropriate balance of transportation and land development influences.

Such cooperative effort is being piloted in Baltimore and other cities in the detailed planning and design of individual corridors. But, the need to utilize and coordinate these abilities and skills during the initial, conceptual stages of overall metropolitan area planning (planning stage 1) is even more important. This is essential in order to set out the basic or rudimentary transportation framework to which specific forms of transportation facilities can be ultimately patterned and to which eventual urban development and all its ramifications can be related.

The application of multiple disciplines at the conceptual stage should be broad and quite different from the detailed planning and design of individual corridors. Obviously, in order for the interdisciplinary efforts to be effective at the later detailed stages of planning (as in Baltimore), it must first be applied in its broader aspects to the overall makeup of urban transportation systems. Furthermore, stages 2 and 3 are continuous planning processes that would update and refine the plan and implementation programs at intervals of 5 to 7 years, subject to continual planning reviews.

In summary, the shape of the network and the spacing and width of its segments are predicated on the broader aspects of the following controls: land use, population densities, topographic features, historical considerations, aesthetic opportunities, future growth and development aspects, and resulting travel demands. In the analysis and formulation of these controls, all of the appropriate disciplines are utilized. These controls, most of which may be expressed as a series of urban structure frameworks, are broadly applied and coordinated with transportation to physically establish the corridors without regard for the particular mode or modes of transportation that ultimately may be required. At this stage, the specific arrangements of future urban development, which may or may not be predictable, play no part in the planning analysis.

In the succeeding planning stages 2 and 3, which consider periods of 20 years or less, the details of urban development are considered. In these stages the mode, type, and size of the transportation facility are determined for the planning or design year. However, because the corridors have been properly established with respect to location and width in study stage 1, the design within the corridors allows for possible adjustment, expansion, or conversion of the facility to its future modal and operational requirements. The major transportation corridors and the network they form are permanent, but the facilities within them are not. The urban development within the cells of the transportation network and within the other frameworks of the urban structure is not considered to be permanent and is subject to change with time.

Thus, in answer to planning deterrent 4, long-range transportation planning can be carried out effectively by establishing a permanent network of major transportation corridors. This can be accomplished with full recognition of the fact that transportation planning is an integral part of total urban development planning, which cannot be specific as to form and detail on a long-range basis.

PLANNING DETERRENT 5

> Deterring Attitude: Long-range transportation plans have little value because there is neither appropriate legislation nor funding capability for the reservation and advance procurement of future right-of-way.

Planning deterrent 5 is the only real deterrent to long-range transportation planning. Because it is the only real deterrent, all possible effort should be made to resolve the problem it presents.

Government at all levels has been grappling with the problem of reserving rights-of-way for future transportation facilities. Even though, in principle, the idea of establishing major transportation corridors does not differ materially from the traditional

concept of platting and dedicating street reservations, the idea has not yet been applied to major transportation networks for expanding urban areas. This practice of street platting was established many centuries before the automobile. To account for current trends of growth in urbanization, similar dedication of larger thoroughfares or major transportation corridors, spaced at 2- to 6-mile intervals, appears logical as it was for the streets of yesteryear that were spaced at 400- to 600-ft intervals.

It is logical that a network of major transportation corridors can and should be established as a foundation and a framework for future travel and to give direction to further expansion and redevelopment of the metropolitan regions. To make such long-range planning possible, needed legislation must be vigorously pursued. Furthermore, it is suggested that the federal government may be the appropriate agency to provide the drive, incentive, and guidelines for establishing major transportation corridors as a matter of national welfare and security.

The Interstate System in the United States and freeway development in the provinces of Canada demonstrate the capability to carry out large freeway programs. Now the emphasis must be placed on transportation within the metropolitan areas. It is expected that 85 percent or more of North America's population will live in urban areas by the turn of the century, and it will be a race with time to provide the transportation facilities that will be needed.

As part of the formidable job of directing and shaping urban growth, it is essential that the dilemma of transportation planning be resolved. This can be accomplished only by a fresh and bold approach—designating, protecting, and procuring major transportation corridors for the cities of tomorrow. Old precedents, concepts, and legislative measures, many of which were developed during horse-and-buggy days, must be changed and modernized.

A positive and systematic means of procuring land for the future transportation corridors must be formulated and adopted. An important feature would involve legislation providing, possibly, for several steps in procuring rights-of-way and for interim uses of designated lands. Incentives to permit the retention of existing development and to foster certain new development in the interim period may be essential. Arrangements for palatable and equitable means of relocating people must be devised. Many disciplines have to be brought together on the legal, economic, and social problems. Once effective legislation is established, it will be necessary to develop and institute a long-range financing program for securing the corridor lands.

Implementation, the reservation of land for long-range plans, is the only real deterrent, and it must be overcome to secure the future of our cities!

THE SOLUTION—SUMMARIZED

The solution to the dilemma of how to accomplish long-range transportation planning for the expansion and redevelopment of cities has been developed in the discussion of the various deterrents and, with some amplification, is summarized here.

Effective long-range planning is essential if we are to properly shape and build the cities of tomorrow. Yet, current planning methods and controls have not been and apparently are not likely to be successful in carrying out long-range plans. Furthermore, planning for transportation for periods beyond 20 years has been confronted with a series of road blocks that are producing confusion, indecision, lack of confidence, and deferment of plans. The public will pay dearly for this in the future, even before 20 years. The deterrents to long-range planning are widely held attitudes, summarized briefly as follows: (a) public transit should replace freeways; (b) transportation will change radically because of new technology; (c) if freeway development were continued to its ultimate conclusion, an impractical number of freeways would be required; and (d) long-range transportation planning cannot be carried out without detailed land use planning.

Each of these deterrents can be overcome by one bold stroke in metropolitan area planning—the application of the concept of permanent major transportation corridors. Just as cities in their early growth were developed on the basis of dedicated streets, so may the metropolitan regions of today expand and redevelop within a framework of designated major transportation corridors. Each corridor would be preserved and

eventually utilized for a major transportation facility—a freeway, a rapid transit line, or a combination of the two—and so dimensioned that it could be converted to any form or mode in accordance with future technological developments. The spacing of corridors and their reservation are fundamental and should be adhered to if fully effective transportation is to be achieved in the future.

With the setting of the corridors, the die is cast. The basic structure is established, and land development can precede or follow the construction of transportation facilities. Detailed land use changes, new development, and redevelopment take place within the cells, the areas between the major transportation corridors. The cells are comprised of one or more environmental areas that can be adjusted or revised within the cell and within the frameworks of the urban structure.

If the permanent major transportation corridor concept is accepted, then only one real deterrent remains: Land cannot be reserved for transportation facilities planned for periods beyond 20 years because of the lack of appropriate legislation and the lack of funds for advance procurement of rights-of-way.

This problem is the responsibility of the various levels of government as a matter of national welfare and security, and the solution must be found if transportation planning and long-range urban planning are to succeed. The solution to the urban transportation problem, in conjunction with the expansion, development, and redevelopment of urban centers, clearly evolves in recognizing the following principles and features:

1. Complete systems of major transportation corridors for long-range requirements should be designated and established now as permanent features of the future metropolitan regions.
2. The major transportation corridors form the basic structural framework for both short- and long-range future urban development and redevelopment.
3. The major transportation corridors are permanent, but the modes and types of facilities they accommodate are not permanent.
4. The cells of land between the major transportation corridors are permanently situated within the corridor network, but the detailed land uses and development within the cells need not be permanent.
5. The corridors are spaced at intervals of approximately 2 to 6 miles, providing for an ultimate average spacing of 2 to 3 miles in built-up areas.
6. As urban areas expand and joint megalopolitan regions are formed, additional corridors are established in the outer reaches of the regions (Fig. 7).
7. The corridor networks, although arranged on an optimum average spacing as a whole, by no means assume a regular rectangular pattern. Land use forms, environmental areas and their interrelation, major travel desire lines, topography, historic and sociological considerations, and various other basic features expressed as urban structure frameworks contribute to the shaping of the corridor networks.
8. The corridors are established at sufficient width (400 ft or more) and appropriate spacing so that they are (a) capable of accommodating travel generated by likely future population densities and of allowing for balanced transportation service, (b) adaptable to design or redesign to carry a freeway, a rapid transit facility, or a combination of the two, and (c) capable of conversion in the future to meet the design requirements of new technological developments.
9. A 20-year plan is based on the established network of permanent transportation corridors and is used for the programming and development of (a) individual transportation facilities within the corridors and (b) detailed plans for land use along the corridors and within the cells formed by the corridors. The detailed planning is updated on the basis of planning reviews at 5- to 7-year intervals.
10. In establishing the long-range plans of major transportation corridors and the more detailed 20-year plans, city planners, highway engineers, traffic engineers, public transit engineers, architects, sociologists, economists, and political scientists all participate in the coordinated effort of solving the joint problems of urban development and transportation.
11. New special legislation and implementation methods are needed to reserve the rights-of-way for the major transportation corridors, to foster certain development within the corridors in the interim periods, and to procure the land when required. A

completely new and direct approach is mandatory. Once it is accomplished, the problem will become clear and its solution direct.

With appropriate changes of attitude and suitable legislation, the permanent corridor concept could form the basis for effective long-range planning. Ultimately, the overall cost would be decidedly lower and the utility, efficiency, and economy of the system much superior to those allowed by the planning processes in use today. In any case, there is no way to accommodate the expanding urbanization cheaply. The problem is great, so its solution must also be great.

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Appendix

TABLE 1

SPACING OF FREEWAYS BASED ON PLANNED SYSTEMS[a]

City	Population of Total Urbanized Area (millions)	Central City		Size of Representative Square-Shaped Area of Central City Used in Analysis		Mileage of Freeways Within Representative Square		Average Spacing of Planned Freeways[b] (mi)
		Area (sq mi)	Population Density (1,000 persons per sq mi)	Side (mi)	Area (sq mi)	Planned (mi)	In Operation (mi)	
New York	14.0	315	25	15	225	150	125	3.0
Los Angeles	6.5	455	5	24	576	312	125	3.7
Chicago	6.0	224	16	16	256	172	76	3.0
Philadelphia	3.6	127	16	10	100	75	20	2.7
Detroit	3.5	140	12	12	144	105	37	2.7
San Francisco	2.4	48	15	7	49	35	12	2.8
Boston	2.4	48	14	8	64	42	11	3.0
Toronto[c]	1.8	55	16	7.5	56	28	13	4.0
Washington	1.8	61	12	8	64	54	24	2.4
Pittsburgh	1.8	54	11	7	49	46	14	2.1
Cleveland	1.8	81	11	9	81	72	15	2.3
St. Louis	1.7	61	12	7	49	40	14	2.5
Baltimore	1.4	79	12	8	64	56	19	2.3
Houston	1.1	328	3	15	225	92	42	4.9
Buffalo	1.1	39	13	6.5	42	31	15	2.7
Cincinnati	1.0	77	7	8	64	35	13	3.7
Dallas	0.9	280	2.5	16	256	105	38	4.9
Seattle	0.9	88	6	9	81	50	20	3.2
Miami	0.9	34	9	6	36	29	8	2.5
Atlanta	0.8	128	4	11	121	79	18	3.1
Jacksonville	0.4	30	7	6	36	30	12	2.4

[a]Derived from Urban Freeway Development in Twenty Major Cities, Automotive Safety Foundation, Aug. 1964. Indicative of freeway systems proposed for the central city (as of 1964); representative of recommendations to meet requirements in about 20 years.

[b]Approximate spacing predicated on a selected square-shaped area representative of the central city; based on the formula $S = 2A/M$, where S is average (equivalent uniform) spacing of freeways in miles, A is square-shaped area containing the freeways in sq mi, and M is the length of freeways within the square-shaped area in miles.

[c]Toronto included, although not part of the ASF report on 20 cities.

Discussion

J. J. BAKKER, Associate Professor, University of Alberta—Jack Leisch makes an excellent case for wide rights-of-way for freeways so that future expansion will be possible. However, he confuses this need for adequate rights-of-way with a cure-all solution for all transportation ills. The cure-all solution proposed is that rapid transit and freeways should be located within the same right-of-way. The permanent corridor concept, however, will work only if the entire system uses individual units such as cars, buses, or multimode vehicles. It is not so suitable for people who may want to transfer from the pedestrian mode to the transit mode, or from an individual unit mode to a rapid transit mode.

The walking distances involved to and from stations in the median of an expressway detract from the transit facility. Moreover, the transit facility often detracts from the smooth operation of the freeway or expressway ramps because of loading and unloading operations at the stations. The transit facility should be surrounded by high-density uses (residential or employment) that cannot easily be provided in the right-of-way of a freeway, air (pollution) rights notwithstanding, or the transit facility should serve parking lots that should be close to a freeway but not in the same right-of-way.

To use the MacDonald-Cartier Freeway (Highway 401) in Toronto as an example of the cure-all solution shows up the fallacy. This highway is a circumferential-distributor type of road. In Toronto there is another east-west expressway (Queen Elizabeth-Gardiner) along the lake front. In between is the Bloor Street subway. A rapid transit facility along the alignment of the MacDonald-Cartier would be unwarranted. A freeway along Bloor Street is not feasible from the point of view of land use and economics. In Toronto both transit and freeways have a role, but not in the same right-of-way.

If the spacing of freeways is going to be 3 to 4 miles, then the transit facility should be located between two freeways. Transit, if it is going to be used by people, will have to be convenient to people and not just to highway planners.

JACK E. LEISCH, Closure—Mr. Bakker seems to have missed the whole point of the permanent corridor concept. It is not merely a case for wide rights-of-way providing a "cure-all solution," as he puts it, and having the criterion that both transit and freeways are located within the same reserve. The permanent corridor concept clearly designates the establishment of corridors "at sufficient width and appropriate spacing so that they are adaptable with full flexibility for design or redesign to carry a freeway, or a rapid transit facility, or a combination of the two." Only some corridors may have both.

The concept embodies a long-range planning procedure that serves as a framework for all facets of urban development. It is a device by which the rebuilding and expanding of old cities and the development of new cities can be accomplished in an orderly fashion, with the assurance that the city can continue to function effectively for all time in the movement of people and goods.

Mr. Bakker purports that where a transit and a highway facility are situated within a common right-of-way, it is not suitable for people wishing to transfer from the pedestrian or private automobile mode to the transit mode. Although some of the earlier combined facilities revealed certain difficulties in operation, it has been shown that these now can be overcome by new design. Whereas transfer facilities used to be combined with interchanges, they are now designed to be altogether divorced from each other with the result that the same degree of freedom is made available to transfer operations as if the freeway and the transit facility were miles apart. Parking facilities, where required, would be located adjacent to or in combination with freeways, and would also be removed from interchanges so as not to interfere with normal traffic movements. Furthermore, accessibility to the rapid transit facility combined with a freeway can be just as effectively accomplished as it can to a separate transit facility.

It is fundamental that a rapid transit facility, if it is to be effective, must serve a general corridor of high-density population. The concentrated development considered necessary to support a rapid transit line takes place within a band at least a half-mile wide and not necessarily surrounded by or within the right-of-way of the transportation facility. The same degree of development concentration, including air rights, can be provided generally when the rapid transit is combined with a freeway or when it is a separate facility, and the corridor concept makes provision for both.

Mr. Bakker's reference to the Toronto transportation situation is again an indication of his apparent misunderstanding of the corridor concept as presented. He states that a rapid transit line in combination with the MacDonald-Cartier Freeway (Highway 401) east-west corridor is unwarranted. It was never intended here that a rapid transit line would be combined with the freeway. This is one of the three possible forms of corridor concept development—a freeway without a rapid transit facility. The east-west Bloor Street subway is a clear case of the second form of corridor development—a rapid transit facility without a freeway. However, another east-west corridor, between Bloor Street and Highway 401, is called for in the future development of Toronto. If designated and preserved now as a major transportation corridor (400 ft or more in width), it would probably be developed as a freeway to start with but could be expanded ultimately to include a transit line; or it could be completely converted in time to whatever form or mode of transportation is required in the future. It is also of interest that plans are currently under preparation in Toronto for construction of two combined facilities (freeway with a rapid transit line in the median), the Spadina Expressway and the Scarboro Expressway.

If the spacing of freeways is to be at 3 to 4 miles, Mr. Bakker indicates that the transit facilities should be located between the freeways. In the corridor concept, the major transportation corridors are spaced at 2 to 3 miles in highly built-up areas and 4 to 6 miles in outlying areas. As and when required each may be utilized to carry a freeway, a transit line, or a combination of the two. This spacing is already optimized for a network of major transportation facilities to carry large numbers of people at high speeds. The modes can be determined or changed in the future. In special cases a subsidiary facility may be required in between the 2 to 3 miles indicated. If so, it would be for a short distance as a distribution facility. This may be in conjunction with a high-traffic generator, such as a downtown area, a university, a recreational complex, or some other form of concentrated development. In such case the intermediate location of the distribution facility, either transit or highway, would deviate from the corridor to give this type of service and then, within a mile or two, would rejoin the corridor.

In the modern approach, transportation planners are working together with other disciplines to resolve the problems of future urbanization and to improve the quality of urban living. Transit, highways, and other modes are being considered in appropriate balance to serve the convenience of the people and to meet the natural desires and normal demands of the public.