In the ten years since the end of World War II, total annual expenditures for highways in the United States have risen from a pre-war time peak of one and a half billion to nearly four billion dollars estimated for 1955. During the next ten years (if the Administration's plan for improving the nation's highways is adopted) expenditures will be over 100 billion dollars - an average annual expenditure of approximately ten billion dollars.

This means that expressways and freeways will be appearing in even greater extent throughout the country. In cities they will, for the most part, pass through areas whose major land use is already well established. In suburban and country areas, on the other hand, they will in many cases cross over sections that have never seen pavement and whose only buildings are occasional houses and barns.

In this report we are concerned with the impact of the expressway upon undeveloped land in the rural and semi-rural fringes of urban areas. (Does the expressway cause a kind of widened strip development similar to that which typically occurs alongside conventional highways, or does it create an entirely different kind of pattern?) To answer this question we must first look at the expressway itself and see how it differs structurally and functionally from the ordinary highway.

The principal difference, as we all know, is control and limitation of access. The Bureau of Public Roads defines an expressway as "a divided arterial highway for through traffic with full or partial control of access and generally with grade separations at intersections." (Freeways have full control of access. The term expressways as used in this report includes arterial highways with full and those with partial control of access. However, when a particular expressway is being referred to as an example, it cannot necessarily be assumed that it, in fact, qualifies.

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for this definition. Some expressway authorities permit special points of access to be built for industries and other kinds of economic interests to the extent that they are expressways in name only.)

To show how the expressway is something more than a super-highway, we can examine the specific features of the expressway that grow out of access limitation. We quote here a portion of a talk by John T. Howard on "The Express Highway: Its Industrial Development Potential," given before a group that met at the Eighth Annual Conference of the Association of State Planning and Development Agencies in 1953:

The two design objectives of an express highway are high speed and high capacity. Its curves are gentle, and its grades up and down are gradual. It has a center separation between the opposite directions of traffic. It has no traffic lights, no cross streets, no pedestrians, no parking. Ons and offs are designed so that traffic entering or leaving does so at high speed without checking the through flow. Most important, these ons and offs are spaced well apart, designed into the highway when it is built, at points where major traffic arteries meet the expressway. Between these points of interchange, no drive-ways enter the expressway; there is no access from abutting private property.

All this adds up to high capacity - about 5,000 vehicles per hour each way, if there are 3 lanes in each direction; and high speed - well over 60 miles per hour for rural expressways, and 30 to 40 miles per hour of sustained, steady speed, without pause or check, in urban areas...

The big difference from an ordinary highway is not merely the speed and the capacity, but also the relationship to adjoining land. A street provides direct access to all its frontage; an expressway, to none; all access must be at the designed interchanges, half a mile to several miles apart. This means that the express highway divides the land on one side from the land on the other; and the width of the right of way - 150 to 300 feet - accentuates this division. This is true both in rural and in urban areas.

This feature makes the expressway like the railroad in serving as a barrier, as well as in carrying traffic relatively long distances at high speeds, with relatively few fixed points of discharge. It is, of course, unlike the railroad in offering far greater flexibility of use, in varying speeds, individualized schedules, and the possibility of door-to-door delivery of both people and freight at points well removed from the route itself.

Another important difference between an expressway and a highway is the purpose for which the road is built. The highway is a land service road, designed, from its earliest days, to give access to farms, homes, and business establishments. The
expressway, on the other hand, is a traffic service road, built for the purpose primarily of facilitating the movement of traffic at high speeds and in large volumes. As we shall see, the function of traffic service stimulates a site demand quite different from that stimulated by the function of land service (although some of the highway businesses will continue to desire expressway sites as well).

In short, expressways are potential urbanizers. Urbanization will probably not develop upon the entire length of the expressway, but where it passes through the rural fringes of a city this influence is apt to show up. And where it passes through the fringes of a metropolitan area, its influence will probably be far greater than we can now anticipate.

What then can we predict - cautiously and tentatively - about the impact of a new expressway in a particular urban area? What new markets for land will it open up? What kinds of economic activities will demand sites on expressway-bordering lands? And finally, how can we guide the development of these newly urbanizing lands to the best interests of the community as a whole?

Part I

THE ECONOMIC IMPACT OF EXPRESSWAYS

Market for Industrial Land

One method of discovering what influence a new expressway will have on the demand for industrial sites is to fit together our knowledge about present-day industrial trends and limited-access highways. In the paper quoted above ("The Express Highway: Its Industrial Potential") Howard points to the technological trends that have led to single-story buildings for many types of plants and the trend toward employee use of private auto which have worked to necessitate larger sites and more ground area per worker or per unit of production. (See also Characteristics of Modern Industrial Plants and Their Relationship to Industrial Zoning and Space for Industry.) This has forced new and expanding industries to seek outlying sites, where land is vacant, and is priced by the acre rather than the square foot.

Another trend mentioned as inviting dispersion of industry is defense security.

To this pattern of industrial decentralization must be added the post-war "explosive decentralization" that every big city is experiencing, with not only industries but residences, major retailing, and even some offices seeking outlying locations at progressively lower densities and even larger land areas. Howard goes on to say:

These trends of land-development have merely spaced farther and farther apart the points between and among which people and goods have to travel.
The express highway, of course, is a part of the answer to this crucial circulation problem. The automobile, the truck, and the gradually improving highway are the technological developments that have made this dispersion possible. And now the dispersion - universally unplanned, chaotic, wasteful, and by no means successful in fully achieving the individual goals of all those separate people who created it - has brought a situation that forced the invention of this super super-highway.

But this generalized dispersion has played a further part in industrial site trends. Industrial workers no longer live exclusively in the central areas; they, too, have decentralized. And, by the nature of their new neighborhoods, they have cars. They are emancipated from public transit. Whether or not it is economically wise, either for the individual worker or for the community, more and more they are not only willing to drive to work - they want to drive to work.

This has released many - but not all - types of industry from what used to be a compelling reason to stay in central locations. And the congestion of downtown traffic, with the corresponding costly delays even in local truck movements, have cancelled out the advantage of being geographically close to suppliers and distributors. The obvious final emancipation is the substitution of truck transport for railroads, for handling both materials and products of a great many kinds of industrial establishments.

Howard then applies the factor of time rather than distance in showing the advantages of an industry of an expressway site. (This technique, incidentally, is equally revealing when used in connection with residential location near expressways, as will be shown later on.)

Expressway speeds, for instance, bring a factory 7 miles from a railroad team track as close in time as a downtown factory 1 mile from its team track. Or, it may take 10 minutes to truck materials from an intown supplier to an intown plant half a mile away; the same 10 minutes would get a truck from a plant to a freeway entrance half a mile from the truck dock, 5 miles along the freeway to an exit, and another half mile to the supplier's dock. But an outlying plant not next to an expressway would take nearly 20 minutes to go the same 6 miles. The time saving in starting a truck on a long haul is just as substantial; and the more of its journey a truck performs by expressway rather than ordinary street, the lower is its operating cost per mile and the less is its risk of accident or delay.

The advantages are more telling still, when accessibility to labor force is compared. If a worker is willing - as most of them are - to travel 30 minutes to work, an intown plant can reach out by street-car only 5 miles for workers, figuring a 5-minute walk at
each end of the trip. An outlying plant not near an expressway can easily reach about 10 miles (figuring a 5 minute walk from the parking lot). But a plant 2 minutes from a freeway, with the same 5 minute walk, can attract workers from 15 to 20 miles away, depending on how far they live from an access point at the other end.

The conclusion:

What an expressway does, then, is to restore to a plant site all of those advantages of accessibility, to suppliers, related industries, markets, and labor, that a similar plant used to enjoy on intown sites before congestion set in, at the same time making possible the big site, the single story building, the room for expansion, the amenity of space for landscaping and planting. These advantages are shared by other outlying plant locations, but not to the same degree. And in addition, the site alongside an expressway offers unparalleled advertising opportunities - the "identity" value that appraisers talk about.

An executive of the General Electric Company (William M. Barker) makes some of the same points when he says his company has the following advantages to gain from locations along modern cross-country expressways.

First: Transportation facilities for our employees. When five thousand people leave one plant at 3:30 in the afternoon, we need all of the highways we can get to speed them on their way home promptly, safely and expeditiously.

Second: By locating on these thruways, we automatically are directly on the route of inter-city and inter-state truck lines, which go right by our door, and are available to serve us.

Third: There are advertising benefits we obtain from a location adjacent to a thruway on which thousands of people pass daily. This is an advantage on which it is impossible to place a price.

Fourth: It just makes sense that an investment in buildings and facilities involving many millions of dollars should be placed where it is readily reached.

Fifth: The Thruway helps make economical a system of satellite plants. Electronics Park is the headquarters of the electronics businesses of General Electric and provides accessibility to the General Electric plants at Buffalo, Auburn, Utica (where we have three plants) and Schenectady.

(From "The Thruway As An Industrial Location Factor," The New York State Planning News, January 1955.)

Another method is to measure the influence exerted by expressways already built or in the blueprint stage. Unfortunately, no really comprehensive survey of this influence throughout the country has been made, although some information on certain expressways has been collected.)
One of the most spectacular examples is the impact of the New York State Thruway upon construction of all sorts. Opened in 1954 for 366 miles of its length (from Buffalo to Newburgh - some distance south of Poughkeepsie) the Thruway was under construction for four years. In that time, according to a survey made by three New York state agencies, private enterprise invested some $150,000,000 in factories, warehouses, truck terminals, gas stations, motels, apartments, housing developments, shopping centers, and tourist attractions along its routes. Not to be overlooked in appraising this impact is the fact that the Thruway passes through the urban-industrial section of the state. Within roughly ten miles on either side of the road are 90 per cent of the state's population, 79 per cent of its motor vehicles, 83 per cent of its trucks, and all of its seven cities with populations of 100,000 or more.

According to news reports, the Thruway was a factor in decisions to build the following industrial plants, to mention a few:

---A $20,000,000 Ford assembly plant at Mahwah, N.J., a mile off the Thruway below Suffern.

---A new International Business Machines' plant at Kingston (5,000 jobs).

---The addition of 80,000 square feet to the Beech-Nut Packing Company's baby-food plant at Canajoharie in the Mohawk Valley.

---A 10-acre General Motors plating works at Syracuse.

---Near Buffalo, a $250,000 steel fabrication plant, an $85,000 meat packing plant, and three smaller companies costing about $30,000. In the same general area, a $120,000 truck factory, a $40,000 tin-shop, a $4,000 truck garage, and a $250,000 building supply house to be started soon.

---General Electric's vast Electronics Park plant near Syracuse where 10,000 persons will be employed.

Similar effects on industrial expansion and location are to be seen along Massachusetts Bay State Route 128, a limited-access highway which encompasses some 83 cities and towns of metropolitan Boston. Several illustrations follow:

---A $10,000,000 industrial center adjacent to Route 128 in Newton and Needham, the following names being just a few of the firms locating there: American Can, General Motors, Kraft Foods, Singer Sewing Machine, Union Carbide & Carbon.

---A new headquarters for Sylvania Electric Products electronics divisions on a 76-acre tract in Woburn.
---A new plant for The Clyde Everett Equipment Company (manufacturing heavy automotive machinery and equipment for contractors and municipalities) in Burlington.

---A new $3,000,000 plant for Rust Craft Publishers (greeting cards) on a 56-acre site near Dedham.

---A 556-acre tract in Canton planned for development by the Metropolitan Industrial Center (site has 2-mile railroad frontage as well, and is near a public airport).

A more detailed examination of the influence of an expressway upon the development of industry was made along a 7 1/2-mile section of the Eastshore Freeway between Oakland and San Jose, on the eastern side of San Francisco Bay, over land that prior to the freeway's construction was farm and unfilled marsh land. This study and others like it were made by the Land Economics Study Section of the California State Highway Right of Way Department and are reported by Frank C. Balfour, Chief Right of Way Agent, in an article entitled "America's Highway Problems and Their Likely Effect on Real Estate Markets," The Appraisal Journal, October 1954. In the area considered to be within the influence of the freeway, and embracing only 9 per cent of the available land in Alameda County suitable for industrial development, it was found that over the last seven years,

---43.1% of the total expenditures for new industrial development had taken place;

---29.6% of the total number of new plants had been built;

---37.7% of the money invested in industrial expansion had occurred.

Still another measure of the influence of an expressway upon potential industrial development is to be found in comparisons of land values before the intention to build an expressway is announced, after the announcement of its forthcoming construction (when benefits are anticipatory), and after the facility actually is in existence. Along the 7 1/2-mile stretch of the Eastshore Freeway, for example, the average value of the undeveloped land was $500 per acre. In 1947 (when the project was reactivated after the war but prior to actual start of construction) acreage was selling at the rate of $2,000 with some sales at $6,000. Not long ago, the last large area of raw land was sold at $10,500 per acre. The study further points out that the most recent development in this area is the creation of industrial subdivisions whose average current selling price is approximately $21,780 per acre. Balfour stresses that these prices are not the asking prices immediately adjacent to the freeway or in the vicinity of the interchanges, "but rather in the entire area of freeway influence."

Equally spectacular figures are quoted in this article in reference to the new Santa Ana Freeway extending southeasterly from Los Angeles for about 35 miles. The study recognized that the Los Angeles metropolitan area is now undergoing the
most rapid industrial development in its history, and therefore made comparisons between changes in land values of property adjacent to the freeway and changes in property situated outside the zone of direct freeway influence.

For example, along a 2,500' test section of a frontage road, the following increases were found to have occurred: in 1947, industrial sites ranging in size from one-half to 3 acres were sold at an average figure of $7,800 per acre. In 1953, the average price was $25,000 per acre, and the most recent sale reported in 1954 was $55,000 for a one-acre industrial site. The increases represent a 605 per cent increase in land value for parcels of land that lie between the freeway and the first parallel street. Properties otherwise comparable but located some distance from the freeway showed a 360 per cent increase during that same period.

One caution should be observed in using these various examples of expressway influence upon industrial site demand: the expressway is not an isolated influence, but one that is operating in a national context of rising productivity and a regional context of expanding population growth. Furthermore, in each instance, the expressway is geographically related to an existing industrial region. This is true too for the New Jersey Turnpike (where the growth of traffic has far exceeded the engineering estimates upon which the road and its financial structure were predicated) which follows a corridor linking the first and fourth largest cities in the country and is in the center of a group of states that have 24 per cent of the country's population and 35 per cent of the nation's industrial production. It seems clear, however, that given a favorable economic environment, areas near expressways are going to be in greater demand for industrial sites than areas outside the influence of the expressway.

If this is the case, what typical portions of an expressway can be expected to exert the greatest pressure for industrial development? Opinion is in agreement that frontage roads* are choice, but are divided on the score of proximity to interchanges.

Howard believes that industry will seek sites "as close to points of access as possible." One first glance, this conclusion is reasonable, and it is quite probable that in many instances, industrial concerns will wish to locate near interchanges. Further examination seems to indicate, however, that a site near an access does not necessarily have an advantage over a frontage road site.

*The Bureau of Public Roads' definition of frontage roadway is: a roadway contiguous to and generally paralleling an expressway, freeway, parkway, or through street so designed as to intercept, collect, and distribute traffic desiring to cross, enter, or leave such facility and to furnish access to property which otherwise would be isolated as a result of controlled-access features. Sometimes referred to as a service roadway. Source: Highway Capacity Manual.
Evidence of this lack of access-preference was found in interviews conducted with the owners of industrial plants in the survey section of the Santa Ana Freeway when it was found that nearly all comments were overwhelmingly in favor of frontage sites. However, the same individuals felt that a location near the center of the frontage road and some distance from the point of access was just as desirable as a site near the ramp. (See Balfour article mentioned previously.) Although the freeway offers an undeniable advertising value to industries located alongside, this factor is not a prime locational motive as is the case with certain retail enterprises such as motels; nor does an industrial plant count in part upon "impulse trade" in the same way that shopping centers do. Finally, a factor to be considered is the time spent getting from the plant along a frontage road to the access point, which except in the case of widely-spaced interchanges, may not be of significance.*

**Market for Commercial Land**

**Motels**

Without going into the many aspects of advantageous site location for motels near highways in general, what are the particular features of the expressway that can be expected to modify choice of site? Since motels exist for highway trade, they must be visible from the highway or they must have an indicating sign that is visible from the highway. From the motel operator's standpoint, both are desirable. Therefore, the primary site preference for motels is direct highway frontage on the right side of the road going into town. On expressways, this choice is no longer possible, and the remaining preferred choices narrow down to (1) location near a portion of an interchange, and (2) location on a frontage road, both locations presumably being visible from the traveled roadway.

Although it is apparent from their discussion that an interchange site is to be preferred over any other, Geoffrey Baker and Bruno Funaro (in _Motels_, Reinhold Publishing Corporation, 1955) point out that all quadrants of interchange land are not by any means equally good. An unfamiliar maze of ramps and their confusing directions coupled with high vehicular speeds make it sometimes difficult for the motorist to turn off at the proper exit ramp that will take him to the motel.

Under these circumstances, the authors point out, topography around the intersection is very important because "an early, distant view from the highway of the motel itself or of a large directing sign" is necessary for the motorist to be able to make the turn in time to get off the expressway. A right-hand spot is also preferred over a left-hand one because "turning right to reach a motel on the left does not seem easy."

*Balfour makes the observation that the situation may be somewhat different with toll expressways, and points to the Pennsylvania Turnpike and the New Jersey Turnpike where, he says, the toll road facilities have had an elevating effect on land values in the immediate neighborhood of the entrances to the toll roads, but relatively little impact upon the area through which the right-of-way passes.
These factors are taken into consideration in a diagram of a clover-leaf intersection where motel locations are numbered in order of preference for a car approaching from an indicated direction. (See Motels, page 138.) They could be applied to the diamond, trumpet, and other interchanges - relative levels of the expressway prop, the ramps, and the surrounding land at all times being kept in mind.

Motel location on frontage roads seem to be second choice. Here again, visibility from the highway is possible, this factor, plus "right-handedness," plus relation to exit ramp affecting site preference. According to Frank C. Balfour, in "America's Highway Problems and Their Likely Effect on Real Estate Markets," (The Appraisal Journal, October 1954), a study of confidential income figures of California motel owners operating on frontage roads revealed that, other factors being more or less equal, motels located on frontage roads are capable of achieving greater success than comparable motels on conventional highways and that this income advantage will be sustained for a longer period of time. Although these figures are cited by the author to show that limited-access highways do not hurt business, they can also be used as evidence of the relative desirability of frontage road sites.

Baker and Funaro maintain also that the most promising location for a motel located near a limited-access highway will be one visible from the highway, on the right side of the "feeder road" when approaching a by-passed town.

Shopping Centers

How great a demand expressways will create for shopping center sites is less clearly established. Although accessibility is one of the most important site criteria for shopping centers, such a center depends primarily upon an established and expanding trade area. Its customers are land-based rather than expressway-based, as in the case of motel trade. Nevertheless, since its clientele is almost entirely auto-borne, a shopping center is critically dependent upon good highway facilities, and on these considerations alone, it seems almost inevitable that land in the vicinity of expressways will more and more be sought for shopping center development.

Probably, sites for shopping centers will continue to be chosen in built-up suburban rather than semi-rural areas. Baker and Funaro in their book on Shopping Centers, Design and Operation (Reinhold Publishing Corporation, 1951) make it clear that even regional shopping centers ("covering anything from 20 to 50 acres") must be located "in a thickly settled suburban area and be easily accessible by a number of major highways." Although the statement in parentheses should probably now be changed to read "covering anything from 20 to 400 acres" there seem to be no signs yet that a shopping center will venture far from a residential base.

Northland Center, on a site of 400 acres, was built on the fringe of a developed suburban area near Detroit. A 93-acre regional business center at King of Prussia (to be located, incidentally, at the point where the Pennsylvania Turnpike,
the Schuylkill Expressway, and Routes 202 and 23 join), is within 30 minutes' distance of 1,000,000 people. A center to be located on a 158-acre tract (at the intersection of U.S. Route 1 and Route 413) in lower Bucks County, Pennsylvania, likewise is in a suburban area.

Although generalizations cannot be drawn from these examples, they do have certain features that bear emphasis. One is that their trade areas are apt to be measured in terms of time rather than miles because they are located near high-speed transportation facilities. (The King of Prussia tract is actually located between interchanges, according to the news announcement; and a 57-acre tract in Clay County, near Kansas City, Missouri, will be sited between the arms of the Y to be formed by the construction of new U.S. Highway 69 and new U.S. Highway 71 freeway.)

The other feature - and this may be even more significant in the long run - is that these giant regional centers are more than just centers for the sale of retail merchandise. "Northland," says a feature writer, "is the nucleus of a new city, built out upon the perimeter of an old city which is being choked off at its center. It will bring about a reorientation of half a million or more people. And it is only the beginning." With only a small portion of the 400-acre tract developed so far, plans are being considered to build office buildings, a medical center and residential developments. "Northland," said Victor Gruen, chief architect, "is the first shopping center of tomorrow to come to life."

On a smaller scale, but still more than a retail center, the King of Prussia center will include wholesale distribution, transportation and servicing headquarters, and office and recreational facilities in addition to stores. Likewise at the lower Bucks County center described above there will be a 3,000-bed private hospital, a banquet hall, four churches, a bus terminal, a nursery and playground, and provision for future county and municipal offices. And the Kansas City center will be built in conjunction with a residential development of single-family houses and 63 two-story apartment buildings.

It seems safe to say, therefore, that in some situations expressways will create a demand for shopping center sites on adjoining land, especially near interchanges. Given an expanding suburban fringe, an expanding, untapped retail trade area, and space, the expressway seems almost certain to precipitate demand for shopping center sites. (In June 1954 it was reported that plans had been filed for the construction of at least forty shopping centers along the New York State Thruway on sites just outside interchanges near major population centers.) Given, however, a rural or semi-rural area, the possible future demand is more uncertain, and will probably await the further spread of houses and possibly the growth of industry.
Market for Residential Land

First-hand knowledge on how expressways create demand for residential land is available to almost any city dweller who has traveled them. Several specific situations are analyzed in the Balfour article referred to previously, most of them being in the state of California. One example deserves particular mention because it illustrates how markets for residential land sometimes are created prior to actual expressway construction. This again is the Santa Ana Freeway for which right-of-way acquisition proceedings extended over a ten-year period. Here the large-scale building activity that preceded the actual freeway construction was accomplished in anticipation of future high-speed transportation to downtown Los Angeles. Knowledge of the freeway was advertised and used as a sales incentive.

A recent study prepared by the Southeastern Pennsylvania Regional Planning Commission (entitled *Time-Distance*, November 1954) makes an analysis of the commuting areas that will be brought within thirty minutes' driving time of the Philadelphia city hall as a result of expected expressway construction. With the use of travel time studies and origin-destination surveys it was found possible to (1) estimate the initial traffic volume on any new expressway facility, and (2) estimate the volume of traffic which would be diverted from existing land service highways to the new expressway. However, the report warns that estimates of this type can only reflect the immediate impact of expressways, because "as experience has shown, the extension of new transportation facilities into outlying sections of the metropolitan area exerts a powerful stimulus upon suburban development," which, in turn, feed increasingly heavier traffic volumes on the expressways, making it impossible to predict traffic volumes which might be channeled onto the facility after several years of suburban growth.

Although thirty minutes is chosen as the basis for the construction of equal-time zones, it is pointed out that "millions of people in metropolitan areas throughout the country accept a 45 minute to one hour trip from home to work as an inevitable part of their daily lives. It is not at all unrealistic to expect new expressways to exert development pressures on areas now far removed from the effective commuting area."

Drawing some conclusions from things that have already happened in the Philadelphia region, this report maintains that suburban development will not necessarily extend outwards more or less uniformly from an existing built-up periphery. One of the possible results of expressway extensions is scattered subdivisions in outlying areas "far too small to provide a normal integrated community, and to support economically a full complement of urban services." The second type of unusual residential growth that expressways are apt to encourage is a "cluster development" in the vicinity of interchanges (a favored location also for commercial and possibly industrial enterprises),
Part II

PLANNING CONSIDERATIONS

In Part I we considered some of the kinds of "development pressures" that might be exerted by an expressway upon relatively undeveloped land on the outskirts of an urban area. The kinds of the demands for land that might be created were considered almost entirely independently of any thought as to their desirability. Nothing was found to contradict Howard's observation that "these expressway systems will play a major part in setting the pattern and influencing the development not only of industrial growth, but also of all urban land uses, in the expanding suburban districts which will be the metropolitan areas of the next century." Evidence is available that in many instances the urbanizing influence of expressways is being exerted chaotically and without thought to its effect upon municipal services, upon quality of housing, upon relation of land use to the established communities. In some places, the authority to regulate land use in expressway environs (or the authority to plan) has been lacking.

In Part II we will consider some of the more specific factors that may modify the independent workings of demand. Most of these factors are widely considered to be related to the general welfare.

Traffic at Interchanges

One of the dilemmas that will confront agencies making decisions regarding land-use near expressway interchanges is that the most choice location for certain types of enterprises is also the point at which expressway capacities are most sensitive to adverse influences. The Highway Research Board's *Highway Capacity Manual* says:

> The efficiency of traffic movement on freeways or expressways and the extent to which their potential capacities can be realized depends directly on the adequacy of the facilities that are provided for entering and leaving these highways. Improperly planned entrances can seriously limit the traffic volumes that can use an expressway, and exit facilities incapable of accommodating vehicles leaving the highway at one point, even though the number be relatively few, can cause complete congestion of all traffic.

There are almost an unlimited number of different conditions and combinations of conditions that limit the number of vehicles that can use a given ramp, according to this same source. Many of them are amenable to engineering design. One that directly concerns planning agencies, however, is uses that may contribute to traffic congestion in the vicinity of ramp entrances and exits. Although in any given situation a great deal can be done through proper design, it seldom if ever happens that ramps are designed with thought to the possibility that a large traffic generator may be located in the neighborhood of the ramp.
The existence of at-grade intersections in the vicinity of the ramp is one of the most important terminal conditions affecting ramp capacity. Quoting again from the *Highway Capacity Manual*:

Traffic approaching a ramp leading to an expressway and traffic on a ramp leading from an expressway must oftentimes pass through an at intersection at grade in the immediate vicinity of the ramp. **THE VOLUME OF TRAFFIC THAT CAN BE ACCOMMODATED BY THE RAMP IS THEN DEPENDENT ON THE CAPACITY OF THE NEARBY INTERSECTION.** When this is the case, the information on intersection capacities should be applied when estimating the maximum volume of traffic that can enter or leave the ramp.

Relation of frontage roads to ramp terminals and the locating of high traffic generators near at-grade intersections are factors, therefore, to be considered in land-use planning. A special problem, however, arises in connection with shopping centers which, as we have seen, often desire interchange locations serving a 30-minute driving time trade area. That shopping centers so located will affect ramp capacities seems almost inevitable, although again, proper engineering design of shopping center facilities provided to take the traffic from and return it to the public roads can make a marked difference. Some idea of the problems that will be created by shopping center location near expressway interchanges can be gained from an article by Victor Gruen on "Traffic Impact of the Regional Shopping Center," written at the request of the editors of *Traffic Engineering* and appearing in the March 1953 issue of that magazine. The following excerpts of a general nature are extracted, not to make a case against an interchange site, but simply to indicate the size of the problem. The article itself should be consulted for information on methods of predicting future shopping center traffic and recommended design standards.

There are many problems involved in the planning and construction of a shopping center and one of the more important is that of providing for a smooth flow of traffic to, through and away from the shopping center. A shopping center is almost wholly dependent upon auto borne trade and the extent to which traffic facilities are provided can be the difference between a marginal or a successful operation. The intensity of the problem will vary with the size of the center - the small neighborhood center may create little or no noticeable effect even at the corner on which it stands, while the regional center with 300,000 to 1,500,000 sq. ft. of store space can cause serious congestion several miles from its site.

The opening of a regional shopping center of 500,000 sq. ft. will divert approximately 10,000 cars per day from the existing traffic pattern. This diversion will extend throughout the entire trade area and, during peak periods, when as many as 3,000 cars per hour are pulled from their normal routes, the consequences can range from little or no effect
near the outer fringe of the trade area to impossible congestion of the existing road net near the shopping center. Nearly every regional shopping center now in operation is experiencing some degree of traffic difficulty. Some proposed sites are being abandoned due to expected traffic problems. Others, now in planning stage, are faced with the alternatives of accepting extreme road congestion with its consequent loss of trade or the expenditures of huge sums of money for highway improvements.

The traffic problems created by a regional shopping center are new. This traffic is highly specialized in nature. It cannot be compared with downtown situations where there is a blend of shopping, business and commuter traffic aided, in most cases, by an integrated public transit system; it is not similar in habit to the traffic generated by the suburban strip or corner development; and, of course, it is very unlike the traffic created by large business or industrial units.

Since a shopping center does not have a slow, evolutionary growth but, instead, emerges full blown on opening day, its problems cannot be solved by periodic traffic counts from which future growth and highway needs can be projected.

The placement of entrances and exits to the parking area can be the determining factor in the degree of congestion created on the public boundary roads and the interior distribution roads. Entrances and exits require a weaving, acceleration and deceleration distance between them. Ideally, this distance should be about 350' to 400'. Under certain site limitations, this distance is sometimes reduced to 200'. Assuming a continuous traffic flow, an entrance or exit can handle about 750 cars per hour. Thus, it is evident that there is a definite relationship between the volume of traffic and the perimeter of the parking area. We call this the contact area.

From all signs, the pressure to locate shopping centers near interchanges will be strong. It should be remembered, however, that although they are adequately served by good roads, some of the most successful regional shopping centers in the country are not located near interchanges, nor even near expressways. Insistence upon an interchange site may have far-reaching effects upon the traffic-service function of the expressway. The possible consequences of such a location should be thoroughly investigated by administrative bodies authorized to approve sites and by legislative bodies considering zoning changes.

Billboards

One of the oldest problems in roadside control is the unregulated, indiscriminate location of billboards and other forms of outdoor advertising, designed to attract the attention of the motorist. A great deal has been written on the subject of billboards, their defacement of the scenic countryside, and more recently, their possible illegitimacy as a highway use when isolated from the product they advertise. In the three and one-half years since the publication of Information Report No. 28 on Signs and Billboards a number of things have happened to indicate that regulation
of billboard location along public highways is an act bearing a reasonable relation to the general welfare. These developments will be described briefly in this section, the reader being referred to the bibliographic section at the end of this report for further references.

The chief regulatory innovation is one that prohibits the erection or maintenance of advertising structures designed to be viewed primarily from the main-traveled roadway of an expressway. This principle was first adopted in 1951 by the city of Los Angeles in an ordinance amending the zoning code, the reasoning and justification therefore being set forth in the ordinance preamble:

WHEREAS, the State, in cooperation with the City of Los Angeles, is actively engaged in the development and expansion of a freeway system within the city limits; and
WHEREAS, freeways are designed and arranged for the movement of large volumes of vehicular traffic effectively and safely at high speeds; and
WHEREAS, there are many billboards and signs which have been erected adjacent to the freeways for the primary purpose of being viewed therefrom, which divert the attention of motorists from the operation of vehicles on such freeways; and
WHEREAS, there are other billboards and signs which are not maintained primarily to be viewed from the freeways, but because of their particular arrangement or characteristics also so distract motorists on such freeways; and
WHEREAS, landscaped borders are customarily provided adjacent to the roadways as a part of the improvement of the freeways for the purpose of preventing distraction from the operation of vehicles and the observation of traffic, and also for the purpose of screening unsightly conditions, and for the beautification of the city; and
WHEREAS, the erection and maintenance of such billboards and signs create a hazardous condition and destroy the purpose of such landscaping, all to the detriment of the public health, safety, and welfare, NOW THEREFORE,

The ordinance defines the term "main traveled roadway of a freeway" to mean "that portion of a freeway, including interchange roadways connecting one freeway with another, which is designed for the movement of large volumes of vehicular traffic, efficiently and safely at high speed, but not including frontage roadways, landscaped areas, or ingress or egress ramps connecting the freeway with other streets."

Regardless of the district or zone in which it is located, no outdoor advertising structure shall be "erected, constructed, relocated or maintained."

(a) If such structure, sign or statuary is designed to have or has the advertising thereon maintained primarily to be viewed from a main traveled roadway of a freeway; or
(b) If such structure, sign or statuary, because of its location, size, nature or type, constitutes or tends to constitute a hazard to the safe and efficient operation of vehicles upon a freeway, or creates a condition which endangers the safety of persons or property thereon.

The balance of this ordinance deals with existing signs, permits, fees, procedures for permits adjacent to freeways, exceptions. Every application for a permit to erect an advertising structure within 500 feet of a main traveled roadway of a freeway shall be considered by the board of public works to determine whether it is designed to have the advertising thereon maintained primarily to be viewed from the main traveled roadway.

Similar legislation followed in a number of other California cities, among them being Oakland, Oceanside, Salinas, Pomona, Riverside, and San Luis Obispo. Atlanta, Georgia, adopted an ordinance based on the same principle banning any billboard or other advertising structure within a distance of 300 feet from the new North-South Expressway which faces or is visible from the expressway - with certain stipulated exceptions. Because of the great width of this expressway at certain locations, the control under the ordinance will apply to areas as much as 900 feet in width, some of which are near the central business district of the city. Similar to the Atlanta ordinance is the one adopted by Denver, Colorado, in 1952, part of which follows:

**Signs Near Freeways.** It shall be unlawful to erect or remodel within six hundred (600) feet of the right-of-way of a freeway any sign the face of which is visible from the freeway unless such sign advertises or pertains wholly to a business conducted on the premises. It shall be unlawful to erect or remodel within three hundred (300) feet of the right-of-way of a freeway any sign the face of which is visible from the freeway which exceeds one hundred fifty (150) square feet in area, and no sign erected or remodeled within such area shall have moving parts, moving or changing illumination, or illumination by means of reflection.

The word "remodel" as used in this section only shall not apply to a repair or repainting of a sign nor shall it apply to a change of advertisers, but it shall mean any change in the structure of a sign not herein exempted.

The Council hereby finds that this ordinance relating to signs is necessary to the immediate preservation of the public health and public safety, declares that it is enacted for these purposes, and determines that it shall take effect immediately upon its final passage and publication.

Similarly the statute establishing the New York State Thruway prohibits any construction on or within 500 feet of the right-of-way without permission of the Authority. Advertising devices are included within the prohibited structures, although petitions may be made for permission to erect them in certain specified areas of the Thruway system where use, population density, and nature of the surrounding community, special conditions prevailing therein or other such factors justify their erection.
The location of billboards along highways has been a subject of litigation for over twenty years (See Information Report No. 28 for discussion of legal basis for billboard control). In 1952, a decision of the Supreme Court of New Jersey on the important case of United Advertising Corporation v. Borough of Raritan (December 22, 1952, 93 A.2d 362, 5 ZD 59) established that, so far as the state of New Jersey was concerned, the distinction between signs advertising the use of premises and others is a valid one. The plaintiff had complained that the subject ordinance was discriminatory because, while it excluded advertising signs in all districts, it does permit signs directing attention to businesses on the premises. In answer to this claim the court had the following to say:

The business sign is in actuality a part of the business itself, just as the structure housing the business is a part of it, and the authority to conduct the business in a district carries with it the right to maintain a business sign on the premises subject to reasonable regulations in that regard as in the case of this ordinance. Plaintiff's placement of its advertising signs, on the other hand, are made pursuant to the conduct of the business of outdoor advertising itself, and in effect what the ordinance provides is that this business shall not to that extent be allowed in the borough. It has long been settled that the unique nature of outdoor advertising and the nuisance fostered by billboards and similar outdoor structures located by persons in the business of outdoor advertising justifies the separate classification of such structures for the purposes of governmental regulation and restriction. . . . And as such separate classification offends no constitutional provision, there also exists no invidious discrimination in the provisions of the ordinance barring plaintiff's signs in the business and industrial zones while allowing therein manufacturing plants, junk yards, coal and coke yards and other uses suggested by plaintiff as also having undesirable attributes. It is enough that outdoor advertising has characteristic features which have long been deemed sufficient to sustain regulations or prohibitions peculiarly applicable to it.

However, in the state of Ohio, a suit contesting the authority of the Ohio Turnpike Commission to retain rights to erect on remaining lands any billboard, sign, notice, poster, or other advertising device "which would be visible from the travelway of the Ohio Turnpike Project No. 1, and which is not now upon said lands," the court held that "visible" is too vague a word. This was the case of Ellis v. Ohio Turnpike Commission, Solether v. Ohio Turnpike Commission, Supreme Court of Ohio, June 30, 1954, 120 N.E.2d 719 (6 ZD 201). The point also was sustained that the Turnpike Commission was given no express authority to deny the owner of lands taken for the construction of a turnpike the right to use his remaining lands for the erection and maintenance of billboards, etc., and went on to say that even if this authority existed, the resolution was too indefinite and uncertain to be valid and enforceable. The word "visible" standing alone is vague and ambiguous. No standard was created whereby the word may be accorded practical meaning and effect.
Another method of billboard regulation - which may, in the long run, be one of the most reasonable solutions to the problem - is documented by few ordinances. This is to consider billboards a legitimate commercial use and to permit them in certain commercial and industrial districts, entitled to the same rights and subject to the same restrictions as comparable to commercial uses. If, for example, a store or a factory is permitted to erect a point-of-sale sign, similar in size to a billboard, then there is no real justification for excluding billboards either on the grounds of aesthetics or of being motorist distractors. By the same token (i.e., that a billboard is a justifiable commercial use) billboards do not belong in residential districts nor in agricultural districts, and probably not in neighborhood business districts.

This principle has been adopted in the zoning ordinance for Grand Rapids, Michigan (1951) where unlimited billboard use is permitted in the heavy industrial district. In the light industrial district, size limitations per number of front feet are imposed, and in the central business district and the suburban business district, the permitted concentration of billboards (on a frontage basis) is progressively less. Billboards are prohibited, generally, in neighborhood business districts and in residential districts.

This solution, if adopted on a county-wide basis, would limit billboards along expressways to those districts zoned commercial and industrial, and unless lengthy portions of the lands bordering expressways were so classified, would prevent the kind of scenic defacement that in the past has been the source of the strongest objection to billboards.

Roadside Zoning

The subject of roadside zoning is so broad that it can only be touched upon briefly here. (See bibliography for references.) It is one of two main techniques for controlling roadside marginal land use, the other being controlled through acquisition by purchase or condemnation of rights essential to roadside development on the method that is an intrinsic part of most toll-road construction. Roadside zoning is an exercise of police power in the same manner as comprehensive zoning. It differs from comprehensive zoning in that it applies only to road-bordering lands. The authority to roadside-zone is found in special roadside enabling laws and statutes that authorize county-wide zoning. In substance, it may be similar to comprehensive zoning, that is, there may be residential, commercial, and industrial zones. Usually, however, the roadside nature of the zone is reflected in the ordinance.

A recent summary of the status roadside zoning in the United States may be found in Highway Research Board Bulletin 55, Land Acquisition and Control of Adjacent Area. This summary (written by Erling D. Solberg) classes roadside-zoning districts into three classes, based primarily on limitations placed on commercial activities.
The first is typified by the roadside zones created by a Richmond County, Georgia, ordinance which excludes any and all types of commercial establishments in an area extending 1,000 ft. on both sides of certain highways.

The second type is the roadside-service district. Commercial activities in these zones are restricted primarily to business that is necessary for servicing the traffic. Among these are motels and auto courts, service stations, restaurants and refreshment stands, and some kinds of retail stores.

The third type, the general roadside commercial districts, is designed to serve both the highway traffic and the adjacent population. In addition to highway service activities, these districts usually permit stores for retail business, commercial recreation, and light manufacturing.

Regulations pertaining to each of these three types of districts usually include setback and off-street parking requirements, limitations on outdoor advertising, and sometimes a measure of control over the design of roadside business buildings.

Solberg goes on to observe that, considering the scope of the problem, only a beginning has been made in roadside zoning, in terms both of total miles of roadside zones and of type and stability of regulations imposed.

Planning and Zoning for Expressway-bordering Lands

Although expressways remove the possibility of unregulated commercial development lining the roadway, their extent of adjacent area control ends at a line that is, at the most, a few hundred feet distant from the edge of the traveled thoroughfare. This means that the tools of billboard control, roadside protection of scenic areas, and roadside zoning can be used in the areas immediately adjacent to the right-of-way proper and along frontage roads.

As we have seen, however, the economic impact of an expressway may extend far beyond lands bordering the right of way. The areas affected are more apt to be measured in square miles than in square feet. In some localities they may be as deep as they are long - as contrasted with the typical strip influence of the conventional highway.

It is well known that the opening of an expressway immediately generates applications for zone changes. (See, for illustration, the July 1954 issue of ASPO Newsletter, which reproduces a diagram made by the Regional Planning Commission of Los Angeles County showing how freeways increase the number of requests for zone changes.) Unless the economic impact of the expressway is anticipated by the governmental body and unless some kind of a plan has been made for its
rational development, each zone change application will have to be considered on
its own merits, and the result may be little different from what would have
happened if there had been no plan and no regulatory authority had been exercised.*

Therefore, suburban or rural land upon a city's outskirts and within the area of
influence of a new expressway should be viewed as land that is going to change
rapidly to urban land. It is a future extension of the urban area, and as such,
should be planned for in the same way as any other part of the urban area. In
this kind of a situation, roadside zoning is at best a stop-gap measure. The
planning steps that precede adoption of an ordinance or ordinance amendment
covering such an area should be no different from those that precede adoption of
a comprehensive zoning plan.

*Even if a zoning ordinance exists, the problem of zone change is going to be a
thorny one. An interesting example of what can be expected in many other places
is occurring along the Bayshore Freeway, San Francisco. In a recent action, the
city planning commission turned down building applications for two more motels on
grounds that a rash of motels near the new freeway would threaten development of
light industry in the area. The area in question is zoned industrial. The 1954 grand
jury had recommended "an ordinance regulating the location of motels (to) eliminate
uncertainty, both for persons desiring to build and property owners desiring to
protect their homes or industrial property from intrusion."
APPENDIX

PLANNED SERVICE FACILITIES ON TOLL ROADS

A kind of monopoly control of roadside business exists in the case of several of the toll roads. (Business Week speaks on the "Captive Motorist" and the "Captive Market", issue of May 8, 1954.) Outstanding planned facilities have been developed along the New Jersey Turnpike and the New York State Thruway. The following description of these facilities is included with this report because it is thought that the high standards employed in designing the facilities may have some applicability to roadside businesses conducted on a free enterprise basis.

New Jersey Turnpike

The expressway service facilities of the New Jersey Turnpike are all on land and in buildings owned by the Turnpike Authority. They comprise an administration building, 6 maintenance headquarters, 20 toll stations for the 17 interchanges, 6 equipment stations for the short-wave communication towers, and a chain of concession buildings.

The concession areas are of particular interest because they serve the traveling public, whereas the other facilities mentioned are intended for maintenance and operation of the Turnpike. The concessions consist of service stations for the dispensing of gasoline and diesel fuel, oil, water, and compressed air, equipped to make oil, tire, battery changes, and minor repairs. At some of the larger facilities (where a restaurant is also located) there are facilities for oil changes, and wash and grease jobs.

In addition to service stations and restaurants, the concession sites have parking for cars and trucks, picnic areas, and are landscaped.

Concession areas are paired on opposite sides of the roadway (each one being called a "half-site"), and are spaced at a distance of 10 to 12 miles. Site locations were chosen on the basis of the following standards established by the Authority:

1. Sites should be on high ground for better visibility and views; and also to aid in the deceleration of vehicles turning into the concession and the acceleration of those returning to the Turnpike.

2. Ample sight distance should be available. Therefore concessions should not be placed just past a crest of the road or directly behind an overpass.

3. Space should be available for full-length (1,200-ft) deceleration and acceleration lanes.
4. Sites should be remote from interchanges to avoid excessive weaving of traffic caused by the two facilities.

New York State Thruway

Profiting from experience on the New Jersey and Pennsylvania Turnpikes, where service facilities are about half an hour's travel time apart - roughly 25 to 30 miles - the Thruway authority decided to stagger the service establishments on either side of the roadway to reduce the distance to around 15 miles so that they would be more readily available in case of emergency. Facilities are of three types; labeled according to size and service.

Super-A Unit (two in number): Dining room and lunchroom seating 340 persons, snack bar, gift shop, and rest rooms. Parking for 314 cars and 40 trucks.

A Unit (four in number): Dining room seating 100, a lunchroom with 76 counter seats, snack bar, gift shop, rest rooms, service station, and parking area for 125 passenger cars and 30 trucks.

B Unit (twelve in number): Lunchroom seating 72, lunch counter, booths, snack bar, rest rooms, service station, and parking space for 125 passenger cars and 30 trucks.

C Unit (eight in number): Snack bar, stand-up counter, rest rooms, gas station, and parking space for 86 cars and 30 trucks.

Minus-C Unit (two in number): Car service areas only, connected with the "Super-A" dining salons by overpasses.

The smaller units are designed so that they can be expanded later to conform with the larger units.

Study and care went into selection of the sites. One newspaper reports the process in the following manner:

After the distance between the areas was determined and plotted generally on a map, it was necessary to determine whether electric power was available at the areas tentatively selected. Then it was necessary to determine whether water was available and, if so, whether it was in sufficient quantity. If both power and water were found, the engineers then searched for access roads for they did not want the many companies servicing the restaurants to use the Thruway. Finally, it was most
desirable to find a location about two or three feet above the level of the Thruway itself and preferably at the end of a long straight stretch. This would provide the motorist with plenty of room to slow down after having had an opportunity to see the service area from some distance.

Thought also was given to the possibility of locating the service units in a center mall so that both north and southbound travelers could use them with equal ease. This idea was rejected because a center mall location was considered a potential handicap, and because it would disrupt the pattern of spacing the facilities strategically.

Contracts were made with concessionaires to furnish food and service of high quality and the Authority plans close supervision. Prices, weights and measures are specified.
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