NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM REPORT **53**

MULTIPLE USE OF LANDS WITHIN HIGHWAY RIGHTS-OF-WAY

HIGHWAY RESEARCH BOARD
NATIONAL RESEARCH COUNCIL
NATIONAL ACADEMY OF SCIENCES—NATIONAL ACADEMY OF ENGINEERING

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Bureau of Public Roads, United States Department of Transportation.

The Highway Research Board of the National Academy of Sciences-National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as: it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; its relationship to its parent organization, the National Academy of Sciences, a private, nonprofit institution, is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway departments and by committees of AASHO. Each year, specific areas of research needs to be included in the program are proposed to the Academy and the Board by the American Association of State Highway Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are responsibilities of the Academy and its Highway Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

This report is one of a series of reports issued from a continuing research program conducted under a three-way agreement entered into in June 1962 by and among the National Academy of Sciences-National Research Council, the American Association of State Highway Officials, and the U. S. Bureau of Public Roads. Individual fiscal agreements are executed annually by the Academy-Research Council, the Bureau of Public Roads, and participating state highway departments, members of the American Association of State Highway Officials.

This report was prepared by the contracting research agency. It has been reviewed by the appropriate Advisory Panel for clarity, documentation, and fulfillment of the contract. It has been accepted by the Highway Research Board and published in the interest of an effectual dissemination of findings and their application in the formulation of policies, procedures, and practices in the subject problem area

The opinions and conclusions expressed or implied in these reports are those of the research agencies that performed the research. They are not necessarily those of the Highway Research Board, the National Academy of Sciences, the Bureau of Public Roads, the American Association of State Highway Officials, nor of the individual states participating in the Program.

NCHRP Project 7-6 FY '66

NAS-NRC Publication 1587

Library of Congress Catalog Card Number: 68-61429

FOREWORD

By Staff

Highway Research Board

This report presents a summary of the existing multiple uses being made of highway rights-of-way. It should be valuable to highway planners, design engineers, maintenance engineers, legal specialists, and those who plan roadside development. Several types of right-of-way uses are described in sufficient detail to assist others in the development of similar facilities for serving the interests of both the highway user and the adjacent community. Potential new multiple uses are also discussed.

It has been increasingly evident that controlled-access highways in urban and rural areas include land which was acquired to provide space for the present and future safe design and operation of highways, but which may have a potential multiple use. Examples of such land include areas associated with median strips, interchanges, elevated structures or bridges, and alongside roadways, all within the functional rights-of-way. This land could conceivably be used for many purposes to serve the motorist and the neighboring community. The objective of this research study was to assemble and analyze information that illustrates what has been and what might be accomplished in using this supplementary land within rights-of-way.

A review of pertinent literature produced an annotated bibliography, which appears as Appendix A of this report. A questionnaire was mailed to state highway departments and toll road authorities in this country and abroad to determine current uses being made of highway rights-of-way. Personal visits to various sites were conducted to acquire additional information on the effects of the various uses. Pertinent sections of state statutes were reviewed to ascertain the policies and legal requirements concerning the use and disposition of land within rights-of-way of controlled-access facilities.

Examples of various types of right-of-way multiple uses are assembled in this report, and their characteristics are evaluated in terms of safety, traffic operations, esthetics, and other considerations. Diagrams and pictures illustrate the geometrics and space involved in developing these existing and planned uses. The survey of past experience and the recommendations in this report regarding multiple uses should be of assistance to agencies who may be considering such developments on new or existing highway rights-of-way.

CONTENTS

FIGURES

TABLES

TABLES

ACKNOWLEDGMENTS

The research reported herein was performed under the direction of Harvey R. Joyner, Principal Investigator, acting for Barton-Aschman Associates, with Darwin G. Stuart as Planning Research Assistant and Richard Serlin as Legal Research Assistant.

Much of this study is based on the results of a survey of the multiple-use experience of 49 state highway agencies, the District of Columbia, 16 toll road authorities, and several foreign countries. The cooperation of each of these highway agencies is gratefully acknowledged.

Nearly 30 agencies furnished additional information in support of basic survey data, with special mention due the cooperation provided by the California Division of Highways (J. C. Womack, State Highway Engineer), the Connecticut State Highway Department (R. G. Mitchell, Chief Engineer), the Massachusetts Department of Public Works (J. C. Powers, Director of Right-of-Way), the Massachusetts Turnpike Authority (J. McCloskey, Assistant Chief Engineer), the New York Department of Public Works (B. A. Lefeve, Deputy Chief Engineer), and the New York State Thruway Authority (C. H. Lang, Chief Engineer).

Photographic illustrations have been provided through the cooperation of the individual highway agencies with which each photo is associated, with the exception of Figure 15, provided by the Bi-State Transit System, St. Louis, Mo. Similarly, graphic illustrations have been adapted from engineering plan drawings and sketches provided by the individual highway agencies with which each drawing is associated. Exceptions are Figure 13, again provided by the Bi-State Transit System, St. Louis, Mo.; Figure 20, courtesy of Vollmer Ostrower Associates, New York, N. Y.; and Figure 30, compiled from various maps of the Chicago metropolitan area.

MULTIPLE USE OF LANDS WITHIN HIGHWAY RIGHTS-OF-WAY

SUMMARY

This is a survey of present experience in the multiple use of lands within controlled-access highway rights-of-way for purposes other than the movement of traffic. Basic data for the study were obtained by a questionnaire sent to 49 state highway departments, the District of Columbia, 16 toll road authorities, and several foreign countries. Replies were obtained from all state highway and toll road agencies contacted in this country, as well as seven Canadian provinces, five Australian states, and five other foreign countries. In some instances additional information was obtained by personal contact follow-ups. An extensive review of all pertinent literature on this subject also was made. In addition, the enabling legislation dealing with highway law for each state was reviewed to summarize pertinent provisions concerning the use and disposition of controlled-access highway rights-of-way.

A general evaluation of the multiple uses reported by the questionnaire survey was made relative to potential demands for such uses, types of right-of-way utilized, effects on traffic operations, safety, cost, and benefits. The survey identified some 20 to 25 types of multiple uses that have been developed in this country, utilizing all types of highway rights-of-way—medians, sidestrips, interchange ramp interiors, and understructure areas. Multiple-use experience in foreign countries seems to be more limited than in the United States and has typically been associated with such highway-oriented activities as safety rest areas.

In conclusion, the findings of the study indicate that multiple-use development opportunities utilizing normal highway rights-of-way will be limited generally to activities which can be adapted to a linear configuration (except for ramp interiors) and which can co-exist with the highway without producing (or being subject to) adverse effects. The greatest opportunity for multiple use lies in the combining of sections of right-of-way with adjacent nonhighway land to form developable parcels. Direct access from controlled-access highway lanes to multiple-use development should be avoided except for such highway-oriented facilities as service plazas and safety rest areas. Given appropriate design standards, fencing, and landscaping, most multiple-use developments do not seem to have any undesirable effects on highway traffic.

Inadequacies and ambiguities in existing state highway enabling legislation relative to the acquisition, interim use, and possible disposition of unused highway rights-of-way were revealed by the legal review. Permitted uses under the term "highway purposes" should be identified and expanded. State highway agencies should be given powers to lease on an interim basis rights-of-way not immediately needed for highway construction, and to lease on a long-term basis those lands no longer needed for highway purposes.

CHAPTER ONE

INTRODUCTION

Continued progress in Interstate Highway construction has made highway administrators and local planning officials increasingly aware of the extensive land requirements associated with controlled-access highways (freeways). In many parts of the country, toll road and urban (non-Interstate) freeway development has further accentuated interest in these sizable highway land areas. Typical freeway right-of-way widths, for example, range from 250 to 300 ft, and cloverleaf interchanges require from 25 to 30 acres for full development. However, substantial portions of freeway rights-of-way are not paved, and are not used for moving traffic. These land areas—wide medians, sidestrips, interchange ramp interiors, and land under elevated structures—appear to offer considerable potential for further development. In urban areas there is a great need for additional parks, playgrounds, industrial and commercial land, parking space, and other facilities which conceivably could make use of these unused rights-of-way. In fact, many state highway and toll road agencies have already participated in the development of numerous multiple uses of right-of-way.

The purpose of this study is to explore what has been done and what might be done in making use of these highway lands not needed for moving traffic. In many cases, this land might be available for temporary use until needed for future highway expansion. Other circumstances may suggest the feasibility of more permanent non-highway use of the land.

Specifically, the objectives of this study are:

1. To review the literature available on the subject and compile and annotate a bibliography.
2. To give examples of what has been accomplished in the various states.
3. To evaluate these examples in terms of safety, traffic operation, highway user interests, community interests, aesthetics, and other considerations.
4. To summarize the policies and legal requirements already established regarding land use within controlled-access highway rights-of-way.
5. To issue a report summarizing all of the foregoing information, as well as recommendations for additional uses of these rights-of-way.

Although the study was limited generally to plots of land completely within the rights-of-way of controlled-access highways, the researchers found that some consideration of a limited expansion of rights-of-way was essential to the evaluation of many important uses. Similarly, the study definition generally excluded consideration of air rights and subsurface developments. However, because such developments usually make use of median or sidestrip land areas as well, they have been given limited attention here.

Chapter Two outlines briefly the survey of highway agencies and the review of the pertinent literature which provided data on multiple-use experience for the study. Subsequent chapters evaluate the uses reported by these sources, identify legal limitations and policies affecting use of rights-of-way, and make recommendations for possible new multiple uses and appropriate legislative and policy changes.

CHAPTER TWO

SURVEY OF MULTIPLE-USE EXPERIENCE

QUESTIONNAIRE SURVEY

As the initial phase of this study, a brief questionnaire was sent to 49 state highway departments, the District of Columbia, 16 toll road authorities, and 14 foreign countries. Information was requested on the types of multiple use that have been developed or seriously proposed within each agency's jurisdiction, the types of controlled-access highway land utilized, and the administrative agencies involved. Each of the state and toll road questionnaires was returned and replies were received from seven Canadian provinces, five Australian states, and five other foreign countries. The results of the survey provide a useful picture of the general distribution and characteristics of various kinds of multiple-use development.

Multiple uses can be grouped conveniently into two broad categories: (1) those which are oriented primarily

toward the freeway user, and (2) those which are more strongly related to the surrounding local area. Multiple uses in the first category usually have been associated with rural sections of controlled-access highways. The great majority of toll road and Interstate highway mileage, of course, has been constructed in rural areas between cities. Multiple uses related to the surrounding area, on the other hand, most often involve urban or suburban freeway rights-of-way. As might be expected, the demand for land and the possible types of multiple-use development are much greater near and within cities.

Three states have had particularly wide experience in the development of multiple uses: Connecticut (13 different types of use), California (12 types), and New York (11 types). In addition, 13 other state highway departments and six toll road authorities have participated in the development of five to seven different types of multiple use.

Table 1 summarizes the number of agencies reporting each of the nine predominant categories of use. Safety rest areas (52 agencies) tops the list, followed by understructure auto parking with 29 agencies, road maintenance facilities with 29, service plazas—20, scenic overlooks—20, highway or state police offices—14, truck weight stations—13, public transit facilities—13, and parks and recreation—11.

The types of highway land that have been utilized for multiple uses of all types are summarized in Table 2. Sidestrips have been developed by the greatest number of agencies (at least 63), followed by understructure land—33 agencies, medians—24, and ramp interiors—16.

The uses reported by each agency responding to the questionnaire are summarized in Table 3, in which state highway departments have been grouped according to major U.S. Census regions, and in Tables 4, 5, and 6 for other agencies and purposes.

TABLE 1

FREQUENCY OF MAJOR MULTIPLE-USE DEVELOPMENT

	NO. OF AGENCIES REPORTING									
		RELATED TO FREEWAY USERS				RELATED TO SURROUNDING AREA				
AGENCY TYPE AND LOCATION	TOTAL	SAFETY REST AREAS	SCENIC OVERLOOKS	SERVICE PLAZAS	TRUCK WEIGHT STATIONS	PUBLIC TRANSIT FACILITIES	MAINTENANCE FACILITIES	HIGHWAY OR POLICE OFFICES	UNDERSTRUCTURE AUTO PARKING	PARKS AND RECREATION
State highway agencies:										
Northeast	9	9	4	4	1	3	5	2	4	2
North Central	12	12	5	0	6	2	4	1	7	1
South	17	14	6	2	3	4	4	1	10	3
West	12	11	5	0	3	1	4	2	5	3
Toll road authorities	16	6	0	14	0	3	12	8	3	2
All	66	52	20	20	13	13	29	14	29	11

TABLE 2

TYPES OF HIGHWAY LAND UTILIZED IN MULTIPLE-USE DEVELOPMENT

	NO. OF AGENCIES REPORTING				
AGENCY TYPE AND LOCATION	TOTAL	SIDE-STRIPS	MEDIANS	RAMP INTERIORS	UNDER-STRUCTURES
State highway agencies:					
Northeast	9	9	2	3	5
North Central	12	12	5	3	8
South	17	16	7	1	11
West	12	11	3	3	5
Toll road authorities	16	15	7	6	4
Total	66	63	24	16	33

TABLE 3

MAJOR MULTIPLE USES OF RIGHTS-OF-WAY BY STATE HIGHWAY DEPARTMENTS

REGION AND STATE	RELATED TO FREEWAY USERS				RELATED TO SURROUNDING AREA				
	SAFETY REST AREAS	SCENIC OVERLOOKS	SERVICE PLAZAS	TRUCK WEIGHT STATIONS	PUBLIC TRANSIT FACILITIES	MAINTENANCE FACILITIES	HIGHWAY OR POLICE OFFICES	UNDERSTRUCTURE AUTO PARKING	PARKS AND RECREATION
Northeast:									
Connecticut	*	*	*	*		*	*	*	o
Maine	o								
Massachusetts	*	*	*		o	*		*	
New Hampshire	o								
New Jersey	*	*	*			*			
New York	*	*	*		*	*	*	*	o
Pennsylvania	*								
Rhode Island	*				o			*	
Vermont	*					*			
Total	*9*	*4*	*4*	*1*	*3*	*5*	*2*	*4*	*2*
North Central:									
Illinois	o			*	*	*		*	*
Indiana	*							o	
Iowa	*			*				*	
Kansas	*			*		*	*		
Michigan	*	*		*				*	
Minnesota	*	*		*					
Missouri	*				*	*		*	
Nebraska	*	*						o	
North Dakota	*	*							
Ohio	*								
South Dakota	o					*			
Wisconsin	*	o						o	
Total	*12*	*5*	*0*	*5*	*2*	*4*	*1*	*7*	*1*
South:									
Alabama	*	*						o	
Arkansas	*							*	
Delaware			*						*
District of Columbia					o	*		*	o
Florida	*			*	o			*	
Georgia	*								
Kentucky	*							*	
Louisiana	*							*	
Maryland		*	*		o	*		*	*
Mississippi	*								
North Carolina	*								
Oklahoma	*	*		*		*	*	*	
South Carolina	*								
Tennessee	o				•			*	
Texas	*	*						*	
Virginia	*	*		*	o	*			
West Virginia	*	*							
Total	*14*	*6*	*2*	*3*	*4*	*4*	*1*	*10*	*3*
West:									
Arizona	o								
California	*	*		*	*	*	*	*	*
Colorado	*	*				*	*		
Hawaii								o	
Idaho	*								
Montana	*	*		*		*			*
Nevada	*	*						*	
New Mexico	o								
Oregon	*	*		*				*	*
Utah	o							*	
Washington	o								
Wyoming	o					*			
Total	*11*	*5*	*0*	*3*	*1*	*4*	*2*	*5*	*3*
Total	46	20	6	12	10	17	6	26	9

* = Existing. o = Seriously proposed.

TABLE 4

MAJOR MULTIPLE USES OF RIGHTS-OF-WAY BY TOLL ROAD AUTHORITIES

	RELATED TO FREEWAY USERS				RELATED TO SURROUNDING AREA				
AGENCY	SAFETY REST AREAS	SCENIC OVERLOOKS	SERVICE PLAZAS	TRUCK WEIGHT STATIONS	PUBLIC TRANSIT FACILITIES	MAINTENANCE FACILITIES	HIGHWAY OR POLICE OFFICES	UNDERSTRUCTURE AUTO PARKING	PARKS AND RECREATION
Florida Turnpike			*						
Garden State Pkwy.	*		*			*	*		
Illinois Tollways			*			*	*		
Indiana Toll Road			*			*	*		
Kansas Turnpike			*			*			
Kentucky Turnpikes	*		*			*			
Maine Turnpike			*			*	*		
Massachusetts Tpk.			*			*	*		
New Jersey Tpk.			*		o				*
New York Thruway	*		*			*		*	
Ohio Turnpike						*			
Oklahoma Turnpikes	*		*			*	*		
Pennsylvania Tpk.	*		*						
Port of N.Y. Auth.					*		*	*	*
Richmond-Petersburg Turnpike						*	*	*	
West Virginia Tpk.	*		*		*	*			
Total	6	0	14	0	3	12	8	3	2

* = Existing. o — Seriously proposed

TABLE 5

MAJOR MULTIPLE USES OF HIGHWAY RIGHTS-OF-WAY BY FOREIGN COUNTRIES

	RELATED TO FREEWAY USERS				RELATED TO SURROUNDING AREA				
COUNTRY	SAFETY REST AREAS	SCENIC OVERLOOKS	SERVICE PLAZAS	TRUCK WEIGHT STATIONS	PUBLIC TRANSIT FACILITIES	MAINTENANCE FACILITIES	HIGHWAY OR POLICE OFFICES	UNDERSTRUCTURE AUTO PARKING	PARKS AND RECREATION
Australia	*			*	*			*	*
Belgium	*		*						
Brazil	*	*							
Canada	*	*	*	*	*	*	*	*	
Great Britain	*	o	*						
South Africa	*				o				
Switzerland	*		*			*			
Total	7	3	4	2	3	2	1	2	1

* = Existing. o — Seriously proposed

TABLE 6

MISCELLANEOUS MULTIPLE USES OF HIGHWAY RIGHTS-OF-WAY

MULTIPLE USE	AGENCY REPORTING DEVELOPMENT
Agricultural inspection stations	California Florida
Agriculture and grazing	California Montana Oregon South Dakota Kansas Turnpike
Boat launching and access to stream	Connecticut Missouri North Dakota
Bridle paths	California Connecticut
Cattle loading pens	Kansas Turnpike
Cultural-recreational centers	Garden State Pkwy.
Parking, bus or truck, understructure	Kansas Missouri Nevada Oregon Port of N.Y. Auth.
Parking, camping trailers, overnight	Minnesota Ohio Turnpike
Parking, autos, interchange ramp interiors	Connecticut Dist. of Columbia New York Massachusetts Tpk. Port of N.Y. Auth.
Parking, autos, interchange side strips	Connecticut Garden State Pkwy. Kansas Turnpike
Parking, tandem trailer operations	Kansas Turnpike Massachusetts Tpk. New York Thruway Oklahoma Turnpike
Ponding for conservation and flood control	Connecticut, Florida, Kansas, Kentucky, Michigan, Nebraska, New York, North Dakota
Pumping stations	Dist. of Columbia
Warehousing and storage, understructure	California, Dist. of Columbia, Louisiana, Massachusetts, Nevada, Oklahoma, Rhode Island, Richmond-Petersburg Tpk.

LITERATURE REVIEW

There is a paucity of material dealing with multiple use of freeway rights-of-way. Only four uses—safety rest areas, service plazas, public transit facilities, and vehicular parking—have been considered directly and at some length in the literature. Many articles concerning service plazas or road user service facilities were precipitated by the federal prohibition of such facilities on the rights-of-way of Interstate freeways. The pros and cons of such facilities are well described in these articles, most of which appeared in the late 1950's.

In addition, three multiple uses have been considered indirectly in the literature. Several recent papers on recreational needs and aesthetics as related to highways have held certain implications for parks and recreational facilities as potential multiple uses. A number of references dealing largely with recent size and weight restrictions on commercial vehicles, and trucking combinations in particular, serve as a background for the possibility of developing tandem-trailer areas at freeway interchanges. Truck weight stations are indirectly involved in a few articles reporting recent technological developments in dynamic truck weighing devices.

An annotated bibliography (Appendix A) briefly summarizes the most significant references. They have been grouped by subject areas, which include the types of multiple uses described in the foregoing plus four other reference categories. General background citations examine a number of multiple uses from various broadly-based frames of reference. Air rights developments, representing a specialized technique for multiple utilization of rights-of-way, have been considered in a number of excellent articles appearing within the last three years. Miscellaneous references deal, in general, with related topics which have an indirect bearing on certain types of multiple use. The final category, legal considerations, covers a number of publications dealing, in part, with legal problems involved in multiple-use development, as well as pertinent sections of state statutes which were reviewed as part of this study.

Where appropriate, significant references from the literature review are discussed as part of the evaluation of multiple uses in the following chapters.

CHAPTER THREE

MULTIPLE USES RELATED TO FREEWAY USERS

This chapter describes current experience with multiple uses that are strongly related to freeway users. It is based on the questionnaire returns from the states and toll road agencies, references from the literature review, and personal contacts with many of the agencies having the most extensive experience with this subject. Particular attention is given to an appraisal of the present and probable future demand for freeway-related activities as multiple users of freeway rights-of-way.

SAFETY REST AREAS

It has become well-accepted that, as a safety measure, motorists traveling on controlled-access highways should be provided with periodic opportunities for rest stops. In most urban areas, the frequency of interchanges and the availability of rest stop facilities on cross-streets will be adequate to fulfill this need. On rural Interstate highways, however, it has been broadly accepted that the construction of special safety rest areas within the right-of-way will be necessary, so that "in combination with other stopping opportunities within or near cities and at service facilities on crossroads with interchange connections, there preferably will be facilities available for short stops about every one-half hour driving time" (*1*). Though the clear implication is that the planning and location of safety rest areas on Interstate highways should be coordinated with the anticipated development of road user services at interchanges, the response of the states in the spacing of rest areas varies widely.

Of course, a number of other controlling factors—such as the availability of favorable sites, distances between interchanges, and the volume of traffic anticipated—affect the spacing of rest areas, which varies from state to state from about 10- to 45-min travel time (Table 7). In general, the average interval of 33 miles for the seven representative states described in Table 7 indicates that many states may accept ½-hr driving time as a general guide in the spacing of rest areas, without regard for possible interchange area development. Certainly, the question can be raised as to whether the motorist who simply wishes to stop for a rest should be required to leave the highway at unknown interchanges and search for an adequate facility.

The experience of 12 interurban toll roads in locating road user service plazas (which serve a rest area function), also within the right-of-way and accessible via direct ramp connections, similarly indicates a ½-hr or 32-mile spacing interval (Table 8). In New York and Indiana there appears to be some evidence that on controlled-access highways for which a relatively high volume of traffic is anticipated, a spacing interval of some 20 to 25 miles—with no consideration of the influence of rural interchange development—may well be desirable. The New York Thruway has provided six pairs of safety rest areas, in addition to its service plazas, producing a spacing interval between all rest stop opportunities of roughly 24 miles. It is interesting to note that in the construction of its 488 rural miles of Interstate highways the New York State Department of Public Works is developing 25 pairs of rest areas spaced at an average interval of 20 miles, which is comparable to Thruway spacing. Service plazas on the Indiana Toll Road are spaced at 20-mile intervals.

There is also some indication from urban toll road and parkway experience (Table 9) that the provision of safety rest areas may be necessary in the country's major metropolitan areas (roughly those 10 urban areas with a population of more than 2 million). Freeways that might be affected include ring routes, peripheral bypasses, and suburban extensions of core-oriented radials. Freeway mileage in major urban areas is extensive, and the volume of through (or even cross-metropolis) travelers may be large enough to warrant rest stop provisions. The vast areas covered by these large urban centers (which in some cases are 40 to 50 miles wide) suggest that opportunities should be provided for motorists to stop, rest, check their maps, etc., without leaving the freeway and getting involved with local arterial traffic. The experience of the Illinois Tollways in the Chicago area and the Garden State Parkway and New Jersey Turnpike in the New York area lend support to this conclusion.

Service plazas on the urban sections of these toll roads appear to be quite successful, in spite of ample opportunities to obtain services in the surrounding local area (of course, the rest stop function at these plazas is identical with that of rural service plazas or safety rest areas). On the two New Jersey toll roads, six pairs of service plazas are located

TABLE 7

SAFETY REST AREA SPACING IN SEVEN SELECTED STATES

STATE	RURAL INTERSTATE MILEAGE	REST AREA PAIRS	SPACING (MI)	SPACING[a] (MIN)
Rhode Island	48	4	12	11
New York	488	25	20	18
Indiana	875	34	26	24
Nebraska	450	14	32	30
Washington	600	16	38	35
Utah	900	21	43	40
Michigan	1,000	20	50	46
Total	4,361	134	33	30

[a] Based on a speed of 65 mph.

Figure 1. Virginia safety rest area. In many states both the general spacing policy and the extent of facilities provided for safety rest areas may vary widely. The Dumfries Wayside Rest Area along I-95 in Prince William County, Va., represents a good example of a well-developed rest area design. Sheltered picnic tables, outdoor grills, toilet facilities, and water supply are all available. Note that the area is well lighted for nighttime use.

TABLE 8

SPACING OF SERVICE PLAZAS AND MAJOR URBAN CONNECTIONS ON INTERURBAN TOLL ROADS

TOLL ROAD	RURAL MILEAGE	INTERCHANGES NO.	INTERCHANGES SPACING (MI)	SERVICE PLAZAS NO.	SERVICE PLAZAS SPACING (MI)	MAJOR URBAN CONNECTIONS NO.	MAJOR URBAN CONNECTIONS SPACING (MI)
Florida Turnpike	265	19	13.9	7	37.9	5	53.0
Indiana Toll Road [a]	136	8	17.0	8	19.5	4	34.0
Kansas Turnpike	233	16	14.6	6	38.8	4	58.2
Kentucky Parkways [b]	199	17	11.7	1	—	2	199.0
Maine Turnpike	106	15	7.1	3	35.3	3	35.3
Massachusetts Turnpike [c]	123	14	8.8	5	24.6	3	41.0
New Jersey Turnpike [d]	96	10	9.6	4	24.0	6	16.0
New York Thruway [e]	496	50	9.9	14	35.4	11	45.1
Ohio Turnpike	241	15	16.1	8	30.1	6	40.2
Oklahoma Turnpikes [f]	300	25	13.6	8	37.5	5	60.0
Pennslyvania Turnpike	469	37	12.7	14	33.5	9	52.1
West Virginia Turnpike	87	6	14.5	2	43.5	1	87.0
Total	2,751	232	11.9	80	32.6	59	46.6

[a] 20 miles additional urban mileage, with four interchanges; this mileage included for plaza spacing only.
[b] Mileage and service plaza figures not included in plaza spacing comparisons.
[c] 11 miles additional urban mileage, with 10 interchanges.
[d] 35 miles additional urban mileage, with 11 interchanges and three service plaza pairs.
[e] 60 miles additional urban mileage, with 48 interchanges and one service plaza.
[f] Four separate turnpikes; three terminal interchanges omitted to compute spacing interval.

TABLE 9

SERVICES ON URBAN AND RECREATIONAL TOLL ROADS

TOLL ROAD	TOTAL MILEAGE	INTERCHANGES NUMBER	INTERCHANGES SPACING (MILES)	RURAL SECTIONS MILEAGE	RURAL SECTIONS INTERCHANGES NUMBER	RURAL SECTIONS INTERCHANGES SPACING (MILES)	URBAN SECTIONS MILEAGE	URBAN SECTIONS INTERCHANGES NUMBER	URBAN SECTIONS INTERCHANGES SPACING (MILES)	SERVICE PLAZAS NUMBER	SERVICE PLAZAS SPACING (MILES)
Atlantic City Expressway (N. J.)	44	14	3.1	44	14	3.1	—	—	—	1	44.0
Connecticut Turnpike	129	92	1.4	77	40	1.9	52	52	1.0	7	18.4
Dallas-Fort Worth Turnpike (Tex.)	30	8	3.8	—	—	—	30	8	3.8	1	30.0
Everett Turnpike (N. H.)	39	13	3.0	25	4	6.2	14	9	1.5	—	—
Garden State Parkway (N. J.) [a]	172	82	2.1	137	52	2.6	35	30	1.2	9	19.1
New Hampshire-Spaulding Turnpikes	39	12	3.2	39	12	3.2	—	—	—	—	—
Illinois Tollways	187	50	3.7	115	19	6.1	72	31	2.3	5	37.4
Kennedy Memorial Highway (Del.-Md.)	53	14	3.8	53	14	3.8	—	—	—	2	26.5
Kentucky Turnpike	40	9	4.4	34	5	6.8	6	4	1.5	2	20.0
Merritt-Wilbur Cross Parkways (Conn.)	58	33	1.8	—	—	—	58	33	1.8	5	11.6
Mountain Parkway (Ky.)	76	13	5.8	76	13	5.8	—	—	—	—	—
Richmond-Petersburg Turnpike (Va.)	35	17	2.1	15	3	5.0	20	14	1.4	—	—
Total [b]	902	357	2.5	615	176	3.5	413	254	1.6	36	22.4

[a] Six rural service plazas (22.8-mi interval) and three urban service plazas (11.7-mi interval).
[b] Urban mileage totals include 126 mi and 73 interchanges on Indiana Toll Road, Massachusetts Turnpike, New Jersey Turnpike, and New York Thruway, service plaza totals include 3 from the New Jersey Turnpike and 1 from the New York Thruway.

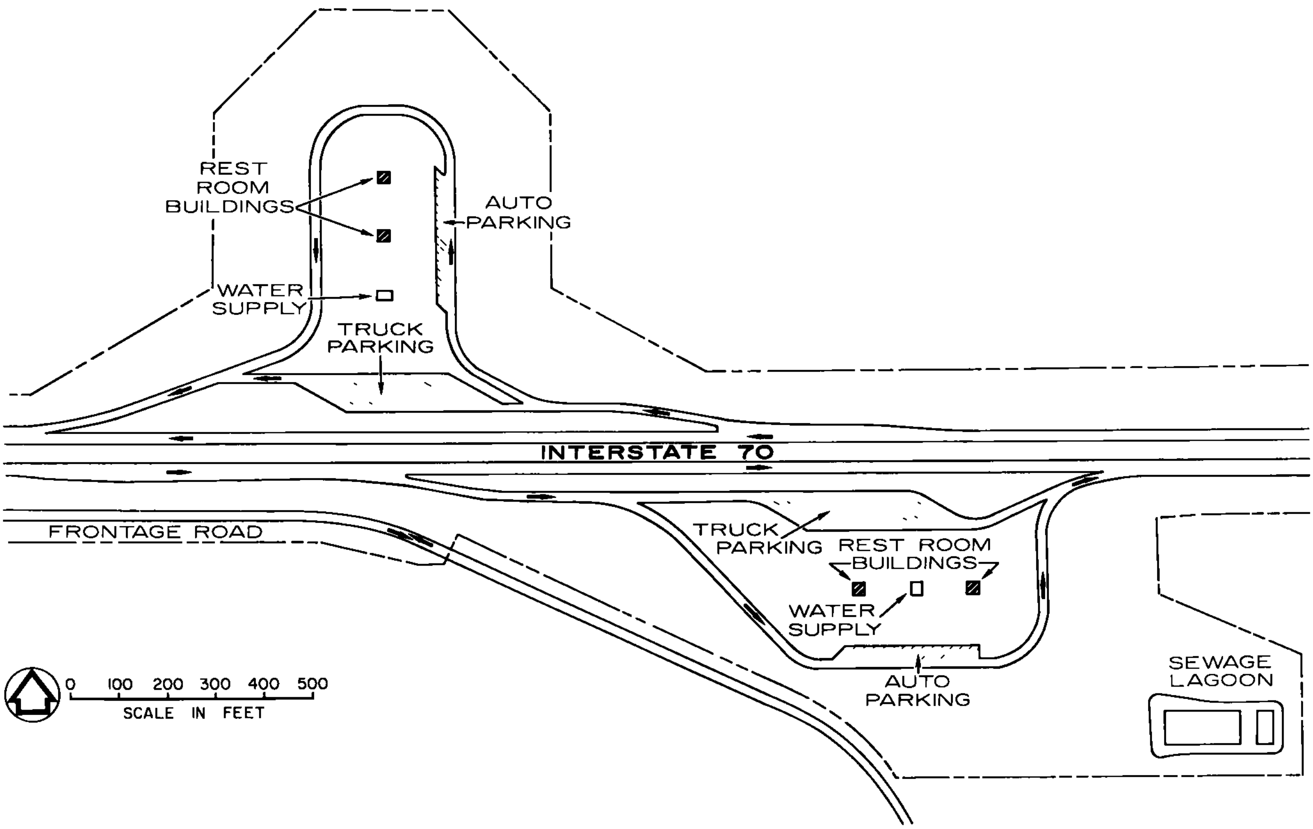


Figure 2. Missouri safety rest areas. Illustrated here is a pair of safety rest areas locate along I-70 in Cooper County, Mo. Various schemes have been employed in Missouri for the layout of rest area drives and parking bays, with the terrain and nature of vegetation as controlling factors. The eastbound rest area requires 15.8 acres of additional right-of-way, the westbound site involves an additional 14.4 acres. Maximum sidestrip widths are 635 ft and 875 ft, respectively.

along 70 miles of highway (a 12-mile interval), and the construction of an additional facility is contemplated for the Garden State Parkway along its busiest section (midway between two facilities now 23 miles apart). Four of the Illinois Tollway's five over-the-roadway service plazas are located within the Chicago area, spaced over about 80 miles of highway, or at a 20-mile interval.

At present, it does not appear that rest areas are contemplated for urban Interstate mileage in any of the major metropolitan areas. An indication of the magnitude of the opportunities involved is evident in the fact that 305 miles of Interstate route will be built in the Chicago urbanized area, and 393 miles in New York. In these two areas, Interstate mileage represents only 42 percent of the total freeway which has been proposed (*2*).

Although the spacing of rest stop opportunities between Interstate highways in selected states and the experience of interurban toll roads appear to be comparable, the nature of development at these rest sites is quite different. Federal statutes prohibit construction of road user services along Interstate rights-of-way and limit the development of safety rest areas to benches, tables, toilets, and water supply —where proper maintenance is assured. In spite of federal and state restrictions, the question of providing road user services on Interstate highways is by no means closed. Highway officials in a number of states and various toll road administrators have seriously considered the gradual upgrading of safety rest areas to the point where limited gas and food services, properly supervised, could be made available given appropriate policy directives. Whether such developments occur depends primarily on the manifestation of public demand for them.

SERVICE PLAZAS

The pros and cons of providing services to motorists on Interstate highways, as they have been explored in a number of research and policy discussions, reveal the complexity of the problem. Three interest groups are involved —highway users, suppliers of services, and various public road-building agencies—and the "best interests" of each in the provision of controlled-access highway services appear to be inherently at odds (*3*). Compounding the problem is a severe shortage of useful data on the behavior of road users in the purchase of such services. It would appear that the imposing magnitude of possible road user service commitments on the Interstate System (more than 1,000 pairs of safety rest area-service plazas at, for example, a 33-mile spacing interval) has dictated a wait-and-see policy on the part of all parties concerned. Lacking sufficient

evidence or justification to do otherwise, public road-building agencies have put the burden of proof upon highway users to demonstrate a significant demand for directly accessible services. As AASHO has stated *(4)*:

> The statutory prohibition against commercial activities on the Interstate right-of-way was enacted on the basis of the best available judgment in consideration of the anticipated physical and operating characteristics of Interstate freeways, governmental responsibilities, and the economic and business factors involved. When a representative number of long, toll-free sections have been in operation for several years in both rural and urban areas, it will be possible to see how well motorist service needs are being met and to evaluate more objectively the soundness of the basic policy which prohibits commercial activities on the rights-of-way. It will also be possible to obtain more definitive data regarding characteristics of Interstate travel, including trip-length trends.

A number of important questions are involved in the provision of road user services. With the highway user's interest in high-speed travel in mind, the delays which will inevitably result in seeking adequate services by leaving the highway at interchanges may be significant, particularly for the long-distance motorist. These time-costs have not received sufficient study. From the point of view of the suppliers of services, the development of road user services with preferential direct access from the highway represents the concession of monopolies to selected suppliers and could work to the detriment of free enterprise competition (although this argument seems weakened if competitive bidding for sites and an eventual variety of lessees were assured by the state). State highway departments see such services as an additional administrative burden, for prices and quality of services must be regulated to protect "captive" consumers. This may be a short-sighted view, however, in light of potential state revenues from lease arrangements.

Six states (Massachusetts, Connecticut, Delaware, Maryland, New Jersey, and Kentucky) are presently involved as lessors and regulators of services located on their highway rights-of-way, as are nearly all toll road authorities. The latter have been concerned with attracting maximum highway use (and extracting maximum revenues) through the provision of convenient services. Most of the state-owned service facilities were built during the early days of controlled-access highway construction when the adequate provision of services by private interests was definitely in doubt. Today, private development of adequate and rea-

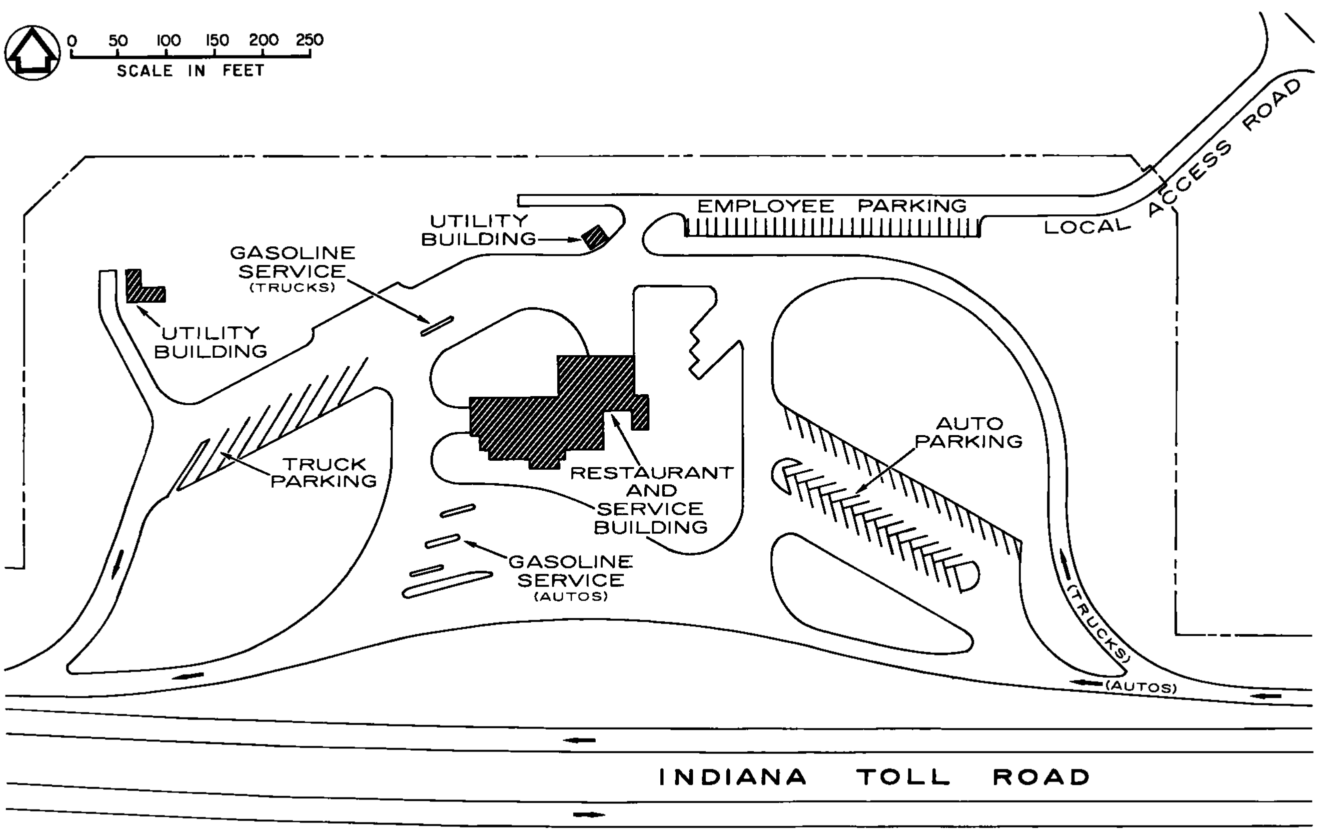


Figure 3. Indiana Toll Road service plaza. The Wilbur Shaw Service Area on the Indiana Toll Road occupies a site measuring 500 ft by 1,200 ft, representing an addition to normal right-of-way of roughly 14 acres. A similar facility is located adjacent to the eastbound roadway. Not all toll roads providing sidestrip service plazas have chosen to locate them strictly in pairs, although more than two-thirds of all toll road service stops have been built on dual sidestrip expansions of this type.

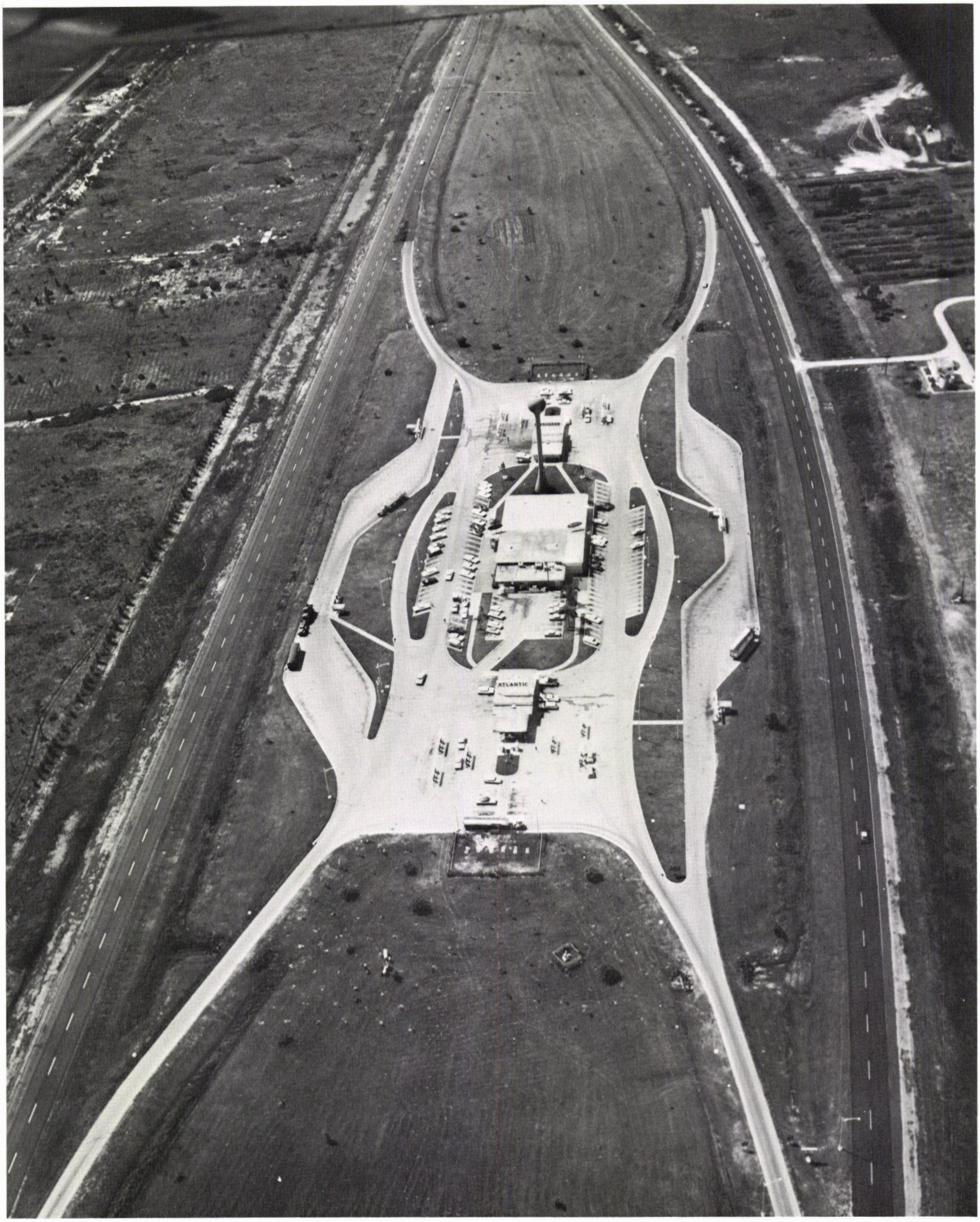


Figure 4. Florida Turnpike service plaza. The Fort Pierce Service Area on the Florida Turnpike (Sunshine State Parkway) is typical of many toll road service plazas which have been located in the median. Here, the median is roughly 550 ft wide, and the service and parking facilities (exclusive of entrance-exit lanes) some 1,200 ft long. Considerable additional land (more than 50 acres) was required to provide this development site.

sonably-spaced road user services at freeway interchanges still remains as a critical unknown in this controversy (see Table 10 for urban and rural interchange spacing data).

Proceeding on the basis of two broad assumptions, it is possible to get a clearer idea of regional variations in the potential demand for road user services on Interstate highways. The first assumption, supported by limited data, is that on long-distance trips motorists plan their travel so as not to have to stop for services (including rest stops) more frequently than every 100 miles. The second assumption is somewhat arbitrary, but appears entirely reasonable. If an Interstate highway passes through or within 10 miles of an urban community of 25,000 persons or more, it might be expected that acceptable road user services will be developed near at least one interchange with a cross-route leading to that community.

Examination of the 1960 Census reveals that of the 449 urbanized areas and urban places with a population of 25,000 or greater, some 257 urban centers (this reflects the grouping of some suburban communities into urban centers) will be interconnected by the 33,500 miles of rural Interstate highways under the criteria just mentioned. Taking into account the fact that some urban centers will be connected by more than one route, the average spacing interval between these major urban connections along the Interstate System is then 96 miles (Table 11). Thus, it would appear that, over the entire system, the likely minimum distribution of adequate road user services at interchanges will be roughly commensurate with the probable habits of road users seeking services (i.e., stops at about a 100-mile interval). However, the regional variations across the country shown by Table 11 indicate that in at least the four western regions, road user services developed by private enterprise may not occur with sufficient frequency.

Perhaps a third assumption involved is that the development of services in sparsely populated rural areas is unlikely. Certainly, the development of desirably spaced, high-quality services over long stretches of rural highway seems improbable without some form of governmental encouragement. In situations of this type, each rural interchange will offer roughly the same potential for development to private enterprise; it would seem more logical, however, if every sixth or seventh interchange were developed to provide high-quality services and if low-quality services were discouraged at the other interchanges. Expected volume of traffic is an important factor here, of course.

These eventualities were noted nearly 10 years ago, when, in referring to the development of services entirely by private enterprise, the National Highway Users Conference stated (*5*):

> This method (i.e., private enterprise development at interchanges) of providing service facilities to the highway user works well as long as sizable communities exist at reasonable intervals and the expressway does not pass too far from such towns or cities. However, in the less populated areas of the country it would seem necessary to provide other plans for facilities and access thereto at reasonable intervals . . . of course, in rural areas (particularly in the western part of the country) where the interchanges are less frequent, service facilities may necessarily be required at strategic areas established between interchanges.

It is interesting to compare the regional variations in urban center spacing along the Interstate System (Table 11) with the same type of data for interurban toll roads (Table 8). The results indicate that most toll roads have been built within urbanized corridors, with an average urban center spacing of 47 miles. This figure approximates the Interstate spacing of urban centers in the two most heavily urbanized sections of the country, the Middle Atlantic states (48 miles) and the Northeast states (49 miles). Thus, it would seem that, regardless of the development which might take place at interchanges, the provision of road user services on highway rights-of-way throughout the country remains an important issue. Certainly the success of toll road service plazas indicates that many road users tend to pay little attention to the location of nearby cities or possible interchange services, if they are given a choice.

A worthwhile study in this connection might be the evaluation of the provision of services *at interchanges* along the 2,550 miles of interurban toll road. A study of this kind should also attempt to determine the allocation of road user purchases among facilities both on and off the right-of-way. Similarly, it seems plausible that longer sections of Interstate highway which have been in operation for some time (as in Michigan, for instance) and which carry comparable volumes of traffic could be compared with appropriate sections of toll road. Here the extent and nature of interchange development along these two mileage samples would be important. Presumably, the fact that rural Interstate interchanges are spaced more than twice as frequently as those on interurban toll roads (Tables 8 and 10) would be of major influence. Also important would be the delay at toll plazas, and the possible extra cost associated with getting off and on the toll road to seek services at interchanges.

SCENIC OVERLOOKS

At present, scenic overlooks have been planned or completed in conjunction with controlled-access highway construction in some 20 states. The location of such facilities depends, of course, on factors of natural beauty and favorable route location in scenic areas. In general, it appears that many of these states have planned their scenic overlooks to supplement their system of safety rest areas. In other words, rest areas have been located according to some general spacing criterion (with full advantage taken of any scenic opportunities), with smaller-scale overlooks then being planned for other appropriate points along the system. Alabama's experience in locating these facilities may be typical: safety rest areas are being planned at intervals of from 20 to 50 miles and require about 12 acres of land each. Appropriately located scenic overlooks consist of about 3 acres each.

Although many of the states contemplating scenic overlooks may provide only simple turn-out and parking facilities, the possibility exists that increasing public use will

TABLE 10

INTERCHANGE SPACING ON INTERSTATE HIGHWAYS

	RURAL			URBAN			
		INTERCHANGES			INTERCHANGES		
ITEM	MILE-AGE	NO.	SPACING (MI)	MILE-AGE	NO.	SPACING (MI)	TOTAL INTER-CHANGES
Ten continuous sections of Interstate [a]	2,439	461	5.3	192	115	1.7	576
Total Illinois mileage [b]	1,356	243	5.6	276	192	1.4	435
Total for sample	3,795	704	5.4	468	307	1.5	1,011
Interstate System projections [c]	33,599	6,461	5.2	5,500	3,667	1.5	10,128

[a] See Appendix C for route locations.
[b] Existing and programmed, as reported by Illinois Division of Highways.
[c] Excludes major toll road Interstate mileage (1,901 miles): Illinois Northwest Tollway (76), Oklahoma Turnpikes (174), Florida Turnpike (45), Indiana Toll Road (157), Kansas Turnpike (187), Maine Turnpike (59), Massachusetts Turnpike (135), New York Thruway (500), Ohio Turnpike (206), and Pennsylvania Turnpike (362).

eventually demand that they be developed along the lines of safety rest areas (where feasible). Several states, particularly California and Wisconsin, have active scenic highway programs in which opportunities to reflect natural beauty in route design are studied in each new route location.

TABLE 11

URBAN CENTER SPACING ALONG THE INTERSTATE HIGHWAY SYSTEM [a]

REGION	RURAL INTERSTATE MILEAGE [b]	URBANIZED AREAS CONNECTED [c]	ADDITIONAL MULTIPLE CONNECTIONS	URBAN PLACES CONNECTED [d]	ADDITIONAL MULTIPLE CONNECTIONS	TOTAL URBAN CONNECTIONS	SPACING INTERVAL (MI)
Northeast	1,120	14	2	7	0	23	49
Middle Atlantic	1,109	11	5	7	0	23	48
East North Central	4,219	34	21	20	1	76	55
West North Central	4,677	13	7	13	1	34	138
South Atlantic	5,002	27½	14½	20	4	66	76
East South Central	3,007	12	11	12	0	35	88
West South Central	4,325	24	9½	4	0	37½	115
Mountain	7,083	13	7	10	4	34	208
Pacific	2,880	12½	5	3	0	20½	140
Total	33,492	161	82	96	10	349	96

[a] See Appendix C for a complete listing of urbanized areas and urban places which are inter-connected by controlled-access highways; both Interstate and major toll road connections are included
[b] Excludes urban Interstate (5,500 miles), toll road Interstate (1,901 miles), and Hawaiian and pending mileage (107 miles). To derive rural Interstate mileage within each region, it was necessary to allocate urban Interstate mileage (which was then subtracted from total mileage) according to urban population within each region.
[c] Urbanized areas contain at least one city with a population of 50,000 or greater. Thirteen of the 212 urbanized areas identified by the 1960 Census have been deleted via metropolitan grouping. Fourteen additional urbanized areas are connected by inter-urban toll roads, so that 88 percent of all spatially distinct urbanized areas (total 199) are inter-connected by controlled-access highways.
[d] Urban places contain a population of 25,000 to 50,000. Sixty-one of the 237 urban places identified by the 1960 Census have been deleted via metropolitan grouping. Eleven additional urban places are connected by inter-urban toll roads, so that 61 percent of all spatially distinct urban places (total 176) are inter-connected by controlled-access highways.

Figure 5. Palisades Interstate Parkway scenic overlook. Scenic overlooks are appropriate, of course, only for sections of highway traversing particularly scenic areas. The Rockefeller Lookout on the Palisades Interstate Parkway, located in the New Jersey Palisades area, affords a fine view of the Hudson River Valley.

TRUCK WEIGHT STATIONS

Recent developments in the technology of truck weighing scales, combined with the successful application of portable scales by various state police departments, make questionable the future prospects for truck weight stations as a multiple use of right-of-way. If portable scales are used (as in New York), there will be little need for special weight stations in conjunction with controlled-access highways (safety rest areas could be used, if properly designed, for portable scale operation). Connecticut, on the other hand, plans to build five permanent weight stations, located near the state line along its Interstate mileage.

Whether permanent or portable regulation techniques are adopted by individual states, recent experimental work in Michigan, Texas, and Kentucky gives strong evidence that in-motion weighing at highway operating speeds will become more important in the future. In this event, the in-motion weight station along I-94 at Grass Lake, Mich., may represent an important prototype for permanent truck weight installations.

Only 13 state highway departments (according to the questionnaire survey) indicated that weight stations along controlled-access highways were planned or built under their jurisdiction. The possibility exists that other states may also eventually construct such facilities, with such decisions usually involving both state police and state highway departments.

TANDEM TRAILER AREAS

On three of the nation's interurban toll roads, special marshalling areas have been provided within the right-of-way for the assembly and break-up of tandem trailer trucking units. Such areas are necessary either because tandem trailer combinations are prohibited from using state highways, or because their overall lengths (up to 108 ft) exceed those permitted on state highways. These so-called "double-bottoms" offer certain obvious advantages to trucking firms, for one driver is able to haul two loads.

The New York Thruway was the first to authorize the operation of 108-ft doubles in 1959, and annual tandem trailer mileage on the Thruway has steadily increased. Data on average trip length for a typical month (Table 12) indicate that roughly two-thirds of the Thruway's tandem trailer mileage represents medium-range trips (200 to 300 miles). Only 15 percent of overall mileage involved trips over 300 miles in length. Truckers bound from Boston to Chicago are able to travel 519 miles with tandem trailer combinations to the New York-Pennsylvania border (via the Massachusetts Turnpike and the New York Thruway). They are then required to break up and travel in single trailer units some 127 non-toll miles (via I 90) to the Ohio Turnpike. At the Turnpike they are permitted to reassemble in tandem combinations and proceed the remaining 336 miles (from Ohio Turnpike Interchange 12) to Chicago

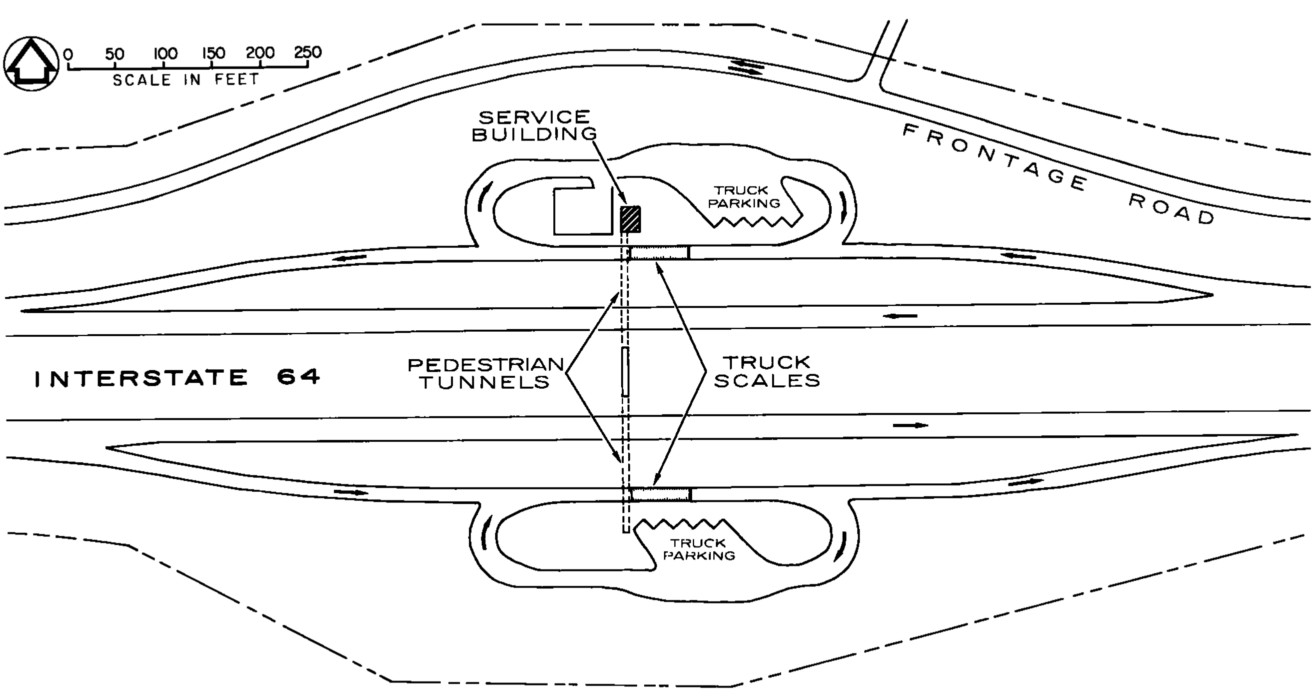


Figure 6. Virginia truck weight stations. These truck weight stations are located along I-64 in Virginia. Normal sidestrip width of 72 ft has been expanded to 250 ft to accommodate each facility (with 50 ft additional for the service road). The additional right-of-way required for the eastbound station is 5.4 acres. Note that pedestrian tunnels under the freeway lanes allow both weighing areas to be administered from a single building

Figure 7. Connecticut safety rest area-truck weight station. The combination of different types of multiple uses at a single site may be appropriate in some situations. A major safety rest area and truck weight station have been proposed along I-91 near Wallingford, Conn. The site is in excess of 50 acres in size. Note that the truck weight station and related parking facilities would be well screened from both the roadway and surrounding automobile parking and picnic areas.

Figure 8. New York Thruway tandem trailer area. Tandem trailer parking facilities at the Suffern Route 17 interchange of the New York Thruway have received heavy use, and the development of additional parking areas in the near vicinity is contemplated. In addition to the five parking areas shown here, two others are located just off the bottom of the photo. The toll plaza (serving both directions) is located at left center. Tandem trailer trucking operations must break up here before traveling on other New York or New Jersey highways, with the principal demand at this interchange being exercised by New Jersey truckers. A number of the "dollies" used to connect trailer units may be seen in the foreground.

(at the Indiana state line), completing the route via the Indiana Toll Road. Any make-up and break-up areas needed on the Ohio Turnpike and the Indiana Toll Road must be provided privately, off the right-of-way, with state permits allowing operations between these sites and the nearby toll roads. According to Turnpike officials, operation of double-bottoms on toll roads and turnpikes has apparently not presented any significant problems in terms of their effect on other traffic.

The Massachusetts Turnpike, the New York Thruway, and the Kansas Turnpike have indicated that the location and provision of tandem trailer make-up and break-up areas along their routes has been determined simply on the basis of individual consultation with the trucking firms involved. These toll roads have provided, respectively, 3, 21, and 4 tandem trailer facilities at interchanges where demand for them was expressed. In addition, the Oklahoma Turnpike has leased interchange right-of-way land for development of a truck relay terminal near Miami, Okla.

A number of factors are important in considering the future potential of tandem trailer areas as a multiple use of right-of-way. Along toll-free routes of the Interstate System, such provisions would clearly benefit private trucking concerns. The states might realize some income from the venture through leasing of right-of-way for tandem trailer areas to trucking companies. Private development of such facilities near interchanges would represent another possibility for accommodating tandem trailer operations on controlled-access highways.

Tandem trailer combinations are now permitted in 29 states, but only 18 of these allow lengths up to 65 or 70 ft. No special provisions have been made for tandem operation on Interstate highways.

Opinion varies as to the preference of the trucking industry for different *sizes* of doubles (even triples are operated in California). In fact, with experience in tandem trailer combinations over 70 ft in length limited largely to the five toll roads previously mentioned, useful speculations are difficult. The trucking industry has gone on record in favor of a 70-ft limit on combinations operated over primary state highways, with this limit extended to 110 ft for Interstate highways (6). In this event, tandem trailer areas—either publicly or privately built—would seem necessary as part of the Interstate System. The most likely occurrence is that progress in Interstate construction will stir the various state highway departments to uniformity in finally adopting the 65-ft combination length limit recommended by AASHO, at least on their Interstate freeways. Of course, this would still require truckers to break up their 110-ft units when they leave the toll roads.

Finally, there can be little question that markets and conditions will exist whereby the operation of *all* sizes and combinations of tandem trailers will be desirable for some segment of the trucking industry. Whether publicly-built tandem trailer areas should be considered for selected interstate trucking corridors (via controlled-access highways), or for certain freeways within various states, represents a difficult policy question for the individual states. Certainly a good many additional data regarding the impact of such facilities upon the national and regional economies would be useful in making these decisions.

TABLE 12

NEW YORK STATE THRUWAY TANDEM TRAILER OPERATIONS [a]

LENGTH OF HAUL	NO. OF FIRMS	NO. OF TRIPS	TOTAL MILES	AVG. TRIP LENGTH (MI)
Long	6	584	203,781	349
Medium	12	4,167	913,464	219
Short	14	1,863	260,394	140
All	32	6,614	1,377,639	208

[a] Source: New York State Thruway Authority Data are for July 1966. Average trip length for first six months of 1966 was 208 miles Long-haul carriers traveled 15 percent of total mileage; medium-haul, 66 percent, and short-haul, 19 percent.

OTHER USES

Rising standards of living, increasing amounts of leisure time, and increasing mobility have had a strong influence in accelerating the rapidly growing demand for outdoor recreational facilities over the past few years. One of the direct manifestations of this growth has been the steady increase in the sale of travel trailers by mobile home manufacturers. The Mobile Home Manufacturers Association reports a 700 percent increase in travel trailer shipments to dealers (from 15,400 units in 1956 to 107,600 units in 1965). Similarly, camping trailers have grown from 18,000 units in 1961 to 67,200 units in 1965 (370 percent increase), while pick-up coaches have increased from 29,000 units to 85,000 units (290 percent increase) during the same period.

In recognition of the increasing presence of long-distance travel trailer motorists, the Ohio Turnpike has established six overnight travel trailer parking facilities at selected service plazas. Four of these provide a separate paved parking area for 8 to 10 trailers, a central safe drinking water station, and a central holding-tank disposal station. No fee is charged and the facilities are used heavily in season. The remaining two installations provide parking for 20 trailers, the same central water and disposal stations, plus electrical outlets and waste-water drains for each space. A $2 fee is charged, and these areas have not been used as heavily as the free areas. At all six parking areas, occupancy is limited to one night.

There are strong indications that as toll road service plazas and Interstate rest areas experience the growing presence of travel trailers seeking overnight parking space, special accommodations such as those described may become necessary. The prospect is not an appealing one to many highway and toll road officials, for the maintenance problems presented are significant. In many states, the

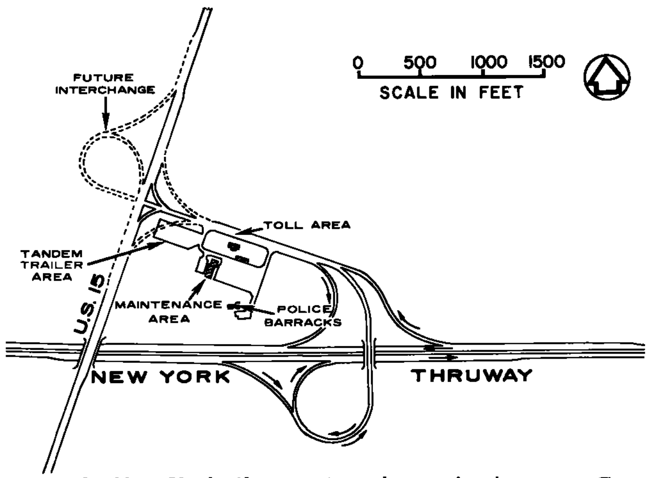


Figure 9. New York Thruway interchange development. Geometric design policies for New York Thruway interchanges have often produced sizeable land areas between the Thruway, the cross-route, and the toll areas. One of the largest of these sites (35 acres) is located at the West Henrietta U.S. 15 (No. 46) interchange. The tandem trailer area occupies 1.3 acres and the maintenance area roughly 4.5 acres. Two-thirds of the Thruway's tandem areas occupy ramp interiors of this type, and a number of police barracks and maintenance areas have been similarly located.

construction of such facilities may appear to be more the responsibility of state conservation and park departments than the highway department. Still, long-distance travel trailer motorists are quite likely to feel that safety rest areas should recognize their needs as well as those of truckers and automobile motorists. Perhaps as an indication of things to come, the New York Thruway currently is giving thought to following the Ohio Turnpike lead, and limited provisions for overnight trailer parking already have been made by the state highway agency in Minnesota.

Another direct response to the increasing demand for outdoor recreational facilities is the current construction of the Garden State Arts Center within the right-of-way of the Garden State Parkway in New Jersey. This cultural-recreational development will be located 30 miles south of Newark, involving some 250 acres of Telegraph Hill Park's 350-acre expanse. The latter represents the major facility among the nine picnic and rest areas located along the Parkway. Among the facilities involved in this development are an outdoor amphitheater seating 4,800 persons, sloping lawn accommodations for another 5,000, art exhibition mall, nature trails, 2,000-car parking lot, Monmouth County Art-Nature-Science Museum, botanical gardens, and drama theater. Parkway authorities clearly have a major, regional cultural facility in mind.

Although this example is unique, in that Telegraph Hill Park was not acquired for a specific highway purpose during the original planning of the Parkway, there are important implications here for the coordination of freeway right-of-way acquisition with the development of major cultural-recreational centers. Direct freeway access to such facilities may well be desirable and is certainly an integral part of the Garden State Arts Center design.

The Anthony Wayne Recreation Area, a similar regional facility located 40 miles north of New York City, also incorporates direct freeway access (Figure 11). Although federal statutes prohibit the development of active recreational or major picnic facilities (other than normal safety rest areas) within the right-of-way of Interstate highways, the *orientation* of freeways to major cultural-recreational areas developed by other agencies remains a distinct possibility. This might involve both the adjustment of route alignment and the provision of direct ramp connections in order to improve the regional accessibility of such sites. Where direct access is provided, at least a minimal indirect multiple use of highway lands is implied.

Two states—California and Florida—have developed agricultural inspection stations within freeway rights-of-way. In Florida these have been developed in conjunction with truck weight stations and have required only small increases in the land area otherwise needed for these stations. Only one such facility presently is located on an access-controlled highway in California, and it is expected that this will be incorporated into a proposed safety rest area. In general, agricultural inspection stations appear to be similar to overnight travel trailer parking facilities in that they can easily be combined with other multiple uses oriented toward the freeway user. If developed separately, they would be practically identical to truck weight stations in design and land requirements. The demand for highway-related agricultural inspection facilities seems to depend on the administrative convenience associated with alternative inspection procedures, a decision resting with state agriculture departments.

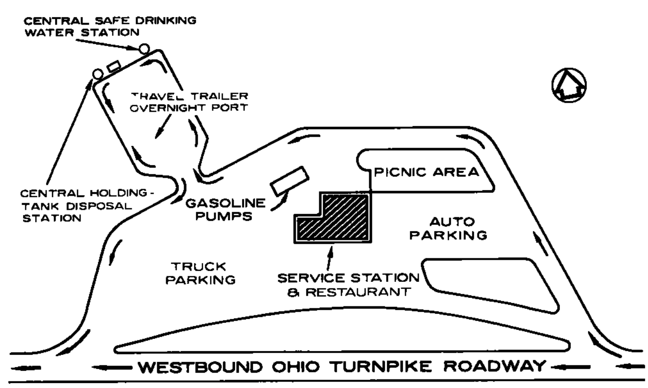


Figure 10. Ohio Turnpike travel trailer parking. This schematic site plan (not to scale) indicates the location of overnight travel trailer parking facilities at the Blue Heron Service Plaza on the Ohio Turnpike. Space for 20 trailers is provided, requiring roughly ¼ acre of additional paved parking area. Similar facilities have been provided at five other service plazas, although four of these provide only 8 to 10 trailer parking spaces. Reference to Figures 2, 3, and 26 indicates that the necessary space for such facilities can usually be found within existing service plaza and safety rest area designs.

Figure 11. Palisades Interstate Parkway recreation area. The Anthony Wayne Recreation Area on the Palisades Interstate Parkway, located some 40 miles north of New York City, represents a successful example of the coordination of freeways with major recreation facilities. Swimming, picnicking and hiking are among the activities offered here. Capacity of the directly-accessible parking lot is more than 2,000 vehicles, and additional parking for 750 vehicles recently has been provided in a cleared area shown at the top of the photo.

CHAPTER FOUR

MULTIPLE USES RELATED TO THE SURROUNDING AREA

A second major category of multiple use consists of those activities which are not strongly related to the freeway user. Use of freeway rights-of-way for these activities has usually been the result of convenience, coincidence of location, or the ability to coexist with the freeway without adverse effect on traffic. The survey and literature review identified a wide range of such uses, which is somewhat indicative of the broad potential for them in the future.

PUBLIC TRANSIT FACILITIES

Two types of public transit facilities have been associated with freeway rights-of-way in urban areas—exclusive transit lanes with stations and passenger stop turn-outs for buses operating with other freeway traffic. In both instances, transit stops or stations have usually been located at cross-streets. In the case of buses operating with other freeway traffic, stops have usually been located near ramp intersections with cross-streets to facilitate transfers from surface street routes.

In general, exclusive transit lanes (whether rail or bus) seem appropriate and feasible only where relatively high-density corridors coincide with projected freeway construction or where coordinated with an ambitious park-and-ride and feeder bus system. Broadly, such circumstances seem likely only within metropolitan areas with populations in excess of about 1,000,000. Given favorable demand circumstances, the well-developed coordination of freeway and transit planning is also a prerequisite.

Bus operations in the freeway traffic stream (whether freeway stops are included or not) offer a less expensive alternative for meeting major transit demands. It appears that such operations could be feasible in metropolitan areas with populations over 200,000.

Median rail transit facilities are operating in two states (California and Illinois), and other exclusive transit lanes are in various planning and proposal stages under six other jurisdictions. The rapid transit line operated by the Chicago Transit Authority in the median of the Eisenhower Expressway has led to the impending construction of other median facilities in the Chicago area. Median strips have already been reserved in the Ryan, Kennedy, and Stevenson Expressways, with exclusive bus lanes, rather than rail, proposed for the last.

The Southern Pacific Railroad operates a commuter line within a freeway median (on its own property, however) in California, and the New York Central Railroad also operates a commuter line on privately-owned sidestrips immediately adjacent to the Massachusetts Turnpike in Boston. These two examples, as well as other railroad operations within privately-owned median areas in Oklahoma and New York, are indications of freeway right-of-way acquisitions made around existing rail lines. However, they are indicative of the fact that such facilities can co-exist with freeways and represent a promising multiple use.

A plan for the coordination of an existing rail line, a proposed rail transit line, and the proposed Southwest Expressway in Boston includes portions of the transit line located within the expressway right-of-way. In San Francisco, the Bay Area Rapid Transit System will locate some of its mileage within freeway medians and sidestrips at four different locations: (1) Oakland's Grove-Shafter Freeway (median, 3.5 miles) where simultaneous freeway-transit line construction is under way, (2) State Route 24 in Contra Costa County (median, 6.5 miles) where the existing freeway is to be rebuilt, (3) San Francisco's Southern Freeway, I-280 (sidestrip, 3.5 miles), and (4) State Route 238 between Hayward and Fremont (sidestrip, 8 miles) where transit line construction will precede freeway construction.

Median bus lanes have been proposed in Miami, Fla., and also have been considered by the New Jersey Turnpike as part of its widening program in northeastern New Jersey. The District of Columbia and Virginia have been involved in proposals for median transit facilities in the Washington Metropolitan Area, and exclusive median bus lanes also have been proposed in Baltimore.

Passenger stops for exclusive transit lanes may require increases in normal urban freeway median widths to accommodate platforms and stair or escalator connections to cross-streets (minimum median width needed is approximately 50 ft). Similarly, where directly adjacent turn-outs and stops are provided for buses operating in freeway traffic, limited additional right-of-way may be required. Stops of this type under cross-street structures will generally require a widened bridge span. Thus far, most experience has been with bus stops on interchange ramps. Ample space for turn-outs is usually available at interchanges, for the actual land requirements are relatively small. The appropriate locations for such stops in terms of safety and access within different types of interchanges are illustrated in AASHO's *Policy on Arterial Highways in Urban Areas* (*7*).

There are two types of express bus operations which have been routed over freeways—individual routes which make no stops along the freeway, and trunk-line routes which do make such stops. To date, freeway bus service has been predominantly of the individual-route type (Table 13). However, as one study in this area has remarked (*8*):

> The need for and location of bus stops on existing and future freeways deserves careful analysis, based on transportation data of the region. Only where the trunk-line type of service is envisioned (as in the proposed Stevenson Expressway in Chi-

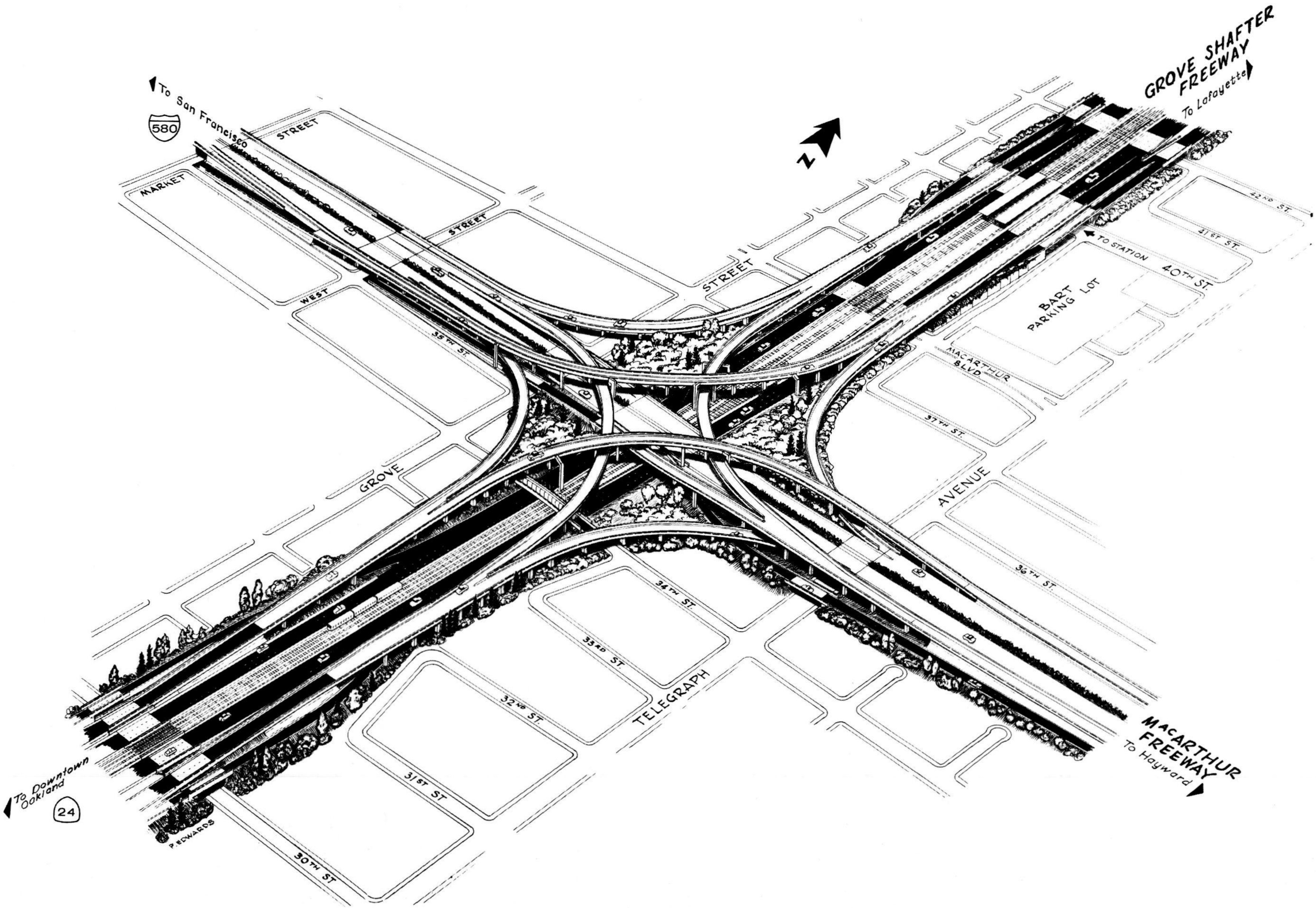


Figure 12. California median rail transit. The San Francisco Bay Area Rapid Transit System will utilize freeway right-of-way extensively for its lines and stations—both median and sidestrip areas. The interchange between the MacArthur and Grove Shafter Freeways in Oakland illustrates the accommodation of median transit facilities under complex highway design conditions.

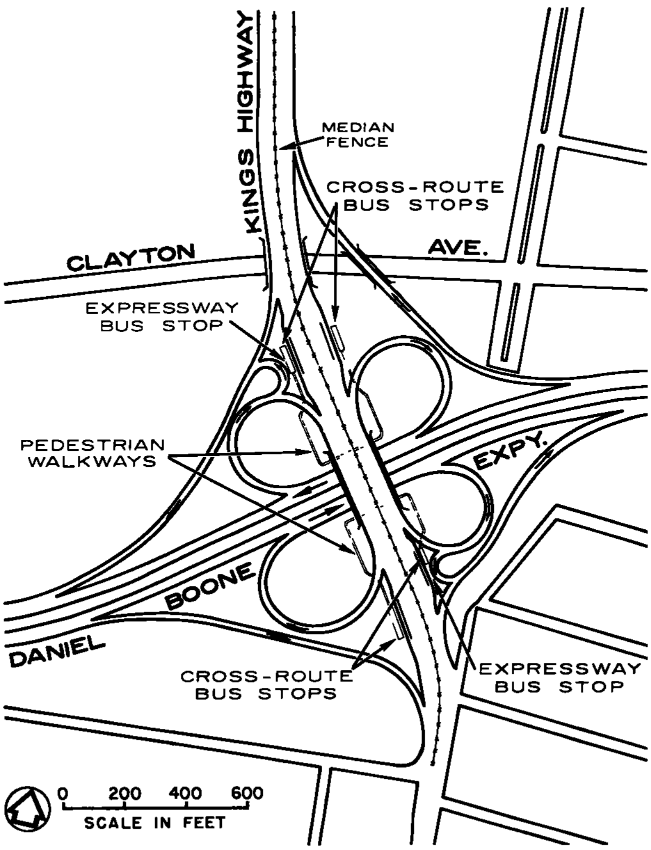


Figure 13. St. Louis interchange bus stops. Another type of expressway bus stop, located in St. Louis at the Kings Highway interchange of the Daniel Boone Expressway, is shown. Expressway buses are required to make an S-type movement via an inter-ramp connector. Each expressway bus stop is directly adjacent to a local cross-route stop, and is also linked to the opposite-side local stop by a pedestrian walkway.

cago) would an extensive system of loading facilities seem warranted in intermediate areas. At special locations, bus stops may be needed for individual-route type of operation. . . . Stops may be established outside the interchange area if the geometric layout allows buses convenient reentry to the freeway, and if passengers do not have to walk excessive distances. Otherwise, bus stops should be built in the interchange area. At some locations, bus stops may also be necessary between interchanges.

Freeway bus operations are growing—at least six cities inaugurated such service between 1957 and 1963 (Table 13). All of the 10 metropolitan areas with populations over 2,000,000 have some form of freeway bus operation, and in four of these freeway bus stops have been built or are planned. Ten of the remaining 13 metropolitan areas with populations over 1,000,000 also have provided freeway bus service, but only one of these had built (by 1963)

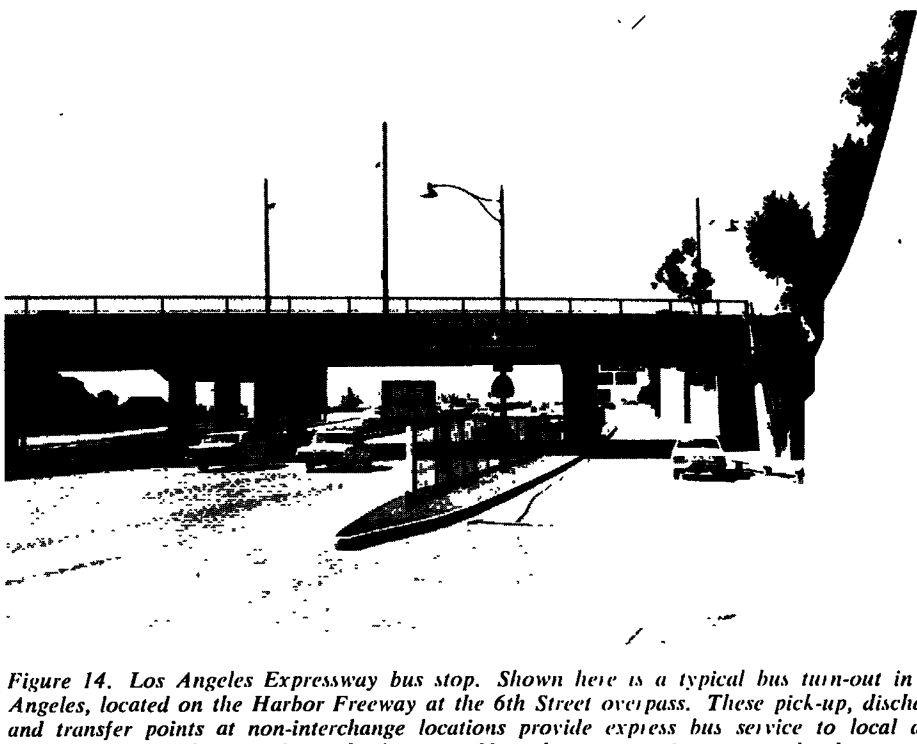


Figure 14. Los Angeles Expressway bus stop. Shown here is a typical bus turn-out in Los Angeles, located on the Harbor Freeway at the 6th Street overpass. These pick-up, discharge, and transfer points at non-interchange locations provide express bus service to local areas without requiring buses to leave the freeway. Note the access stairs to street level.

Figure 15. St. Louis Expressway bus stop. Bus stop provisions have been made at 10 locations along the St. Louis Expressway system. Although nearly all such facilities, both here and in other cities, have been associated with cross-route interchanges (see Fig. 13), this stop is located between interchanges. It was established to serve a concentration of nearby industrial land-use and differs from the Los Angeles stop in Figure 14 in that it does not coincide with a vehicular overpass of the expressway. A pedestrian overpass connects bus stops and serves land-use on both sides of the Mark Twain Expressway.

TABLE 13

EXPRESS BUS OPERATIONS ON FREEWAYS

SMSA RANK	METROPOLITAN AREA	1957 [a]	1963 [b]	BUS STOP FACILITIES
1	New York	o	NA	—
2	Chicago	*	5	—
3	Los Angeles		26	10
4	Philadelphia	—	15	—
5	Detroit	*	5	—
6	San Francisco	*	34	1
7	Boston	o	NA	—
8	Pittsburgh	*	3	—
9	St. Louis	*	21	10
10	Washington	o	3	1
11	Cleveland	*	2	—
12	Baltimore	—	2	—
14	Buffalo	—	12	—
15	Houston	o	NA	—
18	Dallas	*	6	—
19	Cincinnati	o	9	—
20	Kansas City	o	NA	—
21	San Diego	o	3	2
22	Atlanta	*	25	—
23	Miami	—	1	—
33	San Antonio	o	2	1
40	Rochester [c]	—	NA	Several
48	Sacramento	—	1	—
56	Richmond	—	1	—

[a] o Indicates limited operations; * indicates nine cities included in 1957 study

[b] Values indicate number of freeway bus routes in operation

[c] Operations inaugurated since 1963

Sources: 1957 data, Ref (*8*); 1963 data, Ref. (*20*)

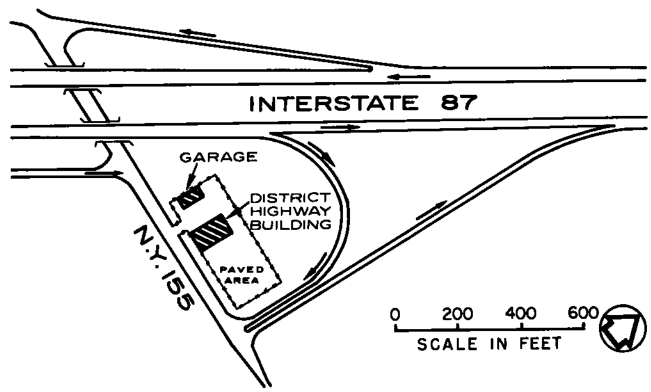


Figure 16. New York interchange maintenance area. An example of ramp interior development is demonstrated in this Albany County (New York) maintenance area constructed along I-87 (State Route 155 interchange). Direct access to the site is from the local cross-route only, though the controlled-access facility is readily accessible via interchange ramps. The total enclosed area consists of 6.0 acres, while the developed site covers 1.8 acres. Resident engineer offices will also be located here.

freeway stop facilities. Los Angeles and St. Louis, each of which has provided 10 freeway bus turn-outs within the highway right-of-way, offer interesting contrasts in the demand conditions which may warrant such service. A relatively high volume of crosstown transfer traffic to and from surface routes is handled by Los Angeles' freeway stops during peak-hour operation. St. Louis, on the other hand, offers core-dominated radial service, and its intermediate freeway stops serve primarily to collect additional passengers going to and from the downtown area.

HIGHWAY MAINTENANCE FACILITIES

In acquiring freeway right-of-way, both the scale of the undertaking and the size of many of the parcels involved have suggested to a number of states the possibility of developing highway maintenance yards on unused right-of-way. In some cases, highway maintenance and storage facilities may be developed on sites acquired especially for that purpose; in others, remnant parcels of adequate size might be utilized. Such facilities include garages or shops for the storage and service of highway maintenance equipment, as well as major material supply depots. On a small scale, less imposing provisions for the storage of aggregate, snow control materials such as sand and salt, and landscaping materials might also be made. In these cases existing right-of-way, without additional land acquisition, may often prove suitable. Most of the major toll road authorities (75 percent) also have developed maintenance and storage facilities within their rights-of-way.

Although several early developments of this type provided access to maintenance areas directly from the freeway, it is now generally agreed that only local, non-freeway access should be permitted (*9*). Nevertheless, median storage areas have been constructed in at least three states (Table 14). In a number of examples (along both toll roads and state-built freeways) direct freeway access to maintenance areas built on sidestrips also has been permitted. Although it might be argued that adequate speed-change lanes associated with these developments would eliminate hazards which might be involved, such lanes usually have not been provided.

Because many maintenance facilities of this type are used infrequently or are used only during low-volume traffic conditions, it might seem reasonable that, where adequate sight distance prevails, direct freeway access is not unduly hazardous. As a general rule, however, the location of maintenance storage facilities within interchange areas (on sidestrips, ramp interiors, or under structures) with cross-route access, or on sidestrips with frontage road access, should receive priority consideration. With these restrictions in mind, the development of maintenance facilities along freeway rights-of-way appears to be a multiple use of potentially wide application, dependent only on policy decisions of the various state highway departments.

HIGHWAY AND STATE POLICE OFFICES

The development of highway or police administrative offices as a multiple use of right-of-way parallels that of maintenance storage areas in most respects. An important difference seems to be that office-type facilities are not as

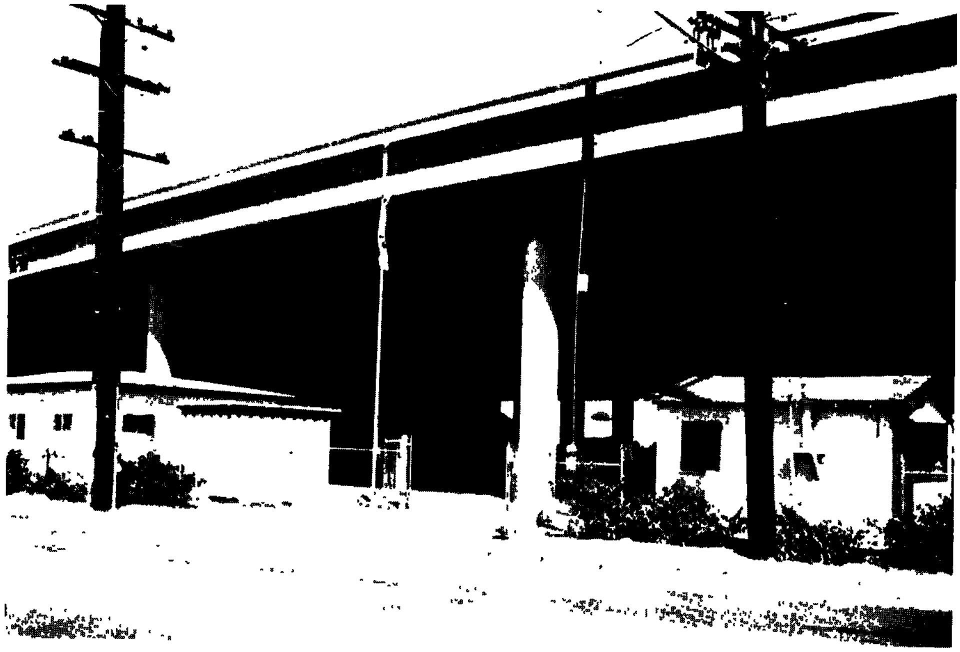


Figure 17. California understructure maintenance area. Twenty highway and landscape maintenance stations have been located beneath elevated sections of freeways in the Los Angeles area. These sites range from 0.28 to 4.27 acres, with an average size of 1.12 acres. Shown is the Sawtelle landscape maintenance station, located at the interchange of the San Diego Freeway and I-10.

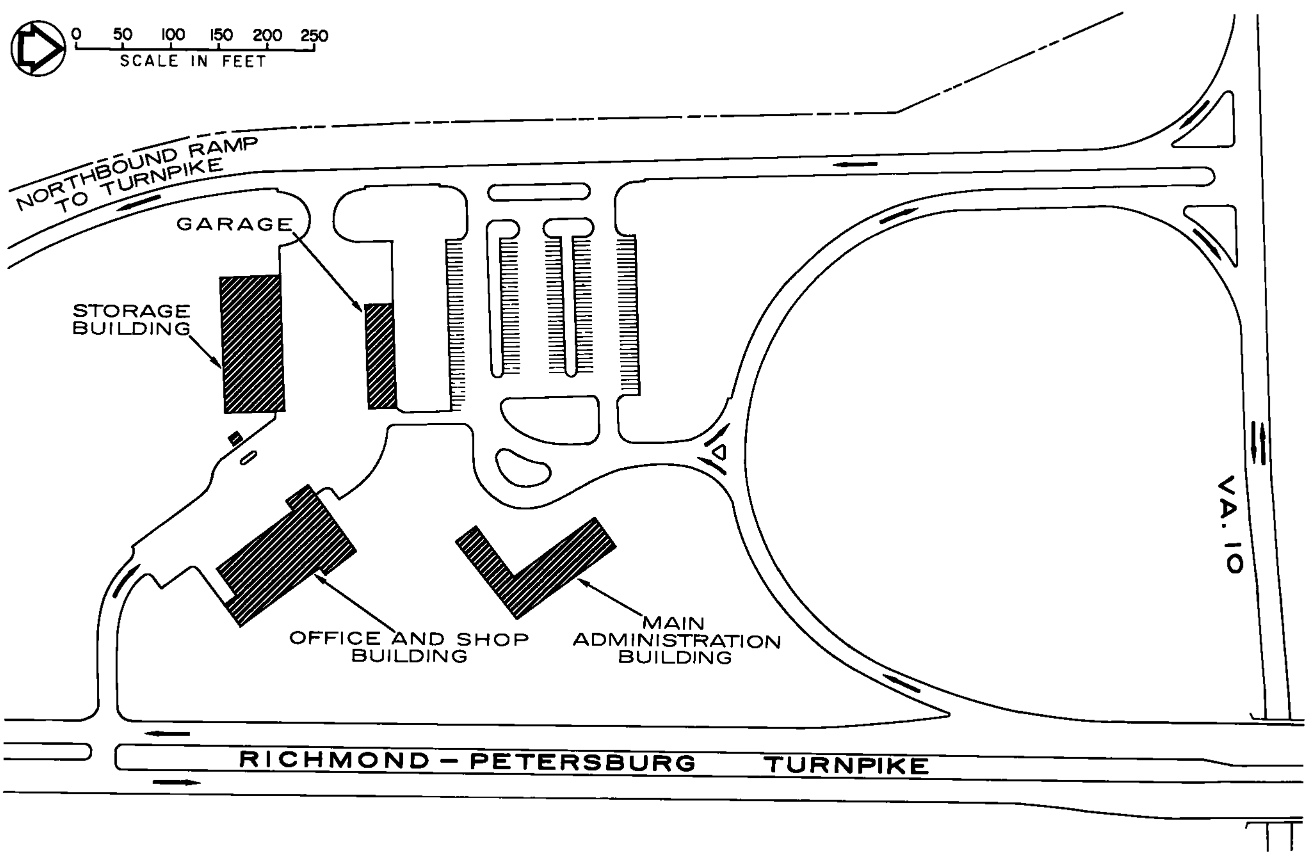


Figure 18. Richmond-Petersburg Turnpike interchange development. The Richmond-Petersburg Turnpike has located its main administration building and maintenance headquarters within a ramp interior at its State Route 10 (No. 6) interchange. Direct access is provided from both ramps and the Turnpike itself. The developed area is roughly 500 by 600 ft, or 7 acres in size, and requires a substantial expansion of right-of-way.

TABLE 14

TYPES OF HIGHWAY LAND UTILIZED FOR MAINTENANCE AND STORAGE FACILITIES [a]

AGENCY	SIDE-STRIPS	MEDIANS	RAMP IN-TERIORS	UNDER STRUC-TURES
15 State highway departments	9	3	8	5
12 Toll road authorities	10	0	2	0

[a] Two states, not included here, did not indicate the type of highway land utilized for maintenance storage.

TABLE 15

TYPES OF HIGHWAY LAND UTILIZED FOR HIGHWAY AND STATE POLICE OFFICES

	HWY. AND STATE POLICE ADMIN. OFFICES [a]		MAINT. FIELD OFFICES	
AGENCY	RAMP IN-TERIORS	SIDE-STRIPS	RAMP IN-TERIORS	SIDE-STRIPS
6 State hwy. depts.[b]	1	2	2	4
8 Toll road auth.[c]	2	4	0	3

[a] State Police barracks have been located along Massachusetts Turnpike (sidestrips) and New York Thruway (sidestrips and ramp interiors.
[b] Landscape field offices located under structures in California.
[c] Port of New York Authority has located administrative offices on air rights over a bridge toll plaza.

amenable to spatial dispersion, but tend to be centralized in a few locations.

Few states have chosen to locate highway or state police offices within freeway rights-of-way, whereas at least four toll road authorities have located their administrative offices in ramp interiors or on sidestrips (Table 15). Again, it generally has been agreed that only local area access should be provided to such facilities.

Although these examples represent administrative functions closely tied to highways and highway services, coordination of the building of government offices (in general) with freeway development offers interesting possibilities for multiple uses. Appropriate areas for such development would be ramp interiors or sidestrips which are accessible from either cross-routes or frontage roads.

PARKS AND RECREATION

Four broad categories of parks and recreational areas were reported as multiple uses by the survey—regional parks, local parks and playgrounds, ornamental parks, and understructure playgrounds. They have involved ramp interiors in two states, sidestrips in nine jurisdictions, and understructure areas in four jurisdictions. The size of the total land area involved and the nature of the facilities provided are the major characteristics distinguishing between these examples (Table 16). In general, these developments represent cases where available and accessible right-of-way has coincided with surrounding residential recreational needs or with demands for specialized parkland generated by an entire urban area or region.

Regional parks are relatively extensive developments for both active and passive recreation whose total area extends (usually) well beyond the right-of-way boundaries of any freeways which might be involved. However, at least the sidestrip portions of the roadway and possibly ramp interiors can be coordinated with the planning and use of the park. In Manchester, Connecticut, proposals have been made for a linear park some two miles in length, which will be coordinated with the relocation of US6. Freeway right-of-way involved in this park project will be used principally for pedestrian walkways and bridle paths, with ramp and roadway underpasses provided where needed.

TABLE 16

TYPES OF HIGHWAY LAND UTILIZED FOR LOCAL AREA PARKS AND PLAYGROUNDS

AGENCY	RAMP INTERIORS	SIDE-STRIPS	UNDER STRUCTURFS
Connecticut	*	*	
New York		*	
Illinois		*	*
Delaware			*
Dist. of Columbia		*	
Maryland		*	
California		*	
Montana	*	*	
Oregon		*	
New Jersey Tpk.			*
Port of N. Y. Auth.		*	*

The ramp interior of a partial clover-leaf interchange represents the focal point of the park proposal (Fig. 19).

In Binghamton, N. Y., a linear park has been proposed for right-of-way land which lies between I-81 and the Chenango River. The area involved is 2½ miles long and averages 600 ft in width. In addition, a 30-acre area accessible from local streets is proposed for development as a part of the project. Walkways, picnic areas, comfort stations, a park roadway, boat basin, and parking for 200 cars are all part of the river bank proposal, while a skating rink, football field, and ball diamond with a 2,000-spectator grandstand are proposed for the adjacent parcel (Fig. 20). Interstate 81 motorists would have access to the area via a safety rest area which connects with the pedestrian path system (*10*).

Interest in the use of freeway rights-of-way for park purposes is evident in other countries as well as the United States. Plans have been completed in Perth, Australia, for a major park facility located within a three-level freeway interchange. Located on the banks of the Swan River, at the fringe of the central business district, the 85-acre interchange will be extensively landscaped and have pools, foun-

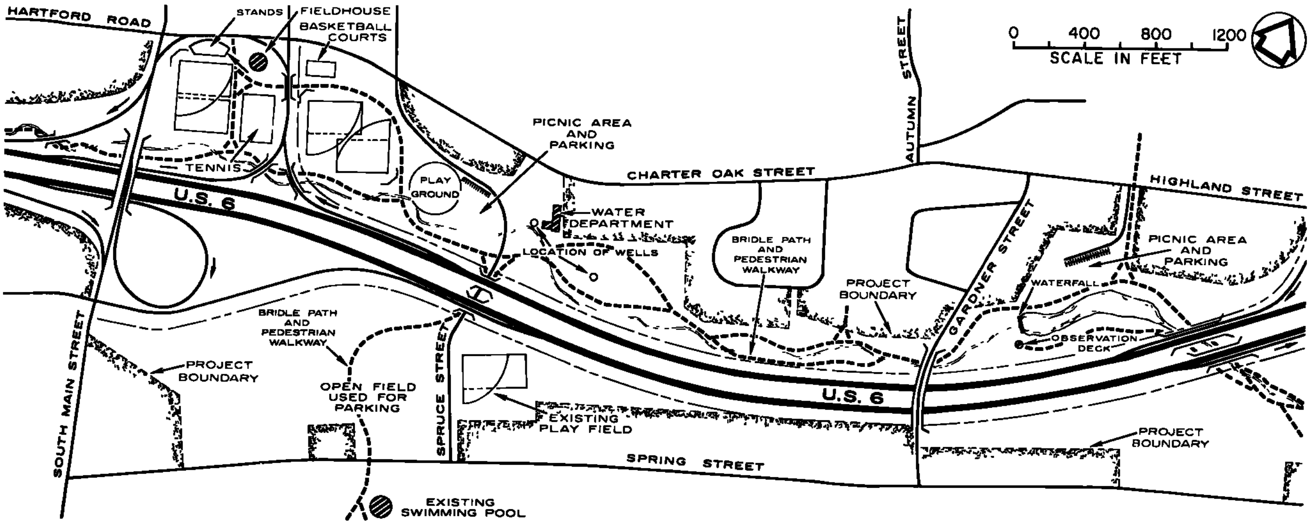


Figure 19. Connecticut linear park proposal. In Manchester, Conn., the local planning and zoning commission has proposed the development of a linear park some 2 miles in length in coordination with the relocation of U. S. Route 6. A 14-acre ramp interior is proposed as a major active recreation area, where athletic fields, tennis and basketball courts, and a field house would be provided. Grade-separated pedestrian walkways form a vital part of the proposal, connecting this area with nearby school and related park facilities.

tains, and grade-separated pedestrian paths. Some 62 acres will be available for park development, with the remainder required for ramps and roadways. Pedestrian access to highway facilities will be prevented by vegetation barriers or by fencing screened by vegetation. Both pedestrians and vehicles will be able to move freely across the entire interchange area via grade-separated facilities.

In Wilmington, Del., an existing park on both sides of Brandywine Creek will be retained underneath the new I-95 viaduct, and an additional playground also has been proposed beneath the viaduct. The coordination of Lake Shore Drive and Lincoln Park in Chicago, and of the Henry Hudson Parkway and Riverside Park in New York, also represent examples of regional park and freeway de-

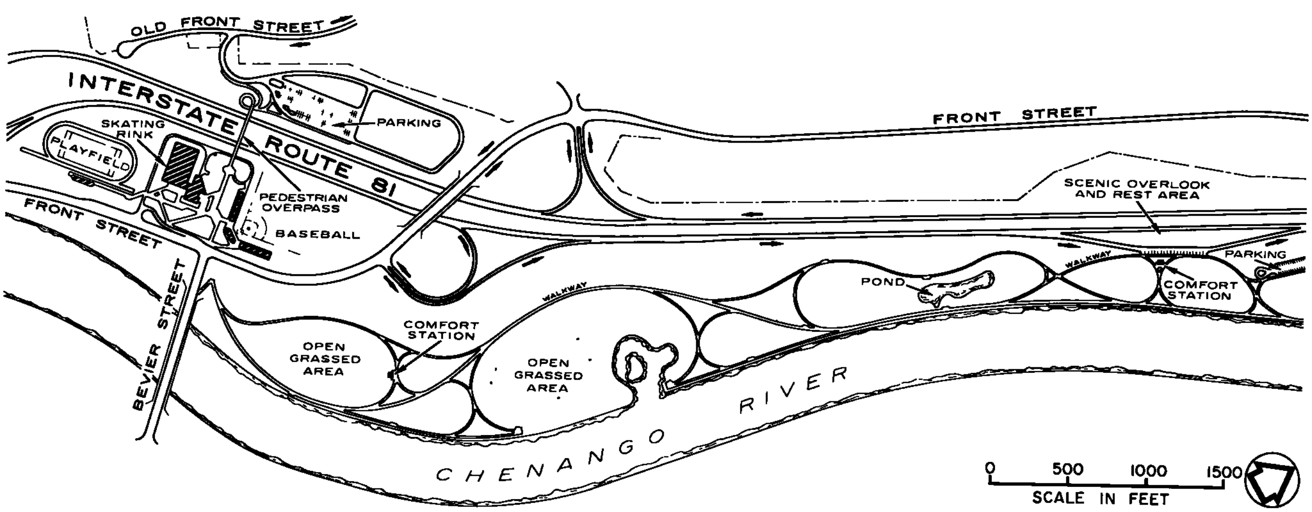


Figure 20. New York linear park proposal. A proposal has been made in Binghamton, N. Y., for the multiple use as a regional park of a 2½-mile stretch of right-of-way lying between I-81 and the Chenango River. The area involved comprises about 200 acres, varying in width from 225 to 110 ft, and was originally acquired for highway drainage and flood protection. A scenic overlook and rest area is included which would make the park directly accessible to freeway auto traffic. The park proposal also includes a 30-acre site between I-81 and Front Street, adjacent to a major interchange with State Route 17. Both this area and another 20 acres extending the opposite sidestrip were also acquired for highway drainage purposes. Proposed here (at left) are a skating rink and outdoor athletic facilities, with paved parking (275 cars) and overflow parking (800 cars) connected via a pedestrian overpass.

velopment. Other less extensive examples of this type may be found in both of these urban areas and in other cities across the country.

The possibility of locating several regional parks along a single freeway has been carried through in a number of examples in the New York area, notably on the Palisades and Taconic State Parkways. Here, as with cultural-recreational facilities, an indirect multiple use of right-of-way may be achieved when direct-access connections between freeway and park are provided. Joint development of such facilities, whether in rural or urban settings, should produce economies in land acquisition for both programs, as well as providing special opportunities for imaginative and aesthetically pleasing freeway design.

As a second broad category, *local parks and playgrounds* serve an immediately adjacent residential area and customarily are small in size. Of 40 remnant parcels along the John F. Kennedy Expressway in Chicago (parcels are triangular in shape, as the expressway is on a diagonal), six have been designated for local park use. All but one of these are separated from the right-of-way proper by a realigned local street, and all are located along a 4-mile diagonal stretch of the expressway. They average less than one-sixth acre in size and probably will be developed as neighborhood tot lots, passive recreation areas, and playgrounds. The Port of New York Authority has permitted sidestrip park development with local access in Bayonne, N. J., and along the George Washington Bridge-Henry Hudson Parkway ramp connections in New York City. Playgrounds and parks on sidestrips have been considered in Washington, D.C., and temporary playing fields and playgrounds have been permitted on future ramp area sidestrips in Maryland.

Ornamental parks, whose primary purpose is beautification to benefit both the road user and the local area to which it is accessible, have been proposed or inaugurated in several states, such as Oregon, Montana, and California. In the last two states (and probably several others) these developments have involved local civic organizations, such as garden clubs, working with the highway departments. Some of the Montana ornamental and leisure parks have utilized ramp interiors and an expansion of normal freeway right-of-way. In Portland, Ore., the city will develop an esplanade park area between the East Bank Freeway (I-5) and the Willamette River.

The fourth type of local area park, *understructure playgrounds*, also primarily serves a surrounding residential area. Examples of this type of multiple use may be found in Jersey City, N.J., under an elevated section of the New Jersey Turnpike (Fig. 21); in Chicago, at two locations under elevated portions of the Dan Ryan Expressway, and in Bayonne, N.J., under the elevated approach to the Port of New York Authority's Bayonne Bridge.

In most cases, these park developments represent multiple uses with an "opportunity seizure" quality about them. For example, in the design and construction of viaduct structures and freeway ramps, the potential use of ramp interiors or understructures for park purposes is not usually considered. These uses are established after the fact, usually in response to an expressed demand for them. In some cases, however, the use of sidestrips for recreational purposes may call for excess right-of-way acquisition, or at least for the coordination of recreation and freeway planning. In the case of regional parks, such coordinated planning is vital. The recent proposals in Manchester and Binghamton may well portend a reawakening of the interest in freeway and recreational land-use coordination which has been relatively dormant since the Lake Shore Drive-Henry Hudson Parkway era of the 1920's and 1930's. The growing demand for recreational land in general—and this demand is most acute *within* urban areas—suggests that the coordination of regional parks with freeway right-of-way acquisition and construction represents a promising area for increased activity. In addition, available understructure, sidestrip, and ramp interior parcels within given urban areas should be closely examined in relation to potential local recreation demands.

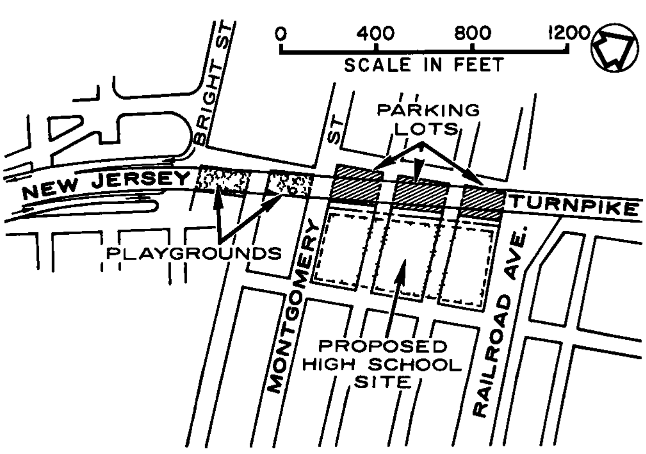


Figure 21. Jersey City understructure playgrounds and parking. These five land parcels are located under the New Jersey Turnpike viaduct in Jersey City. The three larger parcels, averaging 1 acre in size, have been developed as paved parking lots. The two sites at left, about ½ acre each, serve as paved playground areas for local neighborhood use. A new high school has been proposed adjacent to the three parking lots.

VEHICULAR PARKING

Understructure Parking

The Automotive Safety Foundation concluded (*11*) that existing urban freeways generally have been built too far from the core of the central business district for understructure parking facilities to serve major parking demands. Accepting 1,000 ft as a maximum acceptable walking distance between parking and CBD destinations, Table 17 reveals that only one-half of those cities with populations over 150,000 have any important potential for major understructure parking developments in their downtown areas. The study also notes that existing understructure parking facilities have been developed at reasonable cost, often serving all-day worker parking, specialized spot-recreational

parking, public transit park-ride, or industrial and commercial parking at various locations throughout urban areas (*11*).

The survey of state highway and toll road agencies indicates that some form of understructure parking has been inaugurated in 21 states (and additionally, in association with three toll roads), and proposed in at least five other states. Four states have also permitted understructure truck or bus parking, and one has authorized truck parking only. Although the location of these facilities (CBD or non-CBD) has not been indicated, it appears that many of them have been developed to serve special demands or specific commercial-industrial land-uses. In this connection, 14 state highway and toll road agencies indicated that lease or permit arrangements for understructure parking had been made with private clients, while 23 reported that either their agency, the local municipality, or a local parking commission was responsible for such facilities. (The administration of understructure parking in two states was not reported, and in one the reported parking was unsanctioned. Unsanctioned parking undoubtedly occurs in other states, as well.)

Although the ASF report (*11*) explores the cost and economic aspects of building a structure instead of an embankment so that the understructure area may be used for parking, Table 17 suggests that the demand for such development is likely to be limited. Proposed understructure facilities of this type must be contrasted with nearby off-freeway alternatives involving cleared land. Comparable cleared land costs (roughly $150,000 to $175,000 per acre) and a sizable parking demand capable of supporting the facility are usually associated only with areas very close to the CBD's of large cities. There are cases where this parking development opportunity may exist, as evidenced by a recent Oklahoma City proposal to raise a section of urban toll road to allow two levels of understructure parking. In general, however, the great majority of understructure parking facilities will represent opportunity projects associated with adjacent land-uses, developed *after* freeway construction. If the demand is sufficient, the construction of such parking lots is not particularly difficult, though the space required per parking stall will be approximately 30 percent more than for an off-freeway lot (*11*, p. 17). Understructure parking represents perhaps the most clearly market-oriented of any of those which have been developed.

TABLE 17

DISTANCE FROM NEAREST FREEWAY TO EDGE OF CENTRAL PARKING DEMAND AREA IN 65 CITIES OF OVER 150,000 POPULATION

AIRLINE DISTANCE (FT)	NO. OF CITIES	PERCENT OF TOTAL
Inside	10	15
0- 500	11	17
500-1,000	14	22
1,000-1,500	11	17
1,500-2,000	6	9
2,000-2,500	5	8
2,500-3,000	1	1
Over 3,000	7	11
Total	65	100

Source: Ref. (*11*), p. 11.

Sidestrip and Ramp Interior Parking

A number of local area freeway-parking developments have utilized sidestrips and ramp interiors at interchanges, and, rather than serving adjacent land-use, have been oriented somewhat to freeway users. These commuter parking facilities have been used both for car pooling and as park-and-ride lots for public transit operations. Although the success and use of the existing facilities have been modest, there would seem to be good potential for commuter parking, particularly in association with public transit operations on the freeway.

Sidestrips and ramp interiors along the Merritt Parkway in Connecticut have been utilized for a number of years for informal car pool parking (*12*). Such multiple uses remain unsanctioned by the state highway department, although consideration was given to the provision of median and ramp interior parking facilities for this purpose. However, questions of state liability for parked autos and the proper use of highway funds has discouraged any serious proposals along these lines. The greatest accumulation of vehicles at any of these nonsanctioned sites (Fig. 22), some of which also includes parking on bridge structures, has usually been only 25 to 30 autos, and there have been no serious problems with regard to freeway or interchange operations.

The Garden State Parkway has formally established a small commuter parking facility (for use by car poolers) at its Redbank Interchange 109, roughly 35 miles south of Newark, N. J. Thirty-three spaces are provided at a $3 monthly or $0.25 faily fee. The lot is located on a sidestrip adjacent to an off-ramp toll booth and is accessible via a local frontage road. Though the facility has been in operation since August 1962, it is rarely filled to capacity. The response by Parkway users to this experimental project has not been sufficient to encourage the construction of others, which originally had been planned. Mitigating circumstances, however, appear to indicate that commuter parking facilities at other locations (for instance, at Irvington, adjacent to Newark, and at Toms River, 60 miles south of Newark) might produce more encouraging results. Many potential users of the Redbank lot utilize the excess parking space at a nearby shopping center for all-day parking. This, of course, may not always be possible at other interchange locations (*13*).

The Massachusetts Turnpike has constructed a ramp loop interior parking facility at its West Newton Interchange, 10 miles from downtown Boston. The lot is adjacent to a toll booth and accessible via a local street connection which underpasses the ramp (Fig. 23). No charge is made for use of the lot, and it is available to either car poolers or New York Central Railroad com-

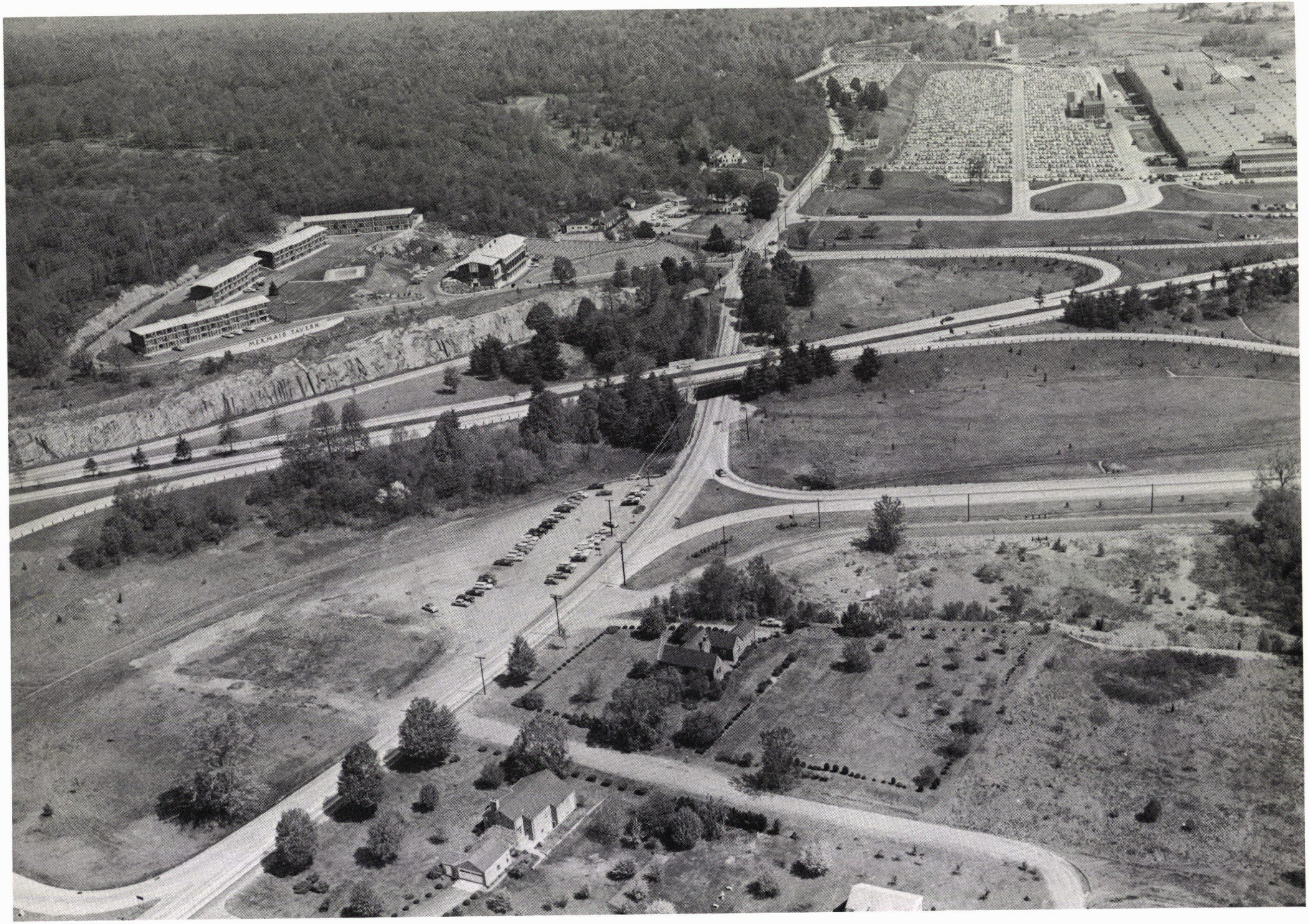


Figure 22. Connecticut interchange parking. Unsanctioned parking within ramp interiors along the Merritt State Parkway in Connecticut has become common in recent years. Nearly all such vehicles belong to car poolers who have proceeded to other points along the Parkway. Shown here is the Connecticut Route 110 interchange.

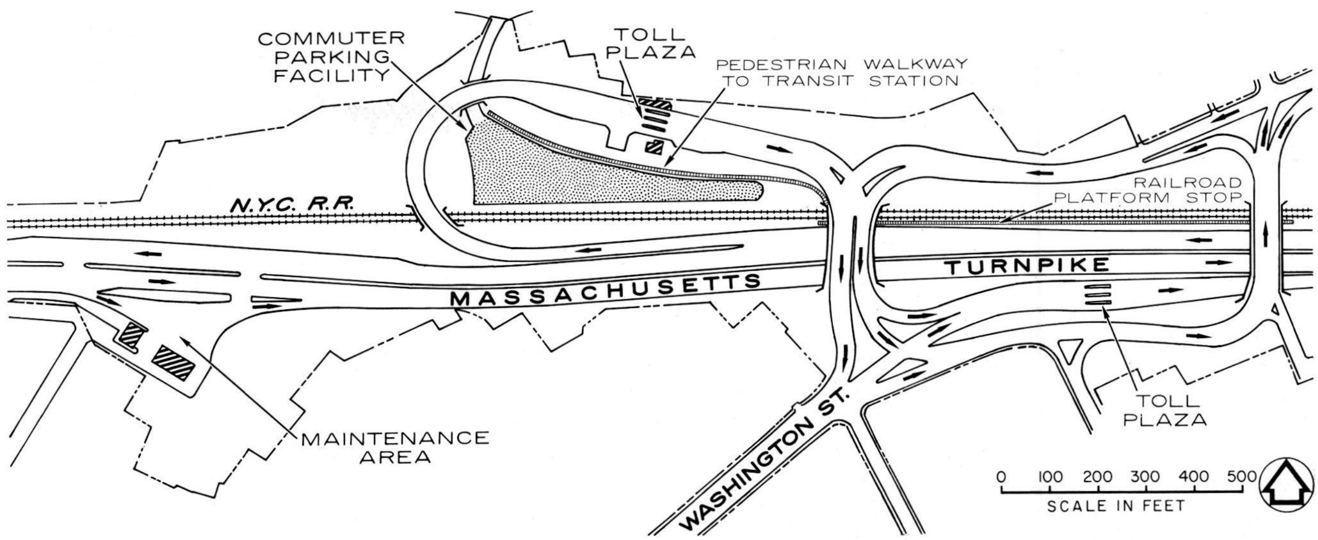


Figure 23. Massachusetts Turnpike interchange parking. One of the few multiple-use examples which involve grade-separated vehicular access to a ramp interior has been developed at the West Newton interchange of the Massachusetts Turnpike. 1.3 acres have been paved for commuter parking, and a pedestrian connection provided to the adjacent New York Central transit platform stop. The facility may also be used by car poolers from the surrounding local area, but with somewhat circuitous access to the interchange. Note the small (1.2 acre) maintenance area at left, and the two undeveloped sidestrip parcels, each about two acres in size, on each side of the Turnpike.

muters (a platform stop is adjacent). Though vehicle capacity is around 150, there are rarely more than 50 cars in the lot.

Other interchange parking facilities have been established in Washington, D.C. (ramp interior fringe parking lot) and within ramp interiors in Utica, Syracuse, and New York, N. Y. The Kansas Turnpike has provided sidestrip parking adjacent to utility buildings at major interchanges for bus commuters making round trips to other points on the turnpike. The Port of New York Authority has constructed a major ramp interior-understructure parking lot, with a capacity of several hundred vehicles, adjacent to the Lincoln Tunnel approaches in New Jersey. In this highly specialized example, buses carry commuter parkers from the lot through the Lincoln Tunnel into New York City.

OTHER USES

A few states have permitted the use of freeway sidestrips in rural areas for agriculture and grazing. The experience of the Kansas Turnpike is probably typical. There, private hay mowing between right-of-way fencing and roadway shoulders is permitted, thus minimizing sidestrip maintenance costs for the Turnpike. Oregon has permitted a similar agricultural use along expanded sidestrips acquired for future route widening. State wildlife officials in Illinois have encouraged the possible retention of natural vegetation or re-seeding of sidestrip areas in low-volume rural freeway sections to provide nesting areas for game birds such as pheasants. Here again, a reduction in mowing or maintenance costs could be realized. In California the highway department has developed fenced stock trails within the right-of-way in a few locations. Sidestrip grazing has been permitted in South Dakota. In a related type of development, the Kansas Turnpike has also constructed cattle loading and unloading pens at two locations adjacent to the roadway, providing both local and direct freeway access. The pens open directly onto the extensive pasture lands through which the route passes.

Boat launching and access-to-stream areas have been developed in at least two states, primarily involving rights-of-way located underneath bridge structures. The Missouri Conservation Commission is currently developing an access-to-stream area where I-70 crosses the Missouri River in Cooper County. Also involved are a boat marina and a local access road constructed within right-of-way limits. The Connecticut Department of Natural Resources has also provided boat launching sites under bridge structures; for example, in association with I-95 in Norwalk, Conn.

A bridle path has been privately developed within a 75-ft sidestrip of the Merritt Parkway near Greenwich, Conn. The path has been in use for some 25 years and apparently has raised no significant problems. In California the Division of Highways has been involved in the planning and construction of riding and hiking trails in two locations—Santa Clara and Contra Costa Counties. Actual utilization of right-of-way in these two instances has been limited, however, to equestrian underpasses which provide for continuous trails. The extension of this category of multiple use to include bicycle paths seems entirely reasonable, though apparently no proposals along these lines have been made.

The New York Thruway has offered its rights-of-way

Figure 24. New Haven directional interchange. The extensive land consumption of major directional interchanges is illustrated, where I-91, I-95, and Connecticut 34 merge together in New Haven. The ramp interior at left is used for nonregulated parking by employees of the parcel post depot at far left. The enclosed area is roughly 2½ acres in size. Some consideration has been given to the construction of another postal building on this site.

for the location of utility lines and commercial pipelines. Although they have had only limited response to this offer (several proposals), coordination in the location of two linear activities such as a freeway and a pipeline seems a logical arrangement where there is a coincidence of demand for both.

Ponding for conservation and flood control purposes has been developed as a multiple use in a number of states. In North Dakota the State Game and Fish Department and the Water Conservation Commission have shared in construction costs for the development of sidestrip dams and lakes. The State Board of Fisheries and Game and the Water Resources Commission have been involved in similar ponding developments in Connecticut (in one instance involving a ramp interior). Five of Nebraska's safety rest areas have incorporated into their overall design small lakes remaining from borrow pits. Near Chicago, ponds have been developed from borrow pits for the Illinois Toll Road and turned over to the Cook County Forest Preserves for recreational use. In Florida, storm sewer ponding areas have been developed by the highway department for municipal maintenance and operation involving both understructure and median (adjacent to high fills) rights-of-way. Pumping stations, a related multiple used, have been developed by the sanitation department on understructure and sidestrip areas in the District of Columbia.

An interesting proposal for the use of understructure areas was recently advanced for a section of I-480 in Omaha, Nebr. A variety of urban activities, including multi-level parking, small parks, a motel, and service stations, have been suggested by local planning officials. Federal and state highway agencies have expressed great interest in this project as an opportunity for coordinating transportation improvements with potential new land development (*14*).

Several examples of understructure warehousing and storage appear to fall into two groups—those which preceded highway construction, and those which followed. In at least three states (Massachusetts, Oklahoma, and Rhode Island) freeway viaducts have been built over existing railroad lines and related warehousing facilities. In New Orleans the police department operates a recently completed warehouse located beneath a freeway overpass. Open material and metals storage also has been permitted beneath viaducts of the Richmond-Peterson Turnpike, and in Washington, D.C., and California.

CHAPTER FIVE

EVALUATION OF MULTIPLE USES

The multiple uses of freeway rights-of-way described in the preceding chapters cover a wide spectrum. Some may be developed within normal right-of-way dimensions, whereas others require limited or extensive expansions of right-of-way. Multiple uses may produce effects which are beneficial to the surounding local area, to freeway users, or both. In some cases uses may simply be the result of "convenient coincidence," with no observable detrimental effects, but no observable direct benefits. In still other cases, multiple uses might represent largely an administrative convenience for highway or highway-related agencies (such as for maintenance or traffic regulation), but again with no identifiable or direct benefits involving freeway users or the surrounding area.

This chapter evaluates those multiple uses that have been developed or seriously proposed, as revealed by the survey and the literature review. For each use, the evaluation considers criteria such as right-of-way requirements, type of land utilized, probable location and demand, temporary versus permanent use of the land, quantity and nature of traffic generation, access requirements, safety factors, aesthetics, costs, and benefits. For discussion purposes these criteria have been grouped into three broad categories: (1) location and land-use, (2) traffic and safety, and (3) costs and benefits. The evaluation is summarized in Table 18, on which much of the discussion is based. These evaluations do not necessarily reflect the actual circumstances associated with a particular use reported by the survey or the literature review. For example, the survey may have reported the location of a certain use in median land, whereas the evaluation in Table 18 may suggest that such a use probably is most suited for a sidestrip location. The actual location and frequency of these uses as reported by the survey and the literature review have already been summarized in Tables 1 through 16 and the two preceding chapters.

LOCATION AND LAND-USE

Probable Location

Although it is conceivable that each type of multiple use might, under certain conditions, be developed within urban, suburban, or rural contexts, each use seems to be oriented toward a particular local environment. This may result from the nature of demand associated with the use, from the type of highway land which is most appropriate, or

TABLE 18

EVALUATION OF MULTIPLE USES OF CONTROLLED-ACCESS HIGHWAY RIGHTS-OF-WAY

LOCATION AND LAND-USE

POSSIBLE MULTIPLE USE	PROBABLE LOCATION[a] (Order 1,2,3)			PROBABLE RIGHT-OF-WAY REQUIREMENTS			PROBABLE TYPE OF LAND UTILIZED (Order 1,2,3,4)[a]				PROBABLE DEMAND FOR DEVELOPMENT	IS USE SUITED FOR TEMPORARY OCCUPANCY OF RIGHT-OF-WAY?
	URBAN	SUBURBAN	RURAL	NORMAL	LIMITED EXPANSION	EXTENSIVE EXPANSION	MEDIAN	SIDE STRIP	RAMP INTERIOR	UNDER-STRUCTURE		
1. AGRICULTURAL INSPECTION STATIONS	3	2	1	-	✓	-	2	1	3	-	Limited To A Few States With Inspection Laws	Possibly
2. AGRICULTURE AND GRAZING	-	-	1	✓	-	-	-	1	2	-	Extensive In Rural Areas	Yes
3 BOAT LAUNCHING AND ACCESS TO STREAM	3	2	1	✓	-	-	-	2	-	1	Limited	Yes
4. BRIDLE PATHS, CYCLING, AND HIKING TRAILS	2	1	3	✓	✓	-	-	1	2	-	Limited	Yes
5. CATTLE LOADING PENS	3	2	1	-	✓	✓	-	1	-	-	Very Limited	Possibly
6. CULTURAL-RECREATIONAL CENTERS	1	2	3	✓	✓	✓	3	1	2	4	Limited	No
7. HIGHWAY AND STATE POLICE OFFICES, BARRACKS	2	1	3	-	✓	✓	-	1	2	3	Limited	No
8. PARKING, UNDER-STRUCTURE	1	2	3	✓	-	-	-	-	-	1	Moderate	Yes
9. PARKING, INTERCHANGE	2	1	3	✓	✓	✓	3	2	1	-	Could Be Extensive In Large Urban Areas	Yes
10 PARKS AND RECREATIONAL, LOCAL	1	2	3	✓	✓	-	-	1	2	3	Extensive In Urban Areas	Yes
11 PARKS AND RECREATIONAL, REGIONAL	3	2	1	-	✓	✓	3	1	2	4	Limited To Coincident Locations Of Parks And Freeways	No
12. PUBLIC TRANSIT LANES (BUS OR RAIL)	1	2	-	✓	✓	-	1	2	-	-	Limited To Large Urban Areas	No
13. PUBLIC TRANSIT STATIONS (INCLUDING PULL-OFF BUS STOPS)	1	2	-	✓	✓	-	2	1	3	-	Limited To Urban Areas	Possibly
14. PONDING FOR CONSERVATION AND FLOOD CONTROL	3	2	1	✓	✓	✓	3	2	1	4	Limited	Possibly
15. PUMPING STATIONS (WATER, FUEL, SEWAGE)	1	2	3	✓	-	-	3	2	1	4	Limited	Possibly
16. ROAD MAINTENANCE FACILITIES	3	2	1	✓	✓	✓	4	1	2	3	Moderate	Possibly
17. SAFETY REST AREAS	3	2	1	-	✓	-	2	1	3	-	Extensive	Yes
18 SERVICE PLAZAS	3	2	1	-	✓	✓	2	1	-	-	Extensive (If Federal Policy Changes)	No
19. SCENIC OVERLOOKS	3	2	1	-	✓	-	2	1	-	-	Coincidental With Scenic Attractions	Yes
20. TANDEM TRAILER AREAS (MAKE-UP AND BREAK-UP)	2	1	3	-	✓	✓	-	2	1	3	Dependent On State Regulation Of Tandems	Yes
21. TRUCK WEIGHT STATIONS	-	2	1	-	✓	-	2	1	-	-	Dependent Of State Regulatory Policies	Yes
22. WAREHOUSING AND STORAGE	1	2	-	✓	✓	-	-	2	3	1	Limited	Yes

TRAFFIC AND SAFETY

POSSIBLE MULTIPLE USE	WOULD QUANTITY OF TRAFFIC GENERATED BE LIKELY TO CAUSE PROBLEMS?	WOULD NATURE OF TRAFFIC GENERATED BE LIKELY TO CAUSE PROBLEMS?	ACCESS REQUIREMENTS		SAFETY PROBLEMS?
			FROM FREEWAY	FROM LOCAL AREA	
1. AGRICULTURAL INSPECTION STATIONS	No	Possibly	Direct	Probably None	Possibly (Entrance And Exit Of Slow Trucks)
2. AGRICULTURE AND GRAZING	No	No	None	Direct	No
3 BOAT LAUNCHING AND ACCESS TO STREAM	No	No	None	Direct	No
4. BRIDLE PATHS, CYCLING, AND HIKING TRAILS	No	No	None	Direct	Possibly (Driver Distraction)
5. CATTLE LOADING PENS	No	Yes	Probably Direct	Direct	Possibly (Entrance And Exit Of Slow Trucks)
6. CULTURAL-RECREATIONAL CENTERS	Possibly	No	Probably Direct	Direct	No
7. HIGHWAY AND STATE POLICE OFFICES, BARRACKS	No	No	Indirect	Probably Direct	Possibly (If Direct Freeway Access Allowed)
8. PARKING, UNDER-STRUCTURE	Possibly	No	Probably None	Direct	No
9. PARKING, INTERCHANGE	Possibly	No	Indirect	Direct	Possibly (Turning Movements On Cross Route)
10 PARKS AND RECREATIONAL, LOCAL	No	No	None	Direct	No
11 PARKS AND RECREATIONAL, REGIONAL	Possibly	No	Probably Direct	Direct	No
12. PUBLIC TRANSIT LANES (BUS OR RAIL)	No	No	Probably Direct (Buses)	None	No
13. PUBLIC TRANSIT STATIONS (INCLUDING PULL-OFF BUS STOPS)	Possibly For Major Stations	No	Direct (Buses)	Direct	Possibly (Pedestrian-Vehicular Conflicts)
14. PONDING FOR CONSERVATION AND FLOOD CONTROL	No	No	None	None	No
15. PUMPING STATIONS (WATER, FUEL, SEWAGE)	No	No	None	Direct	No
16. ROAD MAINTENANCE FACILITIES	No	Possibly	Indirect	Probably Direct	Possibly (If Direct Freeway Access Allowed)
17. SAFETY REST AREAS	No	No	Direct	None	Possibly (Particularly Access To Median Uses)
18 SERVICE PLAZAS	No	No	Direct	Probably Direct	Possibly (Particularly Access To Median Uses)
19. SCENIC OVERLOOKS	No	No	Direct	None	Possibly (Particularly Access To Median Uses)
20. TANDEM TRAILER AREAS (MAKE-UP AND BREAK-UP)	No	Possibly	Indirect	Direct	Possibly (Slow Truck Movements)
21. TRUCK WEIGHT STATIONS	No	Possibly	Direct	None	Possibly (Entrance And Exit Of Slow Trucks)
22. WAREHOUSING AND STORAGE	No	No	None	Direct	No

COSTS AND BENEFITS

POSSIBLE MULTIPLE USE	HOW EXTENSIVE IS THE CAPITAL INVESTMENT INVOLVED?	WOULD ADDITIONAL HIGHWAY CONSTRUCTION COSTS BE INVOLVED?	DOES USE BENEFIT FREEWAY TRAFFIC? -Reduce Freeway Volumes -Provide A Service -Regulate Or Control Traffic -Offer Rest Opportunities	DOES USE BENEFIT SURROUNDING COMMUNITY?	AESTHETIC CONSIDERATIONS
1. AGRICULTURAL INSPECTION STATIONS	Small	Yes (Access Lanes)	Yes (Regulate Certain Truck Traffic)	No	Landscaping Needed
2. AGRICULTURE AND GRAZING	None	No	No	Yes (Local Farmers)	None
3 BOAT LAUNCHING AND ACCESS TO STREAM	Small	No	No	Yes (Recreational Opportunity)	None
4. BRIDLE PATHS, CYCLING, AND HIKING TRAILS	None	Possibly (Longer Bridge Spans In Some Cases)	No	Yes (Recreational Opportunity)	None
5. CATTLE LOADING PENS	Medium	Yes (Access Lanes)	No	Yes (Local Ranchers Or Meat Packers)	Probably Objectionable
6. CULTURAL-RECREATIONAL CENTERS	Large	Possibly (Access Lanes And Pedestrian Or Vehicular Grade Separations)	Possibly (Rest Opportunities)	Yes (Recreational Opportunity)	Dramatic Architectural And Landscaping Possibilities
7. HIGHWAY AND STATE POLICE OFFICES, BARRACKS	Medium-Large	Possibly (Access Lanes)	Indirectly	Indirectly	Landscaping Needed
8. PARKING, UNDER-STRUCTURE	Small-Medium	No	Possibly (If It Reduces Freeway Volumes)	Yes (Meets Local Parking Needs)	Landscaping Desirable
9. PARKING, INTERCHANGE	Small-Medium	Possibly (Pedestrian Or Vehicular Grade Separations)	Possibly (If It Reduces Freeway Volumes)	Yes (Meets Local And Commuter Parking Needs)	Landscaping Needed
10 PARKS AND RECREATIONAL, LOCAL	Small	Probably No	No	Yes (Recreational Opportunity)	Landscaping May Be Needed
11 PARKS AND RECREATIONAL, REGIONAL	Medium-Large	Possibly (Access Lanes And Pedestrian Or Vehicular Grade Separations)	Possibly (Rest Opportunities)	Yes (Recreational Opportunity)	Preserve Natural Beauty And Open Space
12. PUBLIC TRANSIT LANES (BUS OR RAIL)	Large (For Rail Lines)	Yes (Longer Bridge Spans And Bus Access Lanes)	Yes (Reduce Freeway Traffic)	Yes (Facilitates Area Travel)	None
13. PUBLIC TRANSIT STATIONS (INCLUDING PULL-OFF BUS STOPS)	Large (For Rail Lines)	Yes (Longer Bridge Spans And Possible Pedestrian Or Vehicular Grade Separations)	Yes (Reduce Freeway Traffic)	Yes (Facilitates Area Travel)	Attractive Station Design Possibilities
14. PONDING FOR CONSERVATION AND FLOOD CONTROL	Small	No	Indirectly (Drainage)	Yes	None
15. PUMPING STATIONS (WATER, FUEL, SEWAGE)	Medium	No	No	Yes	Landscaping And Screening May Be Needed
16. ROAD MAINTENANCE FACILITIES	Medium	Possibly (Access Lanes)	Indirectly	Indirectly	May Be Difficult To Landscape And Screen
17. SAFETY REST AREAS	Medium	Yes (Access Lanes)	Yes (Rest Opportunities)	No	Landscaped Or Natural Beauty
18 SERVICE PLAZAS	Large	Yes (Access Lanes)	Yes (Provide A Service)	No	Good Architectural Possibilities, Should Be Landscaped
19. SCENIC OVERLOOKS	Small	Yes (Access Lanes)	Yes (Rest Opportunities)	No	Preserve Natural Beauty
20. TANDEM TRAILER AREAS (MAKE-UP AND BREAK-UP)	Small	Possibly (Access Lanes)	No	No	May Be Difficult To Screen
21. TRUCK WEIGHT STATIONS	Small-Medium	Yes (Access Lanes)	Yes (Regular Truck Traffic)	No	Landscaping Needed
22. WAREHOUSING AND STORAGE	Medium	No	No	Yes	Landscaping And Screening Needed

[a]Rank order based on (1) as most probable location or type of land utilized

from the size of the land area involved. Eleven multiple uses appear to be most suitable for rural locations, while seven are more urban-oriented in nature (Table 18). Four uses are somewhat flexible as to probable location and are listed as most likely to occur in suburban areas.

Road user-oriented activities are the likeliest uses for rural rights-of-way, although Chapter Three has illustrated a possible need for them on urban and suburban freeway sections. Multiple uses associated with the surrounding area are, understandably, more likely to arise in urban and suburban areas simply because there are more opportunities to establish relationships with adjacent development (such as a local park on freeway land to serve an adjacent neighborhood). For the same reason, the greatest potential for multiple uses not identified by the survey or the literature review would seem to be in urban and suburban locations. The closer spacing of interchanges in these areas offers more oportunities for use of ramp interiors. Working against the potential for such uses, however, are the more limited right-of-way widths in urban areas.

Right-of-Way Requirements

At least 14 types of multiple use are amenable to development within normal right-of-way dimensions. Four of these (boat launching and access to streams, understructure parking, local parks and playgrounds, warehousing and storage) are oriented particularly toward understructure areas, while three are linearly-oriented toward sidestrip development (bridle paths, agriculture and grazing, public transit lanes). Two special cases are median transit facilities and air rights developments, which might also involve parcels of land adjacent to sidestrips or interchange areas. The largest number of uses which seem suited for a particular type of freeway land are those associated with ramp interiors (cultural-recreational facilities, parking, local parks and recreation, ponding for conservation and flood control, public transit stations or stops, pumping stations, road maintenance and storage facilities, and general warehousing and storage).

Nine of the uses mentioned could require limited expansions of right-of-way under certain situations, while

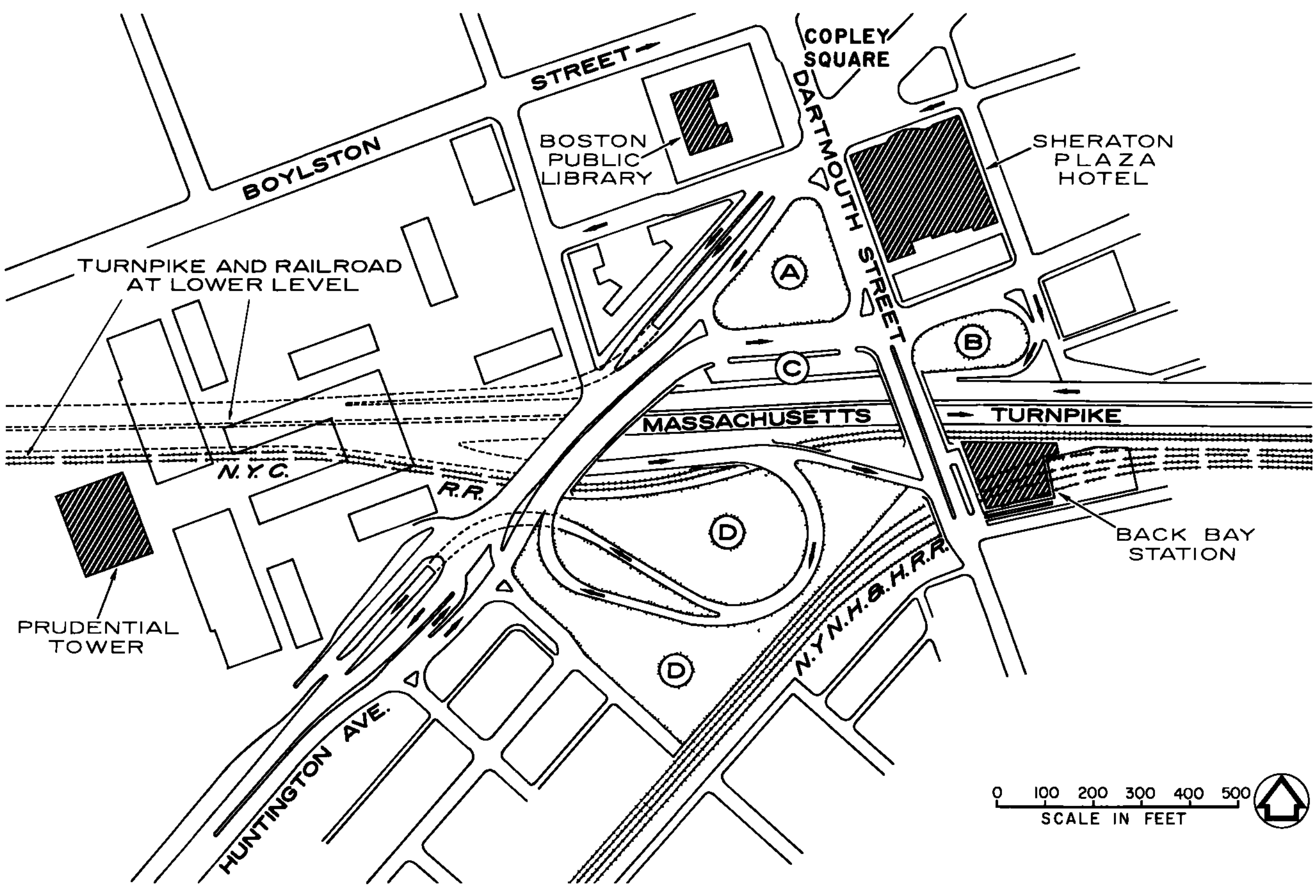


Figure 25. Massachusetts Turnpike urban interchange. The Massachusetts Turnpike-Huntington Ave. interchange, located adjacent to Boston's Prudential Center and Copley Square, has attracted considerable interest as a possible site for major air-rights development. A number of high-rise residential and office proposals have been made by private groups which would span the ramp area at D. Roughly five acres (including ramps) are available here. The Sheraton Plaza Hotel has expressed interest in parcels A and B, also Turnpike right-of-way property, for possible parking garage development. Parcel A, one acre in size, is presently unrelated to the highway, with final use as yet undetermined. Parking for 30 vehicles at C is reserved for Turnpike personnel, whose offices are in the nearby Prudential Tower.

four of them would require extensive expansion if major facilities were contemplated (cultural-recreational centers, interchange parking, flood control ponding, road maintenance and storage areas). In addition, eight multiple uses normally can be developed within a limited expansion of right-of-way (agricultural inspection stations, cattle loading pens, highway and state police offices, regional parks and recreation, safety rest areas, scenic overlooks, tandem trailer areas, and truck weight stations). Another use (service plazas) could be developed with limited right-of-way expansion if the facilities are built over-the-road, such as those on the Illinois Tollway (Fig. 29). Five uses would require an extensive expansion of highway land acquisition in the event that major facilities were developed.

The size of area associated with the terms "limited" and "extensive" right-of-way expansion should be discussed briefly. Limited expansion is defined as right-of-way increase ranging from a few additional feet of width up to a maximum of about 10 acres. This maximum increase approximates the size of standard sidestrip rest areas being constructed on much of the Interstate System (Fig. 26). Many of the more extensive multiple uses in terms of site size occupy both freeway right-of-way and adjacent non-highway land. Some of the largest expansions of highway land have resulted from median service plazas and rest areas (Figs. 4 and 27). In some cases, however, wide medians have been developed to retain some outstanding natural feature of the region or for topographical reasons, wherein the directional roadways are built at different elevations.

Type of Highway Land Utilized

Four basic types of highway land are available for multiple-use development—sidestrips, medians, ramp interiors, and understructure areas. In Table 18 these areas are ranked according to feasibility of site for each type of multiple use revealed by the survey and the literature review.

Although *medians* represent possible locations for at least 13 reported uses, there are serious problems involved in achieving development of these areas. The principal impetus for developing multiple uses within medians—with the exception of exclusive transit lanes, utilities, and commercial pipelines—involves a desire for accessibility to freeway traffic from both directions. Although median developments have generally been discouraged by state highway agencies because of potentially hazardous left-side access points, two of the more recently completed toll roads, the Florida Turnpike and the Atlantic City Expressway, have both provided median service plazas. It appears that adequate signing and length of speed-change lanes can do much to alleviate the potential safety hazards of the left-side movements. In this connection, it is significant that nearly one-third of the service plaza pairs now serving American toll roads are located in the median (Table 19). In addition, at least four states have constructed median weight stations (Illinois, Oklahoma, Montana, Minnesota) and a number of others have also located safety rest areas within wide medians.

A critical variable influencing the suitability of median locations as development sites appears to be the volume of traffic which the freeway is expected to carry, The Garden State Parkway, with seven of its nine service plazas located in the median (and three of its nine picnic and rest areas), reports a relatively high level of accident experience as a result of left-side access requirements. Traffic volume on the Parkway is comparatively heavy. Perhaps for similar reasons, Illinois has described its median weight stations as "undesirable." The AASHO policy guide on safety rest areas (*1*) notes that such uses should be located within a median only where local conditions are not favorable for the preferable "right-side" sites.

A simple technique for developing median locations

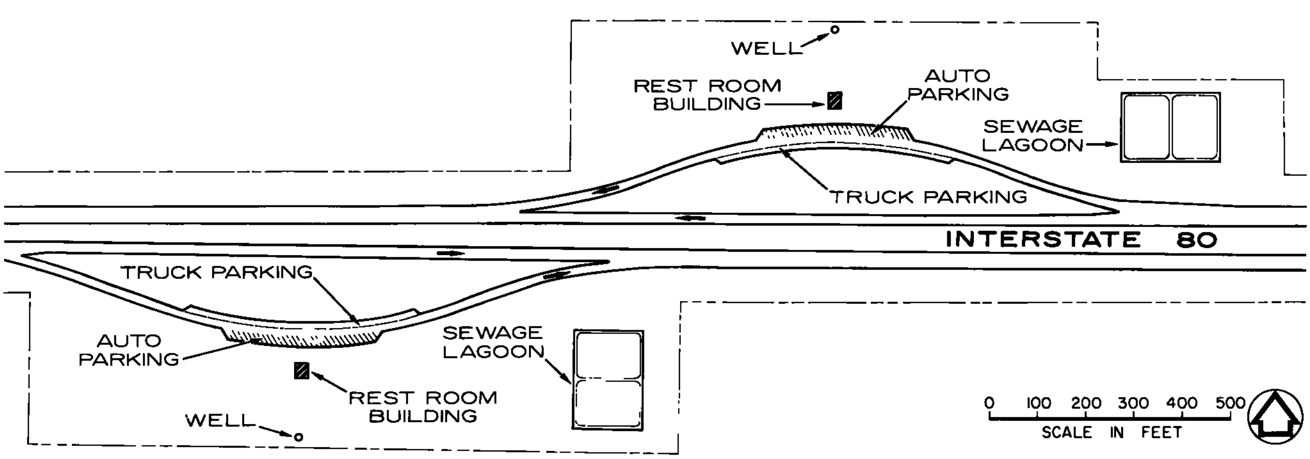


Figure 26. Iowa safety rest areas. Rest areas have most often been designed in pairs, with the rightside facility usually sited slightly in advance of its companion. This pair of rest areas is located along I-80 in Polk County, Iowa. Rest room buildings also provide space for an outdoor, weather-protected, information display case offering highway and service information. The normal 80-ft sidestrip has been increased to 400 ft and the additional land required is some 10 acres for each site.

while eliminating left-side access has been carried out at the Angola service plaza on the New York Thruway (Fig. 28). Service plazas involving air-rights structures spanning the roadway accomplish the same "one-restaurant-serving-both-directions" objective, while also eliminating left-side access (Fig. 29). In addition to the examples discussed here, multiple uses not related to freeway traffic might conceivably be developed at median locations—principally within urban areas—if grade-separated pedestrian or vehicular access were provided. Generally, however, the demand for land in most urban areas has been great enough to restrict freeway cross-sections to relatively narrow medians and to favor sidestrips and interchange areas for possible multiple-use development.

As might be expected, *sidestrips* are potentially feasible locations for the widest variety of multiple uses, and appear to be the best sites for at least 14 of the reported uses. An obvious reason for the wide range in possible uses of sidestrips is that they can be combined with adjacent non-highway land to form parcels that are of a size suitable for development. This has been the case in most significant sidestrip developments.

Although some multiple use of existing sidestrips in *urban* areas is possible (as part of air-rights structures, for utility lines, local area park developments, and interchange area parking) these highway lands, by themselves, are generally too narrow for urban development (see Table 20). A few examples may exist where adjacent buildings or other types of land-use are permitted to encroach upon normal right-of-way, but these are of relatively minor importance. Similarly, in rural or surburban fringe areas, the two multiple uses which appear best suited to normal sidestrip widths—riding, hiking, and cycling trails and agriculture-grazing— have been developed only infrequently.

This need for more land implies, in general, that the development of sidestrip multiple uses is best coordinated with freeway planning and alignment studies. Preferably, the acquisition of freeway right-of-way and any additional parcels needed to produce a developable site should proceed together. The possibility of acquiring certain right-of-way sections well in excess of normal width requirements—without specific multiple-use development in mind—appears to merit serious consideration as well. It would then be possible to combine portions of normal sidestrips with directly adjacent parcels, forming single land areas with a much higher development potential. Air-rights structures might also form part of such projects, with the range in possible sidestrip uses considerably expanded. Former Federal Highway Administrator, Rex M. Whitton, detailed some of the practical aspects of such a concept in an address before the November 1966 meeting of the Portland Cement Association, as follows:

> Normally, urban freeways are planned and designed to use a minimum right-of-way, to minimize displacement of people and businesses, and any other possible community disruption. In acquiring such land, however, highway departments often have to pay considerable amounts to affected property owners for severance damages; that is, payments for decreased value to remaining property because of the sale of part of the property for the freeway.
>
> Our preliminary studies show that in some urban situations the cost of acquiring whole blocks or squares of property would be about the same, or only slightly higher, than the cost of acquiring

TABLE 19

TYPES OF HIGHWAY LAND UTILIZED FOR SERVICE PLAZAS

FACILITY	MEDIAN	SIDE-STRIPS (PAIRS)
Inter-urban toll roads:		
Florida Turnpike	7	—
Indiana Toll Road	—	8
Kansas Turnpike	6	—
Kentucky Parkways	1	—
Maine Turnpike	—	3
Massachusetts Turnpike	—	5
New Jersey Turnpike	—	7
New York Thruway	1 [a]	14
Ohio Turnpike	—	8
Oklahoma Turnpikes	3	5 [b]
Pennsylvania Turnpike	5	9
West Virginia Turnpike	—	2
Urban and recreational toll roads:		
Atlantic City Expressway	1	—
Connecticut Turnpike	—	7
Dallas-Fort Worth Turnpike	—	1
Garden State Parkway	7	2
Illinois Tollways	—	5 [c]
Kennedy Memorial Highway	2	—
Kentucky Turnpike	2	—
Merritt-Wilbur Cross Pkwy.	—	5
Total	35	81

[a] Restaurant in median with pedestrian bridges to sidestrip parking lots and fuel service

[b] One facility involves pedestrian bridge to parking lot and fuel service on opposite sidestrip; another provides air-rights restaurant and sidestrip parking lots and fuel service.

[c] All five involve air-rights restaurants with sidestrip parking lots and fuel service.

TABLE 20

OUTER SEPARATION OR SIDESTRIP WIDTHS FOR URBAN DEPRESSED FREEWAYS [a]

RIGHT-OF-WAY	WIDTH EACH SIDE (FT)	ACRES PER ROUTE-MILE (BOTH SIDES)
Restricted	10	2.4
	20	4.8
	30	7.2
Intermediate	40	9.6
	50	12.2
	60	14.6
Desirable	70	17.0
	80	19.4
	90	21.8
	100	24.2

[a] Source: Ref (7), pp 325-335.

Figure 27. Michigan safety rest area. Only a few states have developed safety rest areas or scenic overlooks on highway land at other than sidestrip locations. Shown here is a median rest area on US-27 north of Clare, Mich. Maximum median width is roughly 700 ft.

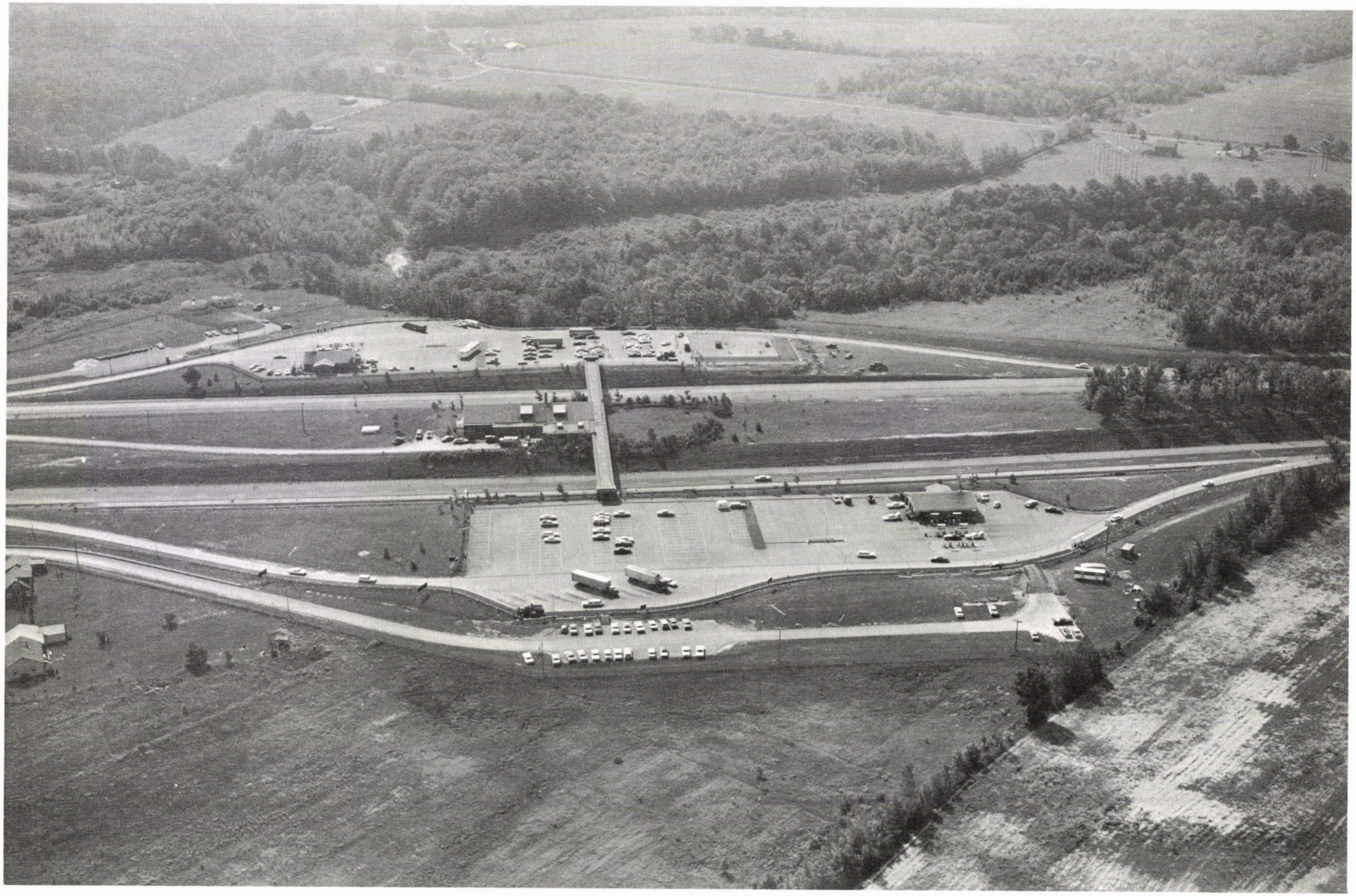


Figure 28. New York Thruway service plaza. The Angola Service Area on the New York Thruway provides a pair of parking and gasoline service areas (one on each side of the roadway) with a single median restaurant facility accessible via pedestrian overpasses. In this way potential left-side access ramp accident hazards are avoided, without costly duplication of restaurant facilities. Maximum sidestrip widths are approximately 300 ft (median width about 250 ft). The service area in the foreground requires some 4.4 acres beyond normal right-of-way limits, with adjacent frontage road access and employee parking involving an additional 3 acres. Restaurant services and deliveries are made (from both directions on the Thruway) via left turns to a median service road.

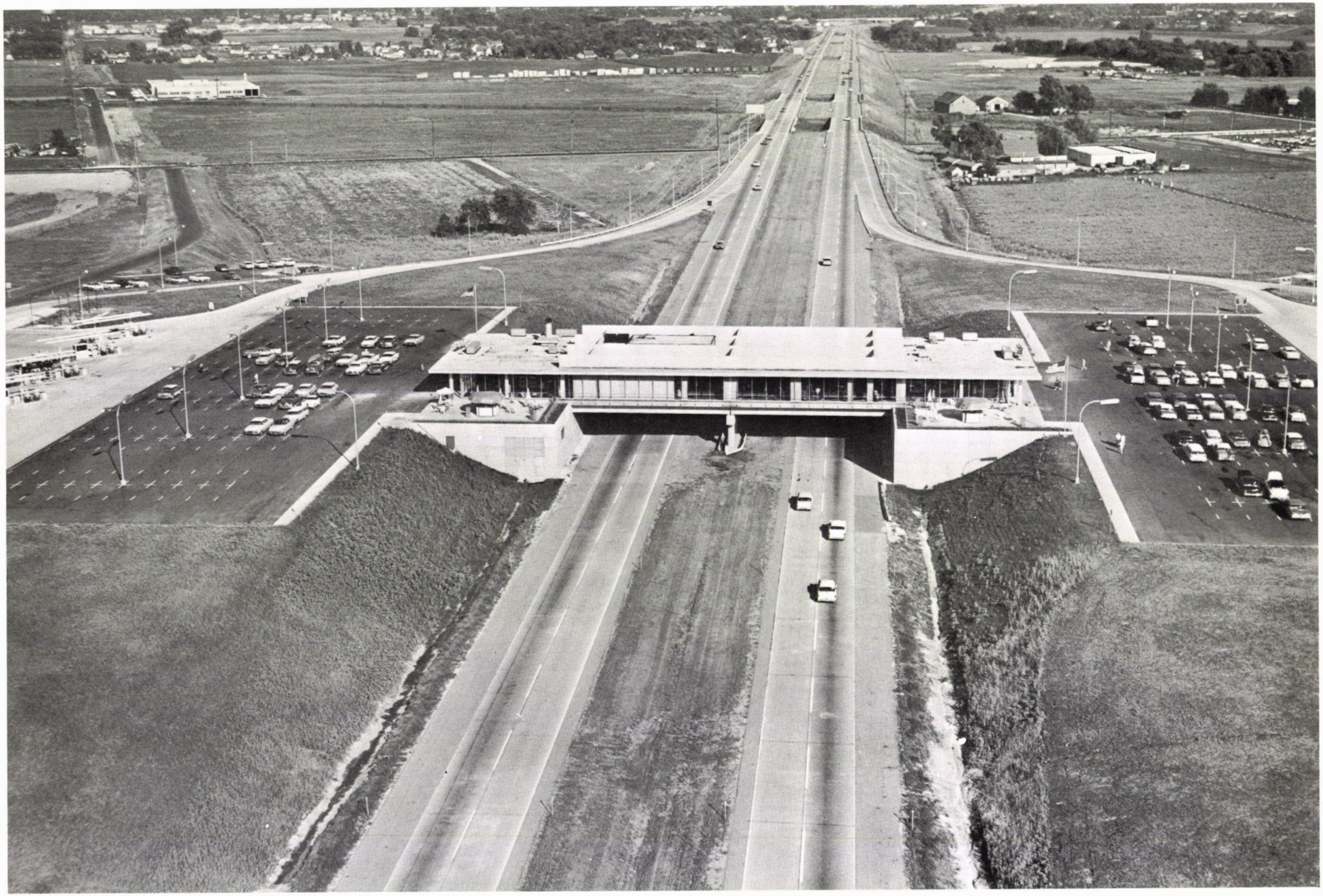


Figure 29. Illinois Tollway service plaza. The Illinois Tollway Commission has built five over-the-roadway restaurants, which allow a considerable reduction in land requirements as opposed to other types of road user service plazas. Shown here is the Des Plaines Oasis on the North-West Tollway. Sidestrip width is about 400 ft at its maximum point, and the total land required (beyond normal right-of-way) on each side is less than 4 acres. No expansion of the median is necessary, of course, and one major restaurant is able to serve road users from both directions. Separate local frontage road access and parking are provided for employees.

freeway rights-of-way including severance damage payments.

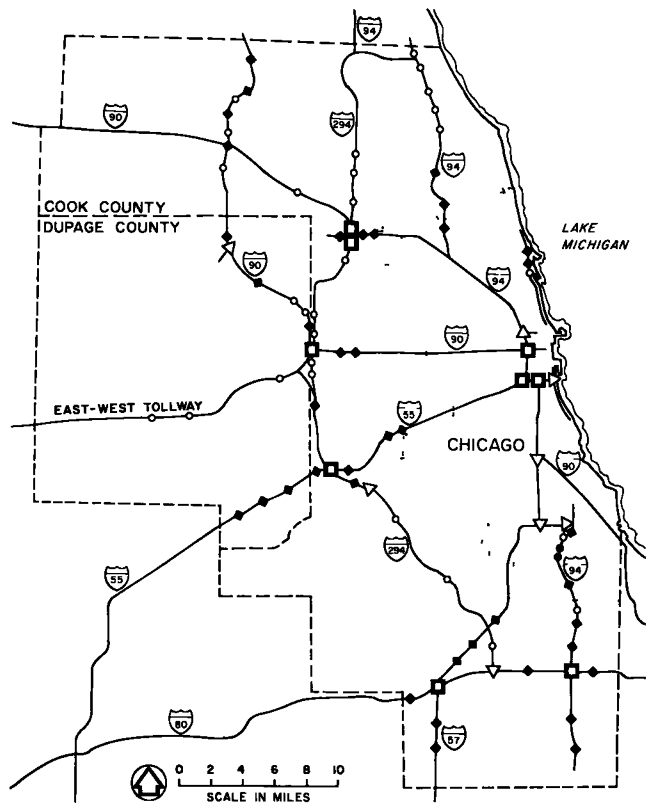
Thus, a city could acquire entire blocks or even wider areas on the route of a planned freeway. Out of whole blocks acquired for joint development, the highway department would need only a permanent three-dimensional easement—an air tunnel for the freeway—which it could buy for an amount equal to its appropriate share of the right-of-way costs, thus supporting the joint development concept without increase in its planned highway expenditure. It would then have available for other development valuable land at a fraction of the cost of acquiring it alone.

This concept is drawing increasing interest around the country and is being seriously examined in conjunction with local urban renewal programs, notably in Chicago and other large cities.

Interchange ramp interiors can provide feasible sites for about one-half of the uses in Table 18, subject to certain design conditions and limitations on size of development. Urban ramp systems frequently enclose land areas which have high multiple-use potential. Though the diamond interchange is the most common design type in urban areas (usually entailing little extra width beyond that provided for the mainline roadway), other interchange types represent major land consumers. Table 21 indicates the size of land areas enclosed by the ramp systems of typical cloverleaf interchanges. Directional interchanges, most often developed where two freeways intersect, frequently require in excess of 100 acres for complete development—with as little as 15 to 20 percent of the right-of-way actually paved for ramps and roadways.

Some idea of the scale of interchange land-use opportunities in urban areas can be gained by examining the 277 miles of existing and programmed freeways in the Chicago area (Cook and DuPage Counties). As Figure 30 illustrates, 87 non-diamond interchanges will shortly be in existence in the Chicago Metropolitan Area. Nearly one-half of these (46 percent) will be full cloverleafs, 19 percent will be directionals, and the remainder will be partial cloverleafs and trumpets. Proceeding on the simple assumption that the 17 large directional interchanges will be offset by the 30 smaller partial cloverleaf and trumpet interchanges, the area of a typical full cloverleaf seems reasonable as an overall average size. Using 20 acres enclosed by the ramps as an average size for this type of interchange, the total non-paved land area associated with all 87 interchanges is around 1,750 acres, or 2.7 sq mi. Similar calculations have been made for the Interstate and non-Interstate freeway mileage (existing and proposed) in 20 major cities (Table 22.) Perhaps more significant than these total acreage figures is the total number of major interchange development opportunities, which may exceed 250 in New York and 200 in Los Angeles.

Although ramp interior parcels of approximately 2 acres in size are fairly common, only a few have actually been developed for multiple-use purposes. The chief difficulty in utilizing such land areas, which are of sufficient size to support a wide range of urban land uses, is in providing access that will not impede traffic operations within the interchange itself. The development of interchange area multiple uses directly accessible from the freeway (provided parcels of adequate size are available) is generally undesirable, as noted in the AASHO policy guide on safety rest areas (*1*). Problems could result from confusion in freeway signing of both interchange ramps and access to the multiple use, and from increasing the number of speed-change lanes along the freeway. Access to ramp interiors from local cross-routes also involves possible confusion and congestion by increasing the number of turning movements in the interchange area. Similarly, direct ramp turn-offs to ramp interior parcels



INTERCHANGE TYPE	SYMBOL	No
TRUMPET	●	2
3-LEG DIRECTIONAL	△	8
4-LEG DIRECTIONAL	◘	9
PARTIAL CLOVERLEAF	o	28
FULL CLOVERLEAF	◆	40
URBAN DIAMOND	NONE	117

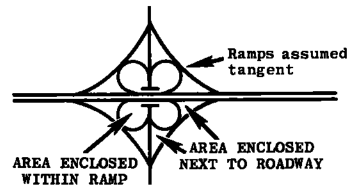
	ROUTE MILES	INTERCHANGES TOTAL	INTERCHANGES MAJOR	%
CITY OF CHICAGO	78	108	17	16
COOK DUPAGE	199	96	70	73
TOTAL	277	204	87	43

Figure 30. Chicago area interchanges. The location of major non-diamond freeway interchanges in Cook and Du Page Counties, Ill., is shown. These 87 interchanges represent 43 percent of a total of 204 in the area. As the accompanying chart indicates, nearly three-quarters of the interchanges constructed outside the city of Chicago are major land consumers. As urban development proceeds, these interchange areas should become increasingly attractive for possible multiple-use development. Nine major directional interchanges have been built in this rural-suburban fringe area.

TABLE 21

LAND AREA ENCLOSED BY CLOVERLEAF INTERCHANGES[a]

LEFT-TURN DESIGN SPEED (MPH)	LEFT-TURN LOOP RAMP: INNER RAD. OF CURV. (FT)	LEFT-TURN LOOP RAMP: AREA ENCL. WITHIN RAMP (ACRES)	RIGHT-TURN RAMP: OUTER RAD. OF CURV. (FT)	RIGHT-TURN RAMP: AREA ENCL. NEXT RDWY. (ACRES)	TOTAL ENCL. NON-PAVED AREA (ACRES)
25	150	1.7	900	1.1	16.0
26	166	2.1	996	1.4	19.6
27	182	2.6	1,092	1.7	23.6
28	198	3.0	1,188	2.0	27.8
29	214	3.5	1,284	2.3	32.5
30	230	4.1	1,380	2.7	37.6



[a] Source: Ref. (7), p. 474.

TABLE 22

ACREAGE IN MAJOR URBAN INTERCHANGES, 20 MAJOR CITIES[a]

URBANIZED AREA	MILEAGE: INTER-STATE	MILEAGE: NON-INTER-STATE	MILEAGE: TOTAL FREE-WAY	INTERCHANGES: TOTAL[b]	INTERCHANGES: MAJOR[c]	ACREAGE IN MAJOR INTER-CHANGES[d]
Atlanta	118	60	178	119	48	960
Baltimore	86	97	183	122	49	980
Boston	208	158	366	244	98	1,960
Buffalo	54	48	102	68	27	540
Chicago	305	363	668	445	178	3,560
Cincinnati	148	53	201	134	54	1,080
Cleveland	152	81	233	155	62	1,240
Dallas	120	100	220	147	59	1,180
Detroit	194	135	329	219	88	1,760
Houston	101	180	281	187	75	1,500
Jacksonville	68	58	126	84	34	680
Los Angeles	241	528	769	513	205	4,100
Miami	20	120	140	93	37	740
New York	383	612	1,005	670	268	5,360
Philadelphia	205	260	465	310	124	2,480
Pittsburgh	92	177	269	179	72	1,440
St. Louis	153	59	212	141	56	1,120
San Francisco	176	367	543	362	145	2,900
Seattle	73	78	151	101	40	800
Washington	136	71	207	138	55	1,100

[a] Total existing and proposed freeway mileage as reported by Automotive Safety Foundation (2).
[b] Spacing interval 1.5 miles.
[c] Forty percent of total.
[d] Twenty-acre average; non-paved and enclosed.

could be somewhat hazardous, particularly at high-volume interchanges.

Generally it appears that most ramp interiors can be successfully developed only if grade-separated local access (pedestrian or vehicular) is provided. The Newton commuter parking facility on the Massachusetts Turnpike illustrates this concept of grade-separated local access (Fig. 23). Techniques for achieving use of cloverleaf interchange ramp interiors are illustrated in Figure 31.

A number of existing multiple uses have been located within ramp interiors that were enlarged in order to accomodate the development (Fig. 18). This concept appears worthy of further consideration, for the access problems associated with ramp interiors that are larger than normal are likely to be decreased. More importantly, as with expanded sidestrip areas, the variety and magnitude of potential uses for enlarged ramp interiors will be increased substantially. Whereas the added costs of grade-separated access might discourage development within normal ramp interiors, relatively modest increases in right-of-way acquisition could produce attractive development opportunities.

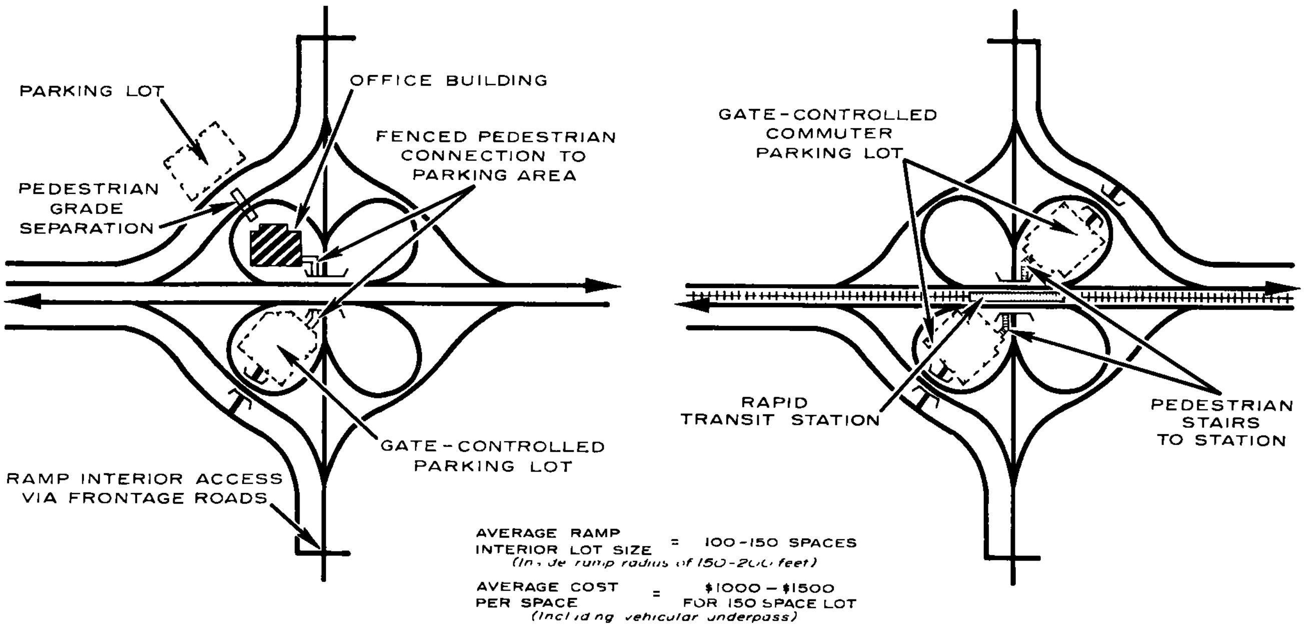


Figure 31. Potential cloverleaf interchange development. In most situations the development of interchange ramp interiors can best be accomplished if grade-separated access is provided. Illustrated in these hypothetical cloverleaf sketches are: (1) techniques for restricting vehicular access to points well removed from interchange traffic operations, (2) possible locations for pedestrian and vehicular grade separations, and (3) the possibility of linking adjacent ramp interiors with special pedestrian connections.

Except for occasional rural river crossings suitable for access-to-stream developments, the great majority of *understructure lands* available for multiple use are found in urban areas. Even in urban areas, however, the proportion of freeway mileage which may be built on structure is usually a very small part of the total mileage. As a result, multiple-use opportunities associated with undestructure land areas are somewhat limited. In general, structures are built in urban areas within complex interchanges, over rail yards and related areas, as approaches to bridge crossings, or under conditions of unusual topography. In many instances understructure parcels may not be amenable to multiple-use development due to relatively small or inadequate clearance height. In cases where the foregoing conditions do not present problems, understructure areas would seem suited for virtually any use that (1) does not require direct freeway or ramp access, (2) can be developed around the limitations imposed by pier spacing, (3) is compatible with surrounding development, and (4) is not adversely affected by the environment created by the structure (such as noise from freeway traffic overhead). It is also apparent that rather active land-use contexts—residential, commercial, industrial—are needed to stimulate interest in understructure uses such as playgrounds, parking, warehousing, and storage. As illustrated in Figure 32, if understructure land can be combined with contiguous parcels to form sites of appropriate size, development potential can be increased appreciably.

Although *air rights* are not considered in Table 18, it would seem appropriate to comment briefly on this type of "freeway land" as a site for potential development. Air-

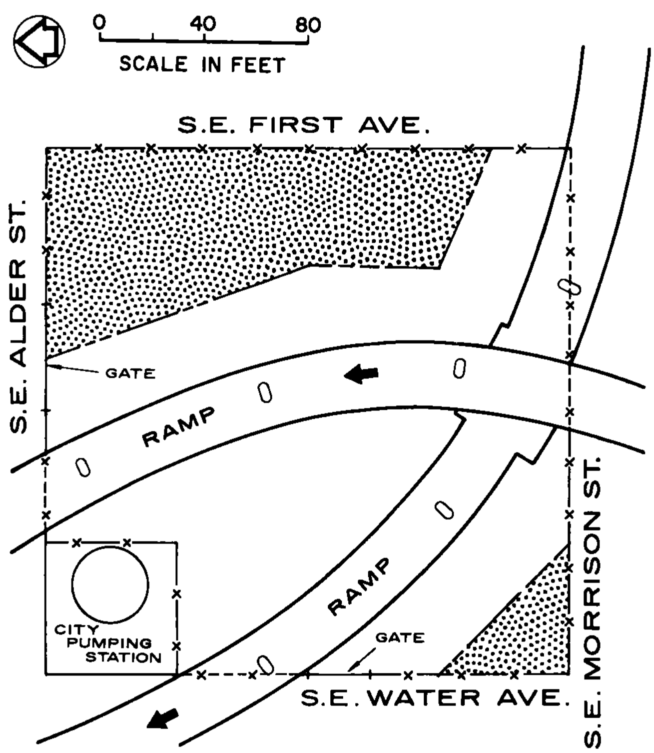


Figure 32. Portland understructure truck parking. Two-thirds of this city block was acquired for interchange right-of-way associated with the East Bank Freeway (I-5) in Portland, Ore Elevation of the ramps involved has permitted use of the site for truck parking, under lease to a private trucking firm. In this way, the entire block remains in local use as a single functional unit.

rights development is receiving increasing attention across the country, as evidenced by the wide variety of buildings that have been erected or proposed over urban freeways (Table 23).

Developments of this type in Chicago, New York, Detroit, and elsewhere have attracted wide interest and represent perhaps the most dramatic multiple uses of right-of-way (see Fig. 33). The Massachusetts Turnpike Authority has noted that any air-rights proposal which will not be detrimental to Turnpike motorists, during construction or upon completion, will be considered for lease arrangement. Presumably, once any local or state legal barriers have been resolved, private or public developers of commercial, office, residential, cultural, parking, or other land-uses could be considered for freeway air-rights tenancy.

Construction costs for any air-rights development will, of course, be higher than normal surface construction. Roughly, the minimum clear span between median piers and sidestrip structures is approximately 60 ft for a three-lane freeway section. For depressed freeways with relatively wide sidestrips, it would be possible to construct up to two-thirds of an air-rights structure directly on side-strip land, with the remaining one-third straddling the freeway (Table 20). Similarly, an air-rights structure spanning an interchange ramp could conceivably be built on ramp interiors and related sidestrips, such that 75 percent (or more) of the building would be constructed on normal foundations. Unrestricted operation of the interchange during construction would present problems, however, unless the building and the freeway were constructed at the same time. The simultaneous development of freeways and related air-rights structures is, in fact, particularly convenient for both developers and eventual users, and is currently being contemplated for housing development over Boston's Inner Belt Expressway.

TABLE 23

AIR-RIGHTS DEVELOPMENTS

STATE OR TOLL ROAD	TYPE OF DEVELOPMENT
Connecticut	Municipal library
Massachusetts	City hall
	Apartments [a]
New York	Apartments
	Commuter rail parking
	Bus terminal
	Civic center [a]
Illinois	Fed. post office
Kansas	Restaurant [a]
Michigan	Convention center
Wisconsin	Courthouse addition
Dist of Columbia	Hotel [a]
	Apartments [a]
	Federal buildings [a]
Oregon	College building [a]
	Restaurant [a]
Illinois Tollway	Restaurants
Massachusetts Tpk.	Grocery store
	Parking garages [a]
	Apartments [a]
	Office buildings
Port of N. Y. Auth.	Admin. offices
Oklahoma Turnpike	Restaurant

[a] Proposed.

Demand for Multiple-Use Development

The existing and potential demand for the multiple uses identified by the survey and the literature review has been discussed in preceding chapters. A summary evaluation of this demand is included in Table 18.

Demands for use of freeway rights-of-way are certain to be greater in number and significance in large urban areas than in small cities and rural areas. The reason for this is a simple matter of high land costs and scarcity of development sites in large cities for community needs such as local parks, public buildings, and parking facilities. These factors enhance the appeal of unused rights-of-way as development sites, even though construction costs may be somewhat higher because of the necessity for partial or complete air-rights development, provision of pedestrian or vehicular grade separations, or other special design features. Certain uses, such as special transit lanes and commuter parking, are wedded to large metropolitan areas because small isolated communities cannot generate sufficient demand to warrant such facilities.

The demand for road user services as a multiple use seems clear; the deciding factor is really the policy regarding such uses that is taken by the states and the federal government. Studies such as one presently being conducted by Airborne Instruments Laboratory for the Highway Research Board (NCHRP Project 7-7) should provide needed feedback data on how well private enterprise is meeting road user service needs at off-the-right-of-way locations.

Similarly, the future for tandem trailer make-up and break-up areas is subject to state policies on allowing double-bottom operation. The development of truck weight stations, although also affected by varying state policies, is probably more dependent on the extent of future use of in-motion weighing devices and portable scales.

Although much has been said about the demand for multiple uses in urban areas, there are some uses in rural areas for which demand may not be obvious or universal, but which could be quite beneficial to both private and public interests. For example, the use of sidestrips and possible rural ramp interiors for agricultural and grazing purposes would benefit local farmers and ranchers, while lowering freeway maintenance costs through reduced roadside mowing.

Temporary Use of Right-of-Way

One criterion which might be considered in evaluating multiple uses is their relative permanency, because the right-of-way which they would occupy could be needed eventually for route widening. Probably the best indication of the permanency of such uses would be the capital

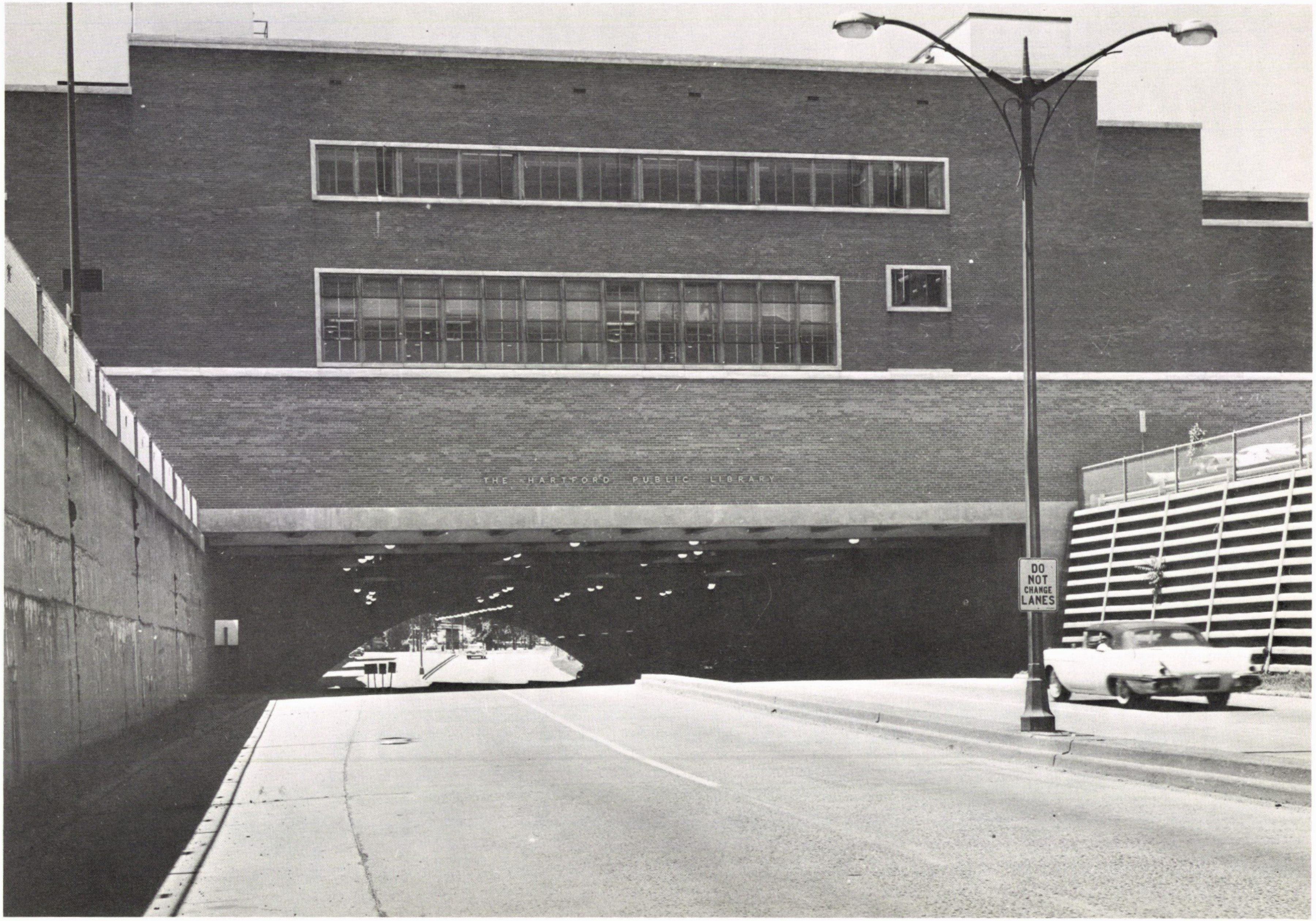


Figure 33. Hartford Public Library. The Hartford Public Library has recently completed this structure over the Whitehead Highway. It demonstrates the feasibility of modest-scale air-rights developments for a wide variety of land-uses, both public and private.

investment involved. Many of the uses evaluated in Table 18, such as agricultural and grazing, surface parking, bridle paths, local parks, and safety rest areas, represent minor capital investments and would generally not include buildings. Other uses, such as certain types of warehousing and storage, highway maintenance facilities, and truck weight stations, represent investments which are still not too extensive and which could be termed temporary uses.

In some cases, temporary development might be permitted in areas slated for future interchange construction. For example, the Maryland State Roads Commission indicated that a county recreation bureau has developed a playground and athletic fields within a future ramp area presently under state highway ownership.

TRAFFIC AND SAFETY CONSIDERATIONS

Quantity and Nature of Traffic Generation

Generally, no serious design or safety problems are associated with any of the multiple uses listed in Table 18, given that appropriate and widely accepted highway design practices are followed. There is some possibility that where major facilities are developed several multiple uses might cause problems in interchange design or in ramp and local street capacity. Specifically, the quantity of traffic generated during peak hours of traffic flow might present problems with air-rights developments, cultural-recreational facilities, highway and state police offices, understructure and interchange parking, and regional parks and recreation facilities.

The nature of traffic generated during peak periods might pose problems with multiple uses involving trucking operations (agricultural inspection stations, cattle loading pens, highway maintenance areas, tandem trailer areas, truck weight stations), and possibly with exclusive bus transit lanes at points where buses are required to merge with or separate from the normal traffic stream.

Although the quantity of traffic generated by certain uses may be small, the potential impact of this generation can vary considerably according to location of the uses. A study of interchange area traffic and planning problems in Illinois revealed a particularly high accident rate along interchange cross-routes associated with turning movements to and from roadside development near ramp terminals (*15*). The Illinois study concluded that:

> . . . Land uses immediately adjacent to interchanges exert an influence on area traffic operations far in excess of the actual quantity of traffic which they generate. The introduction of local traffic (even of small quantities) into the cross-route at critical sections adjacent to ramp terminals can seriously conflict with entering or exiting ramp movements. The access points serving this local traffic also create difficulties in adequately signing ramp movements and often confuse ramp-bound traffic.

Thus, it seems highly desirable to provide access to ramp interior developments via grade-separated crossings of the ramps, except possibly in enlarged ramp interiors where adequate speed-change and storage lanes for turns can be provided.

Access Requirements

Several multiple uses which are most appropriate for sidestrip areas require direct freeway access. These include agricultural inspection stations, safety rest areas, scenic overlooks, service plazas, and truck weight stations. In addition, direct freeway connections may be desirable for at least four other uses in Table 18 (including sidestrip bus stops). The principal stipulation for accommodating these access needs is simply to provide adequate speed-change lanes.

Except for toll road experience in providing access to service plazas, tandem trailer areas, and cattle pens, direct freeway access to multiple uses has been limited to public facilities for the highway user, such as safety rest areas and scenic overlooks, or administrative facilities such as truck weight stations. The states have followed a general policy in not allowing direct-access ramps to private developments such as shopping centers and industrial plants. In urban areas the relatively close spacing of interchanges with major surface streets will often preclude, from a design standpoint, intermediate access ramps to any development either on or off the right-of-way. Where adequate design standards can be applied, however, it would seem that direct freeway access should be considered for any major traffic generators that (1) generate significant quantities of valid freeway traffic and (2) do not stimulate short-trip use of the freeway.

Indirect freeway access through interchanges with major surface streets seems most appropriate for at least five multiple uses (highway and state police offices, understructure and interchange parking, highway maintenance and storage facilities, and tandem trailer areas).

Direct access from the local street or road system is required by more than one-half the multiple uses in Table 18, and is highly desirable for four others. In fact, few uses have been developed which do not particularly need or benefit from access to the surrounding local street system. Possible examples of such uses are scenic overlooks, truck weight stations, and safety rest areas.

Safety Problems

Most of the potential safety hazards associated with multiple-use development are related to the provision of freeway access to such uses. Preceding sections have already mentioned this problem in connection with left-side ramps to and from median areas on the Garden State Parkway in New Jersey. Although there appears to be a general reluctance among state highway agencies to develop left-side ramps, there is no conclusive evidence that this form of access is inherently more dangerous for auto traffic than any other, if appropriate sight distances and speed-change lanes are provided (*16*). This is particularly true in urban areas, where speeds in the left-side lane (normally the passing lane) would be relatively low and vehicles in this lane could better react to entering and departing traffic. The slower speeds of truck traffic, however, and the greater difficulties experienced by the driver in seeing the traffic stream with which he must merge suggest that uses attracting trucks are not generally appropriate for

median areas. In cases where such uses are developed in medians, longer speed-change lanes (2,000 to 3,000 ft) should be considered.

Screening of some multiple-use developments with appropriate landscaping would be desirable to aid in reducing possible freeway driver distraction. Generally, however, distraction from such uses should not be a significant problem, providing such obviously undesirable features as flashing lights, excessive smoke and dust, and glare are not permitted.

COSTS AND BENEFITS

Cost Considerations

Two types of direct costs seem important in potential multiple-use developments. One of these, the extent of the capital investment involved in the use itself, can be gauged only roughly in view of the considerable variation in size and scale of most multiple-use possibilities. Generally, air-rights developments involve the largest capital investments of any of the multiple uses—one reason, perhaps, for the increased attention they are receiving. Service plazas, exclusive transit lanes, and cultural-recreational centers usually have involved large capital investments, while three uses (highway and state police offices, regional parks, and safety rest areas) may involve investments of appreciable size.

Pumping stations, road maintenance and storage areas, scenic overlooks, truck weight stations, and warehousing and storage facilities appear to fall in the "moderate" investment range, with five other uses probably involving capital costs of a relatively minor to moderate nature. Of course, these relative comparisons must be interpreted liberally with regard to specific cases according to the size of developments. For example, the interchange parking facility developed by the Massachusetts Turnpike Authority (Fig. 23) represents a modest investment when compared to the large BART interchange parking facility illustrated in Figure 34.

A second type of direct cost involves highway-related expenditures required to provide access to, or otherwise facilitate the development of, multiple uses. These might be incurred solely by either the highway agency or the developer of the multiple use, but more likely by both in a joint effort.

Typical of improvements included in this group are the following:

1. Speed-change lanes and ramps to serve multiple uses requiring direct freeway access.
2. Vehicle and pedestrian grade separations to provide access to ramp interiors from adjacent areas.
3. Additional spans in freeway bridges to accommodate linear multiple uses paralleling the freeway (such as exclusive transit lanes and bridle paths).
4. Expansion of interchange ramp interiors beyond normal right-of-way needs to create developable land areas (additional right-of-way costs plus additional construction costs resulting from longer ramps).

Whereas each of the foregoing improvements conceivably could be constructed on or along an existing freeway, the last two would produce a significant disruption of traffic during construction and could best be accomplished at the time the freeway is built.

There are certain multiple uses, such as agricultural and grazing, local parks, and other sidestrip uses oriented to the surrounding area, which require little or no highway-related costs, and, in fact, may reduce highway maintenance costs.

Of course, the use of understructure areas can be ac-

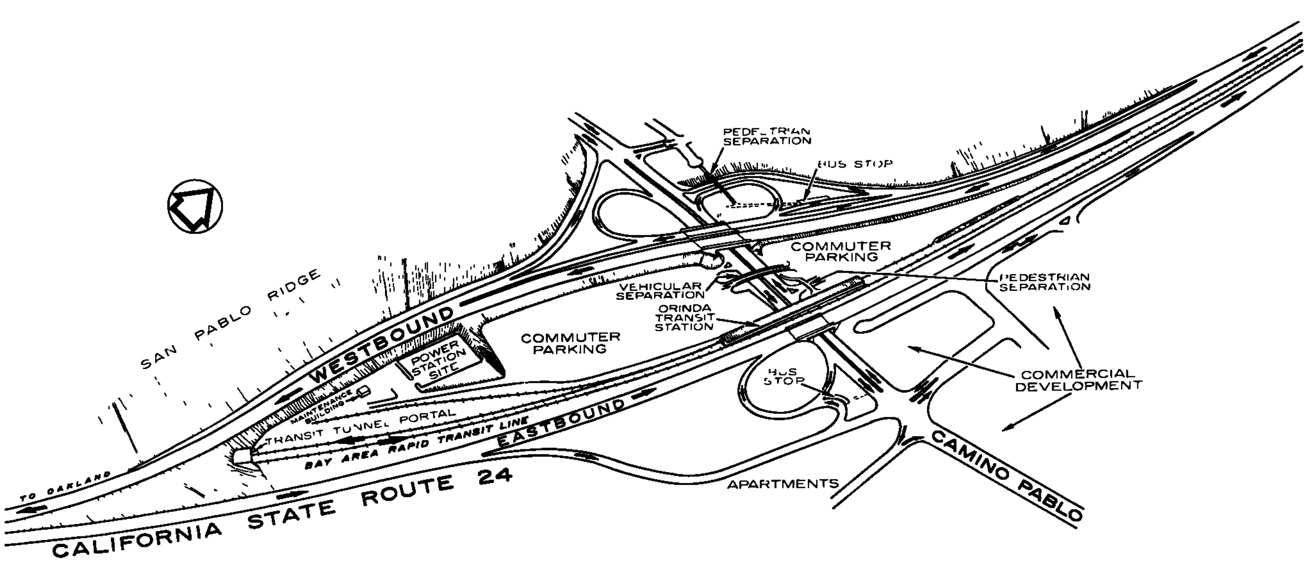


Figure 34. California median transit and parking. An existing freeway interchange at Orinda Crossroads will be reconstructed to allow development of a median transit line and station, as well as a large commuter parking lot. The parking and transit facilities are being constructed by the San Francisco Bay Area Rapid Transit System to serve a growing suburban area east of Oakland.

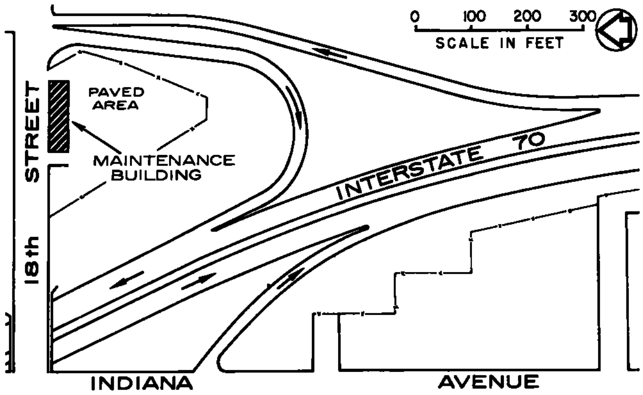


Figure 35. Missouri interchange maintenance area. This is another example of the multiple use of a ramp interior parcel (3.4 acres) for maintenance purposes. Note that the developed area is of sufficient size (1 3 acres) to support a wide range of alternative urban land-uses. This maintenance area is located along I-70 in Kansas City, Mo.

complished with no extra highway cost (assuming the freeway was built on structure for reasons other than to provide multiple use of the land).

In summary, it would seem that most of the multiple uses evaluated in Table 18 do not represent major capital investments and could be considered as temporary occupants of the right-of-way until such time as the land is needed for route widening. Most uses oriented to the surrounding community, rather than the freeway, can be developed with little additional highway-related costs, except possibly for interchange ramp interior developments.

Where it is necessary to provide local access to ramp interiors, the cost for a vehicular underpass under the ramps of a typical cloverleaf map range from $80,000 to $100,000. A pedestrian underpass might be developed for $20,000 to $30,000. Grade-separated access to diamond ramp interiors should be less expensive than cloverleaf interiors because only one ramp must be bridged or underpassed.

Finally, in addition to the capital costs discussed for various uses, it should be remembered that several will involve significant maintenance costs to the public. For example, with the increasingly wide range of facilities offered at safety rest areas, their maintenance represents a growing cost to state highway agencies. The eventual widespread use of rest area attendants may become necessary to protect these facilities from vandalism and to ensure reasonable standards of service and upkeep.

Multiple-Use Benefits

Generally, multiple-use benefits might be classified as those accruing primarily to (1) freeway users, or (2) the surrounding community and general public. Both types are essentially public in nature, as distinguished from those which also may accrue to private individuals or firms (although "private" benefits may also be termed public in that increased private investments add to the community tax base).

Several multiple uses in Table 18 produce benefits for both freeway users and the surrounding community. Public transit facilities on freeway rights-of-way may provide a higher level of transportation service to more urban residents than would otherwise be possible or practical. Increases in transit use resulting from such improvements can provide a direct benefit to freeway users by accommodating trips which might otherwise contribute to freeway loads. Similarly, parking facilities developed on freeway rights-of-way directly benefit residents of the surrounding area by facilitating car pooling and park-and-ride transit use, while, again, reducing volumes on the freeway. Cultural-recreational centers and regional parks help to meet growing local area recreational needs, and may be of benefit to freeway users by making important regional-recreational facilities accessible.

Several uses provide direct benefits primarily to freeway users rather than the surrounding community. Safety rest areas make appropriately spaced rest opportunities available to long-distance travelers and have become well-established in the interests of highway safety. Service plazas on toll facilities also provide this rest stop opportunity, while also offering directly accessible food and fuel services. Scenic overlooks combine rest opportunities with important aesthetic amenities. Truck weight stations, agricultural inspection stations, tandem trailer areas, road maintenance facilities, and highway and state police offices provide a subgroup of indirect benefits to freeway users and the general public through their regulative and administrative functions. The function of virtually all of these uses is strongly related to, or facilitated by, a location on freeway right-of-way.

At least four multiple uses produce benefits primarily for the surrounding community, rather than the freeway user. Air-rights developments can take the form of many activities serving a wide range of community functions, and where appropriate can unite activities which might otherwise be split by freeways. Local parks and playgrounds as multiple uses also help to meet growing urban recreational needs, while understructure parking serves to accomodate local parking needs. More limited benefits seem to be associated with the specialized recreational activities which have been developed upon highway lands (bridle paths, boat launching, and access to streams), and with such coincidental local uses as flood control ponding and pumping stations.

Aesthetic Considerations

With the increasing national interest in highway beautification, aesthetic considerations may well become prime criteria in evaluating multiple-use development proposals. Unquestionably, the development of many types of multiple use will present a challenge to building and landscape architects in preparing both functional and attractive designs. At the same time, many of these uses can present opportunities to reflect imaginative and varied aesthetic roadside design. For example, the concept of linear com-

munity parks paralleling and incorporating portions of freeway rights-of-way can provide a more attractive environment for the freeway motorist, as well as meeting an important community need.

A number of multiple uses offer important opportunities for development of outstanding architectural landmarks. Air rights and interchange area rights-of-way offer potential sites for such regional landmarks. On a more limited scale, such mundane uses as transit stations, service plazas, and highway and state police offices offer architectural possibilities. Safety rest areas, regional parks, and, in some instances, local parks represent uses where aesthetically pleasing natural features are typically permitted to dominate site development.

Only two or three multiple uses might be so situated that planting and landscaping would be unable to relieve their essentially unsightly character—road maintenance and storage areas and tandem trailer areas (cattle loading pens probably would fall into this category, but the infrequent occurrence of this use suggests that it presents no great problem). A number of other uses are quite amenable to landscaping and visual site improvement, oriented to both freeway and cross-route traffic. These include agricultural inspection stations, understructure parking, interchange parking, local parks and playgrounds, pumping stations, truck weight stations, and warehousing and storage.

POSSIBLE NEW MULTIPLE USES

Probably the greatest potential for future multiple use of freeway rights-of-way lies not in activities making exclusive use of such areas, but in opportunities for combining unused rights-of-way with adjacent parcels to form developable sites. The linear park proposals discussed previously provide examples of this coordination of right-of-way with adjacent land area to achieve a broad community goal, whether it is the provision of needed parkland for neighborhoods or parking for industrial and commercial development.

Although the idea of combining freeway rights-of-way with adjacent land to form park sites may not be new, the concept of such actions on a metropolitan basis through coordination of the Federal Highway and Open-Space Land Programs may provide a new source of needed urban parkland. In portions of many cities the grassed and landscaped slopes of freeways already represent the only substantial "open space" through an area. If this space could be partially recaptured and extended, it could contribute significantly to achieving the goal of the Open-Space Land Program; namely, the assurance of a pleasant living environment in urban areas.

Under this program, federal grants to an eligible public body may be made for up to 20 percent of the cost of the land acquired, and up to 30 percent in cases where the public body has authority to acquire open space for an urban area as a whole or for all of a substantial portion of an urban area under an interstate or intergovernmental compact. The open-space lands must also conform to a comprehensive plan for the urban area. Use of this joint approach to freeway development can aid considerably in reducing frictions between the traffic facility and adjacent land-use in helping to weave the freeway unobtrusively into the community.

Activities encompassing both freeway right-of-way and adjacent land (such as described previously) are most likely to use sidestrip areas including unused parcel remnants. Special uses occupying only freeway rights-of-way are more likely to utilize median and ramp interior areas where it is impossible (without grade-separated connections) to link these areas adequately with adjacent development sites. Thus, possible new multiple uses might be categorized in two major groups: (1) a wide range of activities representing simply an extension of adjacent land-uses into portions of the freeway right-of-way, particularly in the case of sidestrip areas, and (2) special uses which are developed entirely upon freeway right-of-way.

Obviously, most of the land-uses in the first category tend to be related to the surrounding community rather than freeway users, and as long as they do not represent substantial capital investments or present safety hazards to freeway traffic, can take virtually any form. For this reason, the discussion of potential new multiple uses is concerned primarily with those that might be developed completely upon freeway right-of-way.

Given that unused right-of-way parcels of one-half acre or more in size are quite common (sidestrips, ramp interiors, understructures) and that safe, convenient access could be assured, a wide variety of multiple uses occupying only freeway land could be developed. A limiting factor is that freeway traffic operations not be hindered by the development and operation of any type of multiple use. The "linear" character of most freeway right-of-way (sidestrips and medians) offers unique opportunities for coordinated locations with land-uses exhibiting similar linear characteristics. Some uses in this group have already been reported by the survey (i.e., bridle paths, parks, and transit lines). These linear uses are often difficult to accommodate in urban areas because of traditional block or grid development, which seldom produces continuous linear sites.

Two uses which would seem uniquely suited for these linear rights-of-way are commercial pipelines and public utility lines, particularly major outfall lines. The survey of state highway agencies did not reveal any cases where these two uses have actually been developed within freeway rights-of-way, although the New York Thruway reported at least one inquiry about a possible pipeline location in its right-of-way between Rochester and Albany. Of course, along with these facilities would go the control and pumping stations required at various points along the lines. The location of these facilities in medians versus sidestrips would likely depend on the probable future location of route widening.

There may be some problems associated with the occasional maintenance of these utilities, particularly where major excavation is involved. Generally, this use of right-of-way would be appropriate only for utilities that could be placed underground, because of the safety and aesthetic problems that could be created by poles, towers, or pipelines above the surface and within the right-of-way.

Decentralized government and professional offices represent another group of activities which would seem appropriate for ramp interior development. Vehicular or pedestrian grade separations would probably be required to provide access to these facilities, although direct access from a cross-route might be possible in some cases (for example, in large diamond ramp interiors in urban areas). Ramp interiors enlarged beyond normal design would be especially appropriate for such activities, inasmuch as the development could be of large scale and major opportunities could exist for distinctive architectural design. Several methods of achieving development and providing access to such development in various types of ramp interiors are illustrated in Fig. 31.

The location of certain types of government offices on freeway rights-of-way, where feasible, would seem to be simply a recognition of the broad public benefit to be gained from coordinating the sites of both public facilities. In effect, public funds would not have to be spent to purchase new building sites with adequate sites already in public ownership in the form of freeway rights-of-way.

A second type of public use which might be made of freeway lands is the development of police and fire stations or other emergency service facilities. Access to these developments would require careful design and special consideration of the emergency vehicles involved. In a more specialized case, these facilities might be emergency services which have a regional significance and could benefit from the access offered by a freeway location.

Another group of possible multiple uses might be activities requiring little or infrequent access which could represent a "convenience" use of interchange that might otherwise remain unused. This group might include such uses as electrical substations, telephone and television relay towers, and traffic signal system control centers. Most uses of this nature occupy relatively small sites and could probably be located in ramp interiors with relative assurance of permanency.

Finally, there would seem to be a wide range of miscellaneous uses which may, under certain conditions, be appropriate for freeway rights-of-way. For example, in urban areas where developable land may be at a premium, an interchange ramp interior might be a suitable location for a church. This use might be appropriate for an interchange location because the times of peak activity, Sunday morning and night, coincide with low traffic periods on the freeway and interchange facility. Another possible use for interchange area and sidestrip land in suburban and rural areas might be plant nurseries, which could be aesthetically pleasing to the freeway user and offer a convenient close-in location for such characteristically rural activities. Again, access to ramp interior developments could be provided by underpass or possibly by direct connection to the cross-route.

Another somewhat unusual use that many warrant consideration in certain sections of the country is the development of military grouping areas, wherein military convoys using the Interstate System are provided with rendezvous areas near military bases. When not in use for this purpose, these facilities might serve as safety rest areas for normal freeway traffic. In order for ordinary safety rest areas to serve this military function, however, normal design standards for these areas, in terms of parking provided, would have to be expanded. (Four facilities of this type have been provided in upstate New York.) Such developments would seem to be clearly within the intent of the Interstate highway program, which has carried a defense connotation since its inception (i.e., as reflected in its title: National System of Interstate and Defense Highways).

Another possible use which might be in line with interest in aesthetic and highway beautification would be the possible use of certain interchange areas to offer major symbolic, landmark, or gateway development opportunities for many cities. These could take the form of monuments or large-scale sculpture to serve as principal orientation points for freeway travelers and imposing entry points to major cities. Such developments could be provided with local access (vehicular or pedestrian) according to the extent of the development or the unique scenic opportunities that might be provided.

A final potential use of freeway right-of-way for which there will undoubtedly be pressure in the future is road user services including lodging facilities. Given policy clearance and recognition of site acquisition for road user services as a valid highway purpose, these facilities could be coordinated with the design of interchanges to provide safe and efficient traffic operation, while at the same time offering maximum convenience to these services. These activities require a high degree of visibility and accessibility from freeways and would thus appear to be logical choices for interchange development.

CHAPTER SIX

LEGAL AND POLICY CONSIDERATIONS

An important phase of this study was concerned with a comprehensive review of state highway enabling legislation throughout the country in order to make an assessment of present legal limitations on the use of controlled-access highway rights-of-way. The pertinent sections of each state's highway statutes were reviewed, as well as many special provisions with respect to turnpike authorities and commissions. The sections of the highway laws relative to counties and local communities were not included in the review.

Specifically, the statutes were reviewed to ascertain state requirements with respect to the following:

1. Express prohibitions against specified types of land-uses on property acquired for "highway purposes".
2. Designated purposes, in addition to area required for road surface, for which property may be acquired for highway right-of-way or highway purposes.
3. Authorization to acquire land deemed necessary for future, as well as present, highway needs.
4. Authorization to lease land acquired, but not immediately required (or possibly no longer needed) for highway purposes, for private or public development.
5. Unique features, if any, pertinent to the general problem of land-uses within right-of-way.

Because most of the freeway mileage in this country is part of the Federal Interstate System, the Federal-Aid Highway Law was examined to identify limitations which it might place upon right-of-way use.

IDENTIFICATION OF LEGAL ISSUES

The review of existing statutes and other background materials identified some of the major legal issues involved, directly or indirectly, in the development of land-uses within *freeway* or *controlled-access highway* rights-of-way. Many of these issues revolve around the limitations on state highway departments' powers to acquire rights-of-way. The highway departments' delegated eminent domain authority is usually limited to acquisition of land for purposes specified in statutes. Furthermore, antidiversion amendments in 28 state constitutions limit the highway departments' eminent domain power to use of highway funds for only certain specific "highway purposes."

Obviously, a key factor in multiple-use development then becomes the description of uses which are considered as legitimate "highway purposes." These, and other issues, which provide a framework for analysis, are as follows:

1. Permitted land-uses for which property may be acquired for "highway purposes" as specified in state enabling legislation.
2. The right of a state under existing enabling legislation to acquire land beyond that which is needed to meet present and identifiable highway needs.
3. If state highway law does authorize acquisition of land for future highway needs, the criteria to be followed in determining reasonably foreseeable future requirements.
4. The right of a state to lease land, not immediately needed for highway right-of-way, for interim private or public development.
5. Restrictions, if any, on length of time land may be leased for such interim development.
6. Restrictions, if any, on the right of a state to lease land for the interim development to any party, private or public, other than the owner from whom the state acquired the property.
7. The right of a state to sell or lease, on a long-term basis, land no longer needed for highway purposes, although originally acquired for such purposes.
8. Restrictions, if any, on the right of a state to sell or lease land no longer needed for highway purposes to a private party or public agency other than the former owner of the land.
9. The right of a state to sell or lease rights to air space above highways and below highway structures, as well as subsurface rights, for private or public development.
10. The right of a state to require a purchaser or lessee of such land to develop the land pursuant to an overall highway or interchange development plan so as to protect the highway improvement; the corollary right of a state to acquire land within a prescribed area adjacent to highway right-of-way, and to sell or lease this land with reservations on future use so as to protect the highway facility.
11. Specified prohibitions contained in state and federal enabling legislation against right-of-way occupancy by certain land-uses (particularly commercial road user service facilities).
12. The general exclusion of turnpike projects from statutory prohibitions against road user services on controlled-access facilities, and the rationale for this distinction in the enabling legislation.
13. The right of a state to assist private development of road user services on land adjacent to highway right-of-way through the construction of service roads.
14. The right of a state to acquire areas not needed for highway purposes to permit resale or lease of land to private interests in order to encourage development of road user service facilities.
15. The right of a state to utilize controlled-access rights-of-way for the provision of public mass transportation facilities.

16. The right of a state to regulate land development within and adjacent to highway rights-of-way by means of zoning, subdivision regulations, and other police power controls.

17. The right of a state to acquire easements for the use of land adjacent to highway rights-of-way in conjunction with the development of multiple uses on the rights-of-way.

"HIGHWAY PURPOSE" IN RIGHT-OF-WAY ACQUISITION

In determining the potential for multiple-use development, each state's enabling legislation must be examined to determine the scope of authority delegation in acquiring property for "highway purposes." State highway laws have generally spelled out the various uses which may be made of property acquired by the state highway agency. If, for example, the delegation of authority sanctioned the acquisition of property only for paved roadways plus shoulders, the question of multiple land development by public or private agencies would be largely academic. A review of existing legislation, however, indicates the delegation of authority goes substantially beyond such narrowly defined restrictions.

Specified "highway purposes" for which land may be acquired have included the following:

1. Camp sites, water sources, rock quarries, gravel pits, soil banks, borrow pits, and deposits of other building materials needed in the construction, improvement, or maintenance of state highways.
2. State offices, shops, maintenance camps, storage yards, inspection or weighing stations, radio transmitter or reporter stations.
3. Roadside parks, picnic grounds, and rest areas; informational sites and communication facilities; recreational and historical sites.
4. Culture and support of trees and bushes.
5. Construction of ditches, drains, gutters, sewers, or other improvements required in the drainage of state highways.
6. Preservation and maintenance of scenic beauty; scenic overlook areas.
7. Provision of unobstructed view in order to promote the safety of the general public.
8. Stock trails and cattle passes.
9. Roadway bridges, including railroad grade separations.
10. Provision of parking, service areas, and similar facilities along or near a controlled-access highway.
11. Control of advertising in areas within 660 ft of the edge of right-of-way of Interstate highways.
12. Land outside the highway right-of-way proper required to establish adequate fuel and other private service facilities for highway users.
13. Provision of access roads from highways to private road user service areas.
14. Protection of the state highway system from physical and functional encroachments.
15. Public mass transit facilities within median strips.

Some states simply delegate broad powers to acquire property for "highway purposes" and leave the determination of the necessary amount and use of land to the discretion of the highway agency. Most states, however, specifically enumerate (without necessarily limiting) uses to be included within the meaning of the term "highway purposes." This approach seems particularly appropriate with respect to the public development of multiple uses for rights-of-way. Provisions authorizing roadside rest areas, camp sites, and similar facilities in connection with highway construction have gained wide public acceptance; the necessity and desirability of such facilities are readily apparent to the motoring public, and their development is accepted as a valid public purpose. Netherton (*17*), in his analysis of the recently enacted federal highway beautification program, suggests that acquisition of land for beautification purposes would be a valid public or highway purpose. Thus, he would favor the approach of expanding those uses falling within the definition of "highway purposes" as a means of acquiring needed land for beautification rather than resort to the concept of "excess condemnation," which has never been particularly popular with the courts.

Public acquisition of private property for eventual redevelopment by private interests is admittedly subject to more criticism than in cases where the land is held for public development. However, this concept has been increasingly upheld by the courts, provided the benefits accruing to private developers are incidental to the achievement of a primary public purpose. Modern urban renewal legislation is based on this concept. The primary purpose of renewal is the elimination of slums and blighting environmental conditions and the subsequent redevelopment of the community, while the benefits which accrue to private redevelopers are incidental.

As is discussed later in this chapter, a few states have recognized that the development of road user service facilities is a legitimate public purpose, even though private enterprise is permitted to buy or lease public land in order to provide such facilities. A comparable rationale has been adopted by several states who authorize the highway agency to establish service roads to facilitate private development of road user service facilities.

ACQUISITION OF RIGHT-OF-WAY FOR FUTURE NEEDS

The right of a state to acquire land for highway purposes beyond that needed to fill immediate highway needs is an important factor in the future potential for multiple-use development. This right-of-way would constitute a prime source of land which could be utilized for public and private development until (if ever) needed for highway purposes.

Several states specifically delegate authority to a state highway agency to acquire such property as it deems reasonably necessary to meet future highway requirements. Many others give such authority by implication. An examination of the statutes indicates a total of 20 states that grant express power to acquire land for future highway needs (Alaska, Arizona, Arkansas, California, Colo-

rado, Idaho, Georgia, Indiana, Kansas, Louisiana, Maryland, Montana, Nebraska, Nevada, New Jersey, North Dakota, Oklahoma, Utah, Virginia, and West Virginia).

As an example of the present ambiguity in some statutes, several states, although not specifically authorizing acquisition for future needs, specifically authorize leasing of land not needed immediately for highway purposes. Several states apparently do not provide for such contingencies, which leaves state highway agencies and the courts with the problem of resolving the intent of the legislature. Because there are many advantages in terms of sound highway planning, as well as potential cost reduction, resulting from advance acquisition, the trend appears to be toward permitting the states to acquire land for determined future needs. This obviously increases the potential land available for interim multiple-use development.

Recent legal studies of judicial decisions upholding the validity of future acquisitions have indicated that the degree of reasonable certainty of future use was more important than the time period into the future for which the highway needs were projected (*18*). Future use acquisitions were more likely to be upheld if made pursuant to definite, comprehensive highway plans.

Related to the problem of future acquisition is the issue of "excess" land acquisition. Although 10 states have constitutional provisions authorizing acquisitions of additional land to protect the public improvement, previous research indicates that state legislatures often have not implemented these provisions by appropriate enabling laws. Moreover, even when implemented by statute, their application in practice has not been extensive. Only in situations where states have attempted to acquire unused remnants of parcels needed for highway improvements has the concept of acquiring land beyond actual highway needs been widely accepted. The rationale for this exception is that damage claims by property owners left with parcel remnants may be greater than the cost of acquiring the entire piece of property. Many states permit this procedure with respect to land acquired for any state highway, while several states restrict the practice to controlled-access routes.

RESALE AND LEASING OF RIGHT-OF-WAY

Assuming a state has the power to acquire land for future highway needs, it must have a corresponding right to make interim use of such land, if full potential for multiple use of rights-of-way is to be realized. Twenty-three states specifically authorize the state highway agency to lease land *acquired for future highway purposes until needed for such purposes* (Arizona, Arkansas, California, Connecticut, Florida, Hawaii, Iowa, Maine, Massachusetts, Michigan, Minnesota, Montana, Nebraska, Nevada, New Hampshire, Ohio, Oklahoma, Oregon, Utah, Virginia, Washington, West Virginia, and Wisconsin). Oklahoma law requires that the former owner, surviving spouse, or children of the former owner be given the right to exercise a first option to lease the property until it is needed for highway construction. New Jersey and other states have comparable provisions for determining priorities for leasing.

Although interim leasing powers have been granted in a substantial number of states, the power to lease land on a long-term basis, *when it has been determined that the land is no longer needed for highway purposes,* has been specifically granted in only a few states (even in those authorizing interim leasing). Only nine of the states listed, while authorizing the sale of land no longer needed, specifically authorize long-term leasing in lieu thereof (Connecticut, Florida, Hawaii, Maine, Massachusetts, Michigan, Oregon, Utah, and Washington). Long-term leasing (but no provisions for interim leasing) is permitted by Kansas, New Jersey, New York, and Vermont. As a practical matter, the absence of delegated long-term leasing authority may simply result in the extension of an interim leasing period and postponement of an administrative decision that such land is no longer needed for future highway purposes. Although most states specially authorize the sale of land no longer needed for highway purposes, some impose certain restrictions on this power. Colorado, Oklahoma, and a few others require that the former owner be given first option to purchase the property, while New Jersey and other states require sales to the highest bidder at public auction.

Some states have adopted special provisions with respect to leasing of right-of-way. Many of these laws deal with the leasing of air and below-grade or understructure development rights. The California Highway Department may lease the use of areas above and below state highways to public agencies or private entities, provided the proposed use is not in conflict with local zoning and adequate measures are taken to protect the safety and adequacy of the highway facility and abutting or adjacent land-uses. Leases to private parties must be awarded by competitive bid unless the determination is made that such bidding would not be in the best interest of the state. Hawaii law authorizes the state to acquire excess land where justifiable to protect and preserve the highway improvement, and thereafter lease the property with appropriate restrictions to accomplish these objectives. The Illinois State Toll Highway Commission is authorized to grant concessions and make "other arrangements" regarding the use of its right-of-way adjacent to, or over, the paved portion of the highway for motor fuel service stations, garages, hotels, stores, restaurants, and any other lawful purpose except for railroad, railway, or street railway use. A recent Massachusetts statute permits the leasing of air rights over state highways for terms of up to 99 years for any non-highway purposes which, in the opinion of the state highway agency, will not impair the construction, full use, safety, maintenance, or repair of the highway. A special provision in Minnesota law authorizes charitable hospitals within the city limits of St. Paul to provide parking facilities within the air space and below a trunk highway improvement.

In New Jersey the state may lease land no longer required for highway purposes to a municipality. New Jersey law also authorizes the state to sell air rights over any state highway facility to a municipality, which may, in turn, lease the air rights to a private party for non-

municipal use for a term of not more than 99 years. Pennsylvania law authorizes the state to permit private parking under the elevated portions of controlled-access highways, provided such parking does not require the construction of private facilities (in effect, a private party cannot construct and operate a parking facility but can use the unimproved area for parking). The state or a municipality, however, does have the right to construct and maintain parking facilities under such elevated structures.

Washington law permits the state highway agency to lease land no longer required for highway purposes to any city or county for a period of not more than four years. Specific authorization is granted to the state to lease the right-of-way adjoining the paved highway surface; any space over, under, or above any part of the controlled-access facility; and space over or under any ramp or any interchange. Use of such leased land and air rights is restricted to the construction of parking lots or other parking facilities so long as the use does not interfere with traffic movement. The lease may be to a private party or a municipality, with the term not to exceed 50 years. The parking improvement reverts to the state at the end of the leasehold term.

The foregoing examples indicate that the concept of interim and long-term leasing is gaining increasing acceptance among highway agencies around the country. Nevertheless, only 27 states have specifically given leasing powers (either long-term or interim, or both) to their highway agencies; this suggests that most state laws are still quite ambiguous, particularly as to interim disposition of unused highway rights-of-way. It is also apparent that many states have not followed through with enabling legislation to allow air-rights and subsurface developments, which the 1961 changes to the Federal-Aid Highway Act made possible on Interstate routes. Because of the significant potential for such developments (without adverse effects on freeway traffic), specific authorization to sell and lease air rights for public and private development should be granted to state highway agencies through state enabling legislation.

There would seem to be several advantages to the states in considering long-term leasing of rights-of-way as opposed to direct sale. A leasing concept has been a part of the federal urban renewal program for several years, and many agencies are now relying on this tool as a valuable device in land marketing. Leasing appeals to many developers, because it allows them to amortize land costs over a period of several years (all or a major portion of the leasehold term). The public agency may still require payments in lieu of taxes, thereby avoiding a loss of the property as a government revenue source. The tenant is generally given an option to purchase the land at a stipulated fair market value during a leasehold term. Upon expiration of the lease, the land reverts to the public agency.

Opponents of a leasing concept argue that the procedure places public agencies in the real estate business on a more or less permanent basis. Proponents contend that leasing gives the public a procedure for offering necessary incentive to developers; keeps land productive in revenues to the public for long periods while, in effect, providing a convenient and profitable method for developing long-range land banks for ultimate public use, if needed. Long-term leasing could possibly provide highway agencies with needed revenues over a period of years to offset a portion of highway operating and maintenance costs. It would seem essential, however, that specific delegations of power to lease be set forth in enabling legislation, because it is doubtful, in the absence of an express grant, that the courts would sustain the right of the highway agency to enter into a long-term lease.

LIMITATIONS ON PROVISION OF ROAD USER SERVICES

The Federal Highway Law, which established the Interstate Highway Program, requires a state, as a condition of federal financial assistance, to agree to prohibit the construction or location of automotive service stations or other commercial establishments serving motor vehicle users on the right-of-way of a highway within the Interstate System. Since 1961, the federal program has allowed states and local communities to use or permit the use of air space above and below the grade line of the highway for any purposes not requiring or permitting direct access to the Interstate Highway or in any way interfering with free flow of traffic on the Interstate System. Prior to 1961 the federal law restricted the use of such air space to the parking of motor vehicles.

In line with the provisions of the Federal Highway Law, 29 states have enacted prohibitions banning all commercial road user service establishments from locations on controlled-access highway rights-of-way (Alabama, Arkansas, Colorado, *Connecticut*, Delaware, Florida, *Georgia*, Idaho, Illinois, Louisiana, *Maine*, *Michigan*, Minnesota, Mississippi, *Montana*, *New Hampshire*, *New Jersey*, *New Mexico*, *North Carolina*, North Dakota, *Pennsylvania*, Rhode Island, South Dakota, Tennessee, Vermont, *Virginia*, *West Virginia*, *Wisconsin*, and Wyoming). In those states italicized in this list, this prohibition is broad enough to constitute a ban on *all* commercial facilities, whereas the remaining 16 states ban specifically road user services. All of these state statutes apply to non-federally-aided controlled-access highways, as well as those built under the federal highway program.

States have adopted two general approaches to soften this blanket prohibition of road user service facilities on controlled-access highways. First, some states have authorized their highway agencies to establish or permit service roads to privately-owned land adjacent to the highway in order to facilitate development of road user service facilities (Colorado, Idaho, New Jersey, New Mexico, North Carolina, Pennsylvania, Rhode Island, Tennessee, and West Virginia). New Jersey law is unusual in that it permits the state to acquire suitable areas for the private establishment of road user services, even though such property is not needed for highway purposes or the right-of-way proper. Presumably, the rationale here is that it is a valid public purpose to provide land for the establishment of such facilities for the general safety and well-

being of the motoring public. The sale of property acquired by the state must be made to the highest bidder at public auction. The purchaser becomes obligated to construct and maintain buildings in conformity with specified exterior design; to provide services reasonably required by users of the freeway or parkway; and to conduct no business other than that for which the property was originally sold without the consent of the state highway agency. Connecticut developed a few service areas in this manner in the 1950's but prohibition of future road user services on highway rights-of-way was enacted in 1959.

Many of the states, while placing severe limitations on commercial use of controlled-access highway rights-of-way, generally exempt turnpike projects undertaken by special authorities from such limitations. The rationale behind this distinction is apparently that a turnpike project, wholly financed by its bondholders, must be financially self-supporting. It must derive as much income as possible to insure payment of its financial obligations to bondholders, while at the same time providing services for the convenience of its cash customers, the motoring public. Thus, in this respect, a turnpike project is considered more as a private enterprise venture than as a public, tax-supported undertaking.

A typical situation exists in Louisiana, where the enabling legislation specifically prohibits automotive service stations or other commercial establishments serving motor vehicle users within controlled-access highway rights-of-way, except for projects of the Louisiana Expressway Authority or any other toll road or turnpike project. State law relative to these facilities specifically permits motor fuel and food services as deemed necessary.

MISCELLANEOUS STATUTORY PROVISIONS

Several states have enacted pertinent provisions which are somewhat unique in comparison with those discussed thus far. California, for example, permits the state to acquire land 150 to 200 ft on either side of the highway improvement and sell such property with appropiiate reservations as to future use of the land in order to protect the view, appearance, light, air, and usefulness related to the highway improvement.

Maryland law gives the state general power to acquire land along or near a controlled-access highway in order to protect the highway or to provide parking or service areas and for similar purposes.

Under Texas law, the state may acquire development rights, thus freezing any development therein for a period not to exceed seven years, for property determined necessary for future highway purposes.

In Wisconsin, the state may file a map of the proposed right-of-way for future expressway or freeway facilities. No building may be erected or altered within the proposed right-of-way unless the owner has given 60 days prior notice to the State Highway Commission. After the highway improvement has been constructed the state may convey the land not needed for highway purposes with such reservations as are needed to protect the highway improvement.

Delaware permits acquisition of timber land lying within a line parallel to and not exceeding 500 ft from the center line of any highway and holding it for future highway use until such time as it is not needed for such purpose.

Virginia law authorizes the state highway agency to acquire sufficient land in median strips for public mass transportation facilities. Such land may be converted to, or otherwise made available to, a public agency, authority, or public service corporation for construction of transit facilities. However, the highway agency may acquire the additional land only if a prior agreement has been reached with the transportation agency, whereby that agency agrees to pay the cost of acquiring the land.

CONTROL OF DEVELOPMENT ADJACENT TO FREEWAY RIGHT-OF-WAY

The appropriateness of multiple-use developments should always be considered within the framework set by the nature of development surrounding the freeway facility. This is particularly important in and around interchange areas. Similarly, the effective development of lands adjacent to interchange facilities must be strongly related to knowledge of the probable extent and impact of multiple right-of-way use development within the interchange facility.

Thus, it is apparent that planning and development of major multiple uses of interchange rights-of-way and land development adjacent to interchanges must be coordinated if efficiency and safety of traffic movement and high standards of land development are to be maintained. The question of how best to achieve some measure of control over land development in and around interchanges has been the subject of considerable research during the past five years. Recent experience with a study of this problem undertaken for the Illinois Division of Highways and the U.S. Bureau of Public Roads (*19*) indicates that local communities have generally failed to exercise zoning and other police power controls in the vicinity of interchanges so as to foster the sound and orderly development of these areas.

This Illinois Interchange Study concluded that new legislation vesting certain police powers in the state highway or state planning agencies would be necessary to supplement local powers. One method to accomplish this might be the adoption of state enabling legislation patterned generally after typical airport zoning laws presently in existence in several states. Such law would be based on the objective of eliminating safety hazards relative to transportation along public travel systems (airports and highways). A secondary objective of the proposed legislation would be to provide effective land-use controls which could contribute to maximum economic development of the interchange areas by: (1) eliminating or reducing uses not functionally related to highways, (2) providing building lots of adequate size to accommodate potential developers, and (3) conserving property values and public investment.

One possible feature of such a statute would be to permit municipalities or counties to prepare interchange

area plans and adopt police power controls for designated highway interchange districts. Such plans and controls would have to comply with state statutory requirements and administrative regulations of the appropriate state agency. The state agency would be empowered to prepare and adopt plans and regulations if requested by the local communities or if the communities fail to act within a specified period of time. In cases where communities adopted their own zoning laws, the state would have supervisory rights, coupled with enforcement powers, to ensure local enforcement pursuant to the objectives of the state enabling act. State powers would be limited to a certain area surrounding interchanges (perhaps a radius of 1 or 1½ miles). A more detailed description of this approach is contained in the final report of the Illinois Interchange Study (*19*).

Under such a program it should be possible to plan and develop multiple uses of rights-of-way with some assurance of the context (in terms of surrounding development) within which the multiple use must function.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

Conclusions to be drawn from the research reported herein are as follows:

1. Opportunities for multiple use of normal, controlled-access highway rights-of-way by activities using *only* those rights-of-way are limited in number and significance (excluding consideration of air and subsurface rights).

2. Generally, uses which might occupy *only* median or sidestrip rights-of-way should:
   (a) Exhibit, or be able to adapt to, a linear configuration.
   (b) Not adversely affect freeway traffic through excessive noise, smoke, dust, or other distractions or hazards.
   (c) Not be adversely affected by close proximity to freeway traffic.
   (d) Be compatible with adjacent land development.
   (e) Not require direct access from freeway lanes (except in certain cases, such as special bus transit lanes).

Examples of such land-uses are bridle paths; hiking and cycling trails; commercial pipelines and associated pumping and pressure control stations; utility lines and associated control stations; stock trails; bus and rail transit lines, stations, and stops; and small local parks and playgrounds.

3. Uses which might occupy normal ramp interiors and understructure areas are larger in number and significance —assuming local access is adequately provided. Generally, these land-uses should exhibit the same characteristics as listed for median and sidestrip areas (except for not having to assume a linear configuration). Examples of such land-uses are vehicular parking, highway maintenance and storage facilities, transit stops, playgrounds, parks, and other recreational facilities.

4. Opportunities for multiple use of sidestrips are greatly increased if these strips of highway land can be combined with adjacent non-highway land to form developable parcels. This technique can be used to develop highway-oriented uses such as safety rest areas, as well as uses oriented to the surrounding area or community, such as parks, grazing lands, and vehicular parking.

5. A promising development concept in urban areas might be the combination of freeway sidestrips and parcel remnants with adjacent land acquired through the Federal Open-Space Land Program to provide needed parkland. The environment of both nearby residents and freeway motorists would be enhanced by this joint program.

Urban renewal offers probably the greatest opportunity for combining freeway sidestrips and adjacent parcels for multiple use in urban areas. This coordination is, of course, limited to routes through blighted areas which qualify for urban renewal.

6. The greatest potential for future multiple uses of highway rights-of-way lies in the coordinated planning and development of the highway facility and adjacent land-use —from land acquisition through actual construction. Such a joint development concept provides an opportunity to optimize the use of these public lands by integrating the design of the traffic facility with the community which it traverses.

7. If appropriate design standards in terms of adequate speed-change lanes, sight distances, and signing are used, there seem to be no significant traffic hazards that might arise from multiple uses of rights-of-way (also assuming that traffic generated by the multiple use does not produce capacity problems).

8. Although safe auto access to median areas can be provided if adequate design standards are applied, land-uses requiring truck access are not recommended for median locations because of the slower speeds and greater driver visibility problems associated with truck traffic.

9. The legal grounds for making multiple use of highway rights-of-way are clouded by ambiguity in state enabling legislation concerning the acquisition, interim use, and possible disposal of lands acquired for "highway

purposes." The term "highway purpose" has been broadened to include many uses other than the paved roadway and varies by state from a specific listing of what the term includes to delegation of general authority to acquire land "as needed."

10. The authority to acquire land for future highway needs is not clearly delegated in many states, nor is the authority to lease on an interim basis lands not immediately needed for highway construction.

11. In many cases, the long-term lease of land no longer deemed necessary for highway purposes might be preferable to outright sale; however, many states are not legally empowered to make such leases.

12. At the state level, there is a serious lack of techniques to control or guide development adjacent to freeways, particularly in the vicinity of interchanges. Control of land-use in these adjacent areas is of significance to this study because it affects the context within which multiple uses of rights-of-way are developed. In effect, the appropriateness of multiple uses in a specific situation may hinge on the nature and character of land development adjacent to the highway facility. A lack of control over such development would seem to hamper approval of multiple-use development, while also being a possible source of congestion and hazard in itself.

13. There may be a need to consider the development of safety rest areas along freeways in major metropolitan areas. The vast areas covered by these large urban centers suggest that opportunities should be provided for motorists to stop, rest, check maps, etc., without leaving the freeway and getting involved with local arterial traffic. Where possible, such areas might be developed jointly with local park facilities abutting freeways.

14. Development of road user service plazas as a multiple use of highway rights-of-way is still very much an open question, with present research directed to an identification of the adequacy of privately-provided services off the rights-of-way in meeting motorists' demands. Infrequent spacing of interchanges and urban areas of substantial size in the western parts of the country may create acute needs for special road user service centers along some Interstate routes.

15. For the foreseeable future, operation of large tandem trailer trucking units (up to 108 ft) is likely to be confined to toll roads and turnpikes. This suggests that tandem assembly and break-up areas will continue to be a multiple use of right-of-way associated uniquely with toll-road facilities. Should restrictions on double-bottom operations on Interstate highways be relaxed, tandem trailer areas might be developed as multiple uses of rights-of-way along these routes, but are more likely to be located on private property off the highway right-of-way.

16. Increasing sales of travel trailer and camping units strongly suggest that overnight parking facilities for such units on highway rights-of-way may be a significant future addition to safety rest areas, particularly on toll roads and turnpikes.

17. Operation of public mass transit facilities within freeway rights-of-way is rapidly increasing across the country, particularly the development of express bus operations with both interchange and main-line stops. The major potential for this type of multiple use is likely to be limited to urban areas of at least 200,000 population.

18. Interchange parking facilities located in ramp interiors and along ramp sidestrips can serve an important park-and-ride function when coordinated with public transit. Use of such facilities by car poolers also seems promising under proper circumstances of demand.

19. Some of the most exciting opportunities for multiple-use development relate to the coordination of freeway rights-of-way with linear regional or community parks. Such developments provide a pleasing environment for motorists, as well as accommodating an acute community need. On a smaller scale, there are opportunities to develop local parks on highway rights-of-way to serve adjacent neighborhoods.

20. Highway understructure areas can sometimes offer significant development opportunities, primarily in urban areas. Where clearance heights are adequate, understructure areas would seem suited for virtually any use that (a) does not require direct freeway or ramp access, (b) can be developed around the limitations imposed by pier spacing, (c) is compatible with surrounding development, and (d) is not adversely affected by the environment created by the highway structure.

21. Demands for use of highway rights-of-way are certain to be greater in number and significance in large urban areas than in small cities and rural areas, primarily because of high land cost and scarcity of development sites in large cities. These factors enhance the appeal of unused rights-of-way as development sites, even though construction costs may be somewhat higher because of the necessity for partial or complete air rights development, provision of pedestrian and vehicular grade separations, or other special design features.

22. Except for those activities providing an essential service to freeway traffic or generating a substantial volume of trips that belong on the freeway, multiple uses of rights-of-way should generally depend on local access rather than direct access from the freeway lanes.

23. Through appropriate landscaping and building design, most multiple uses of rights-of-way can be developed as attractive elements of the highway environment. Certain uses, such as park facilities, can significantly enhance the highway environment.

RECOMMENDATIONS

Pursuant to the conclusions stated in the preceding section, the following recommendations are made:

1. Federal, state, and local highway and planning officials should actively pursue the coordinated planning and development of new freeways with land-use surrounding the highway facilities. The possibilities for joint acquisition of rights-of-way for highway and other community purposes should be explored. Where possible, departures from standard freeway and interchange design techniques might be considered to further integrate freeway and community design and development.

2. Local officials should actively seek opportunities to meet community needs for recreational areas, parking, transit, and other land-uses through existing and proposed freeway rights-of-way in their localities. State highway agencies, in turn, should seriously consider local proposals for the use of such rights-of-way and, to the extent possible, cooperate in facilitating such developments in freeway location and design.

3. It is recommended that states consider taking the following legal actions (where they are presently lacking):

(a) State enabling legislation should spell out the land-uses to be included in the term "highway purposes."

(b) These "permitted uses" should be as comprehensive and inclusive as possible.

(c) The states should enact legislation specifically delegating power to acquire land needed to meet future highway needs as defined by sound, comprehensive transportation planning.

(d) The states should enact legislation specifically delegating power to lease on an *interim* basis highway lands not presently needed for highway purposes, and to lease on a *long-term* basis or to sell lands no longer needed for highway purposes. Long-term might in some cases include ramp interiors and understructure areas.

(e) The states should enact legislation specifically delegating power to lease or sell air and subsurface rights on highways consistent with present federal policies on the Interstate System.

(f) The states should consider legislation to empower state highway agencies to exercise police power controls in the vicinity of freeway interchanges to ensure traffic safety and efficiency. Such legislation should have a further objective of guiding land development in these areas so as to achieve orderly growth and optimize economic development opportunities.

FURTHER RESEARCH

This study has provided a comprehensive survey and overview of multiple-use experience. Primary emphasis in future research should be placed on action-oriented projects directed to a demonstration of the feasibility of some of the forms and techniques of development described here. Top priority should probably be given to one or more demonstration studies in urban areas dealing with the coordinated location, planning, and development of a freeway with the community through which it passes. Demonstration studies along these lines are currently being considered by the U.S. Bureau of Public Roads and would represent an excellent opportunity to demonstrate the feasibility of multiple-use developments, particularly when they can be reflected in the original location and design of the freeway facility.

A second type of demonstration study might involve the development of multiple use of rights-of-way along an existing freeway through a joint effort by federal, state, and local officials. Again, the major purpose of such projects would be to demonstrate how multiple uses of rights-of-way might be achieved and to further identify any adverse effects on freeway traffic which such activities might produce.

Similarly, additional research is needed to determine the adverse effects which freeway traffic might have on possible multiple uses. For example, the effects of traffic noise, fumes, vibration, and air pollution on multiple uses, particularly those involving concentrations of people, should be examined. These effects would probably be most serious in association with air-rights developments, which have the most direct exposure to them.

Finally, subject to results of present research, the question of road user services on highway rights-of-way must be resolved through further study. One approach (being followed by present research) is to try to identify the adequacy of services provided by private enterprise at off-the-right-of-way locations. Another, possibly more basic, approach might be to determine the total costs to the public of services "on" versus "off" the right-of-way. When the cost to freeway drivers of leaving the freeway to search for services, plus the possible congesting effects of such traffic on interchanging cross-routes, plus increased patrol costs on the freeways, are all considered, this may present a strong case for allowing services on freeway rights-of-way.

REFERENCES

1. *A Policy on Safety Rest Areas for the National System of Interstate and Defense Highways.* AASHO (1966) 42 pp.
2. *Urban Freeway Development in Twenty Major Cities.* Automotive Safety Foundation (1964) 64 pp.
3. TAYLOR, M. C., "Services on Limited-Access Highways: Organized Pressures and the Public Interest." *Land Econ.* (Feb. 1959) pp. 24-34.
4. *An Information Guide on Services to Motorists on Interstate Highways.* AASHO (1961) 30 pp.

5. *The Problem of Service Facilities on Planned-Access Highways.* National Highway Users Conf. (1957) 12 pp.
6. *Recommendations for Commercial Vehicle Sizes and Weights.* Industry Advisory Committee (1963) 16 pp.
7. *A Policy on Arterial Highways in Urban Areas.* AASHO (1957) pp. 139-172, 435-437.
8. HOMBURGER, W. S., and KENNEDY, N., "The Utilization of Freeways by Urban Transit Buses: A Nationwide Study. *Res. Rep. No. 28.* Inst. of Transportation and Traffic Eng., Univ. of California (1958) 67 pp.
9. *A Policy on Locating Police Stations and Maintenance Yards Serving Interstate Highways.* AASHO (1959) 5 pp.
10. VOLLMER OSTROWER ASSOC., *Recommendations for Highway Beautification and Related Recreation: Interstate 81 Near Binghamton, N.Y.* (Sept. 1966) 19 pp.
11. *Freeway-Parking Developments.* Automotive Safety Foundation (1964) 73 pp.
12. GRUENBAUM, M. T., and HALE P. P., "Parking Conditions and Habits Near Expressway Interchanges." *Traffic Eng.* (June 1960) pp. 18-21.
13. LEVY, M. J., "Garden State Parkway Reports Interchange Parking Experience." *Traffic Eng.* (May 1966) pp. 14-15.
14. SILBER, H., "Elevated Freeway Gives City Chance to Use Imagination." *Omaha World-Herald* (Feb. 7, 1967).
15. BARTON-ASCHMAN ASSOC., *Highway and Land-Use Relationships in Interchange Areas, Supplementary Report No. 3: Case Studies of Selected Interchange Areas.* Illinois Div. of Highways (Aug. 1966) 82 pp.
16. BERRY, D. S., ROSS, G. L. D., and PFEFER, R. C., "A Study of Left-Hand Exit Ramps on Freeways." *Highway Res. Record No. 21* (1963) pp. 1-16.
17. NETHERTON, R. D., and MARKHAM, M., *Roadside Development and Beautification: Legal Authority and Methods: Part I.* HRB (1965) p. 23.
18. *Acquisition of Land for Future Highway Use. HRB Spec. Rep. 27* (1957) 80 pp.
19. BARTON-ASCHMAN ASSOC., *Highway and Land-Use Relationships in Interchange Areas, Supplementary Report No. 1: Current Laws and Practices Affecting Interchange Area Planning.* Illinois Div. of Highways (Aug. 1966) 19 pp.
20. RAINVILLE, W. S., *Expressway Bus Operations.* Amer. Transit. Assn. (1963).

State Highway Enabling Legislation Reviewed

Code of Alabama, Title 23, 1965 Cum. Supp.
Alaska Statutes, Title 19, 1966 Cum. Supp.
Arizona Revised Statutes of 1955, 1966 Cum. Supp.
Arkansas Statutes of 1947 (1957 Replacement Volume), Title 76, 1965 Cum. Supp.
Annotated California Streets and Highways Code, 1966 Cum. Supp.
Colorado Revised Statutes of 1963-64, Ch. 120.
General Statutes of Connecticut, Title 13a, rev. to 1966.
Delaware Code Annotated, Title 17, 1964 Cum. Supp.
Florida Statutes Annotated, Title 24, 1966 Cum. Supp.
Code of Georgia Annotated, Title 95, 1966 Cum. Supp.
Revised Laws of Hawaii 1955 (1965 Supp.)
Idaho Code, Title 40, 1965 Cum. Supp.
Illinois Revised Statutes (1965).
Annotated Indiana Statutes (1949 Replacement Volume), Title 36, 1966 Cum. Supp.
Iowa Code Annotated, Vol. 14, 1966 Cum. Supp.
Kansas Statutes Annotated (1963), Ch. 68, 1965 Cum. Supp.
Kentucky Revised Statutes (July 1962), Title 15.
Louisiana Revised Statutes (1965) Sect. 48, 1966 Cum. Supp.
Maine Revised Statutes Annotated, Title 23, 1966 Cum. Supp.
Annotated Code of Maryland—1957 (1964 Replacement Volume), 1966 Cum. Supp.
Annotated Laws of Massachusetts, Title 14, 1965 Cum. Supp.
Michigan Statutes Annotated (1958 Revision), Title 9, 1965 Cum. Supp.
Minnesota Statutes Annotated, Vol. 12A, 1966 Cum. Supp.
Mississippi Code of 1942 (Recompiled 1956), 1964 Cum. Supp.
Annotated Missouri Statutes of 1949, Title 14, 1966 Cum. Supp.
Revised Codes of Montana (1947), 1961 Replacement Volume, 1965 Cum. Supp.
Revised Statutes of Nebraska (1948), reissued 1960, Ch. 39, Cum. Supp. 1963.
Nevada Revised Statutes, Title 35 (1965).
New Hampshire Revised Statutes, Annotated (1964), Title 20, 1965 Cum. Supp.
New Jersey Statutes Annotated, Title 27 (1966).
New Mexico Statutes Annotated (1953), Replacement Volume 8, Ch. 55, 1965 Cum. Supp.
New York State Highway Law, 1966 Cum. Supp.
General Statutes of North Carolina, Ch. 136, 1965 Cum. Supp.
North Dakota Century Code, Title 24, 1965 Cum. Supp.
Ohio Revised Code Annotated, Title 55, 1966 Supp.
Oklahoma Statutes Annotated, Title 69, 1966 Cum. Supp.
Oregon Revised Statutes, 1965 Replacement Parts.
Pennsylvania Statutes Annotated, Title 36, 1966 Cum. Supp.
General Laws of Rhode Island (1956), Title 24, 1965 Supp.
Code of Laws of South Carolina (1962), Title 33, 1966 Cum. Supp.
South Dakota Code of 1939 (1960 Supplement), Title 28, (plus session laws through 1966).
Tennessee Code Annotated, Title 54, 1966 Cum. Supp.
Civil Statutes of State of Texas Annotated, Title 116 1966 Cum. Supp.

Utah Code Annotated (1953), Title 27, 1965 Cum. Supp.

Vermont Statutes Annotated (1959 Revision), Title 19, 1965 Cum. Supp.

Code of Virginia Annotated (1950), Title 33, 1966 Cum. Supp.

Revised Code of Washington Annotated, Title 47, 1966 Cum. Supp.

West Virginia Code, Ch. 17, 1966 Cum. Supp.

Wisconsin Statutes Annotated, Ch. 84, 1967 Cum. Supp.

Wyoming Statutes Annotated (1957), Title 24, 1965 Cum. Supp.

APPENDIX A

BIBLIOGRAPHY

GENERAL BACKGROUND

Landscape Design Guide. Amer. Assn. of State Highway Officials (1964) pp. 24-33, 60-82.
Among the topics discussed are the design of both urban and rural interchanges, safety rest areas, scenic overlooks, parking lots, and recreational and park areas.

Urban Freeway Development in Twenty Major Cities. Automotive Safety Foundation (1964) 64 pp.
An examination of the distinguishing characteristics of various freeway systems, among them multiple uses such as buildings spanning freeways, freeway transit systems, understructure parking, emergency stop areas, restaurant-service station areas, adjacent parks, and water collector areas. Extensively illustrated.

What Freeways Mean to Your City. Automotive Safety Foundation (1964) 56 pp.
A review of the economic and social consequences of freeways in urban areas, including travel time savings, increased traffic safety, business-industry location and relocation, effect on property values, and the coordination of freeways with public transit, recreation, and parking. Extensively illustrated.

BARNETT, J., "Policies Affecting Interstate Design." *Traffic Eng.* (May 1958) pp. 14-17.
A discussion of the Interstate System policies of the U. S. Bureau of Public Roads concerning such multiple uses as safety rest areas, frontage roads, service stations, police and maintenance facilities, and tourist information stations.

The Art and Science of Roadside Development. HRB Spec. Rep. 88 (1966) 81 pp.
A comprehensive review of the many facets of roadside development, including discussions of aesthetics and roadside development in highway location and design; right-of-way, scenic areas, and adjacent land-use; roadside rest areas; and scenic turnouts and overlooks.

THEIL, F. I., "Highway Interchange Area Development." *Hwy. Res. Record No. 96* (1965) pp. 24-25.
A review and evaluation of recent research studies of the "interchange problem" which considers the economic and traffic complexities of land development at interchanges, police power and eminent domain controls available for guiding such development, priorities for land-use planning of interchanges, space needs at interchanges, and an overview of additional information needed.

SAFETY REST AREAS

A Policy on Safety Rest Areas for the National System of Interstate and Defense Highways. Amer. Assn. of State Highway Officials (1966) 42 pp.
Safety rest areas may be designed for short-term picnic use as well as parking of vehicles for short periods, but areas for leisure picnics, active recreation, waterfront activities, or overnight camping are not to be developed as a part of an Interstate highway, nor are such areas to have direct freeway access. Discussed are the location, spacing, and size of safety rest areas, factors in site selection, site layout and design, and safety rest areas at interchanges. Extensively illustrated.

ECKERT, E. C., "A Concept for Interstate System Rest Areas." *Hwy. Res. Record No. 23* (1963), pp. 42-47.
A detailed description of natural characteristics, locational factors, site design, facilities provided, landscaping, and maintenance standards important in the provision of Interstate rest areas.

HEAD, J. A., "Use of Safety Rest Areas." *Proc. HRB,* Vol. 41 (1962) pp. 375-414.
This study provides data on the amount and character of use of seven existing rest areas on the Interstate System.

ATEN, C. E., "Safety Rest Areas on Wisconsin's Interstate System." *Proc. Amer. Assn. of State Highway Officials* (1960) pp. 313-314.

BRANT, F. H., "Roadside Development as Related to the Interstate System." *Roadside Development—1958,* Hwy. Res. Board, pp. 55-70.

ECKERT, E. C., "Design of Roadside Rest Areas and Weigh Stations." *Proc. Amer. Assn. of State Highway Officials* (1960) pp. 212-218.

GARMHAUSEN, W. J., "Roadside Parks on Limited-Access Highways." *Roadside Development—1956,* Hwy. Res. Board, pp. 57-60.

GARMHAUSEN, W. J., "Roadside Rest Requirements on the Interstate Highways." *Roadside Development—1962,* Hwy. Res. Board, pp. 40-44.

GARMHAUSEN, W. J., "Roadside Rest Sign Welcome Sight for Motorists in Ohio." *Better Roads* (May 1961) pp. 25-27.

GARMHAUSEN, W. J., "Trends and Use of Highway Safety Rest Areas." *Proc. Amer. Assn. of State Highway Officials* (1960) pp. 242-245.

"Parking Turnouts and Rest Areas." *HRB Spec. Rep. 7* (1952) 52 pp.

KAY, B. J., "Roadside Rest Area Design." *Proc. Amer. Assn. of State Highway Officials* (1963) pp. 158-166.

SIMONSON, W. H., "Roadside Problems on the Interstate Highway System." *Roadside Development—1957,* Hwy. Res. Board, pp. 3-32.

SERVICE PLAZAS

An Information Guide on Services to Motorists on Interstate Highways. Amer. Assn. of State Highway Officials (1961) 30 pp.
A discussion of (1) normal services for motorists and vehicles, including fuel, automotive service, comfort stations, restaurants, lodgings, and safety rest areas; (2) freeway patrolling; and (3) emergency assistance. All of the uses under (1) except safety rest areas must be located on crossroads and frontage roads accessible to Interstate travelers only through interchanges.

HARTFORD, C. W., "Public Services on Controlled-Access Highways." *Jour. Hwy. Div., Proc. Am. Soc. Civil Eng.* (Dec. 1959) pp. 143-147.
Distinguishing between services of necessity and services of convenience, this article notes that the former are necessary on all controlled-access highways, whereas the latter may be necessary on rural freeways. Data are presented on gas station-restaurant operations on the Ohio Turnpike.

MARBLE, D. F., "User Services and the Demand for Land at Interchange Points." *HRB Bull. 288* (1961) pp. 25-31.
An evaluation of available information regarding road-user behavior under conditions of limited and unlimited access to service facilities, also noting the possible development of tandem-trailer truck transfer terminals at Interstate interchange areas.

The Problem of Service Facilities on Planned-Access Highways. Nat'l. Highway Users Conf. (1957) 12 pp.
A review of the reasoning behind the establishment of controlled-access highways, the desire to avoid monopolistic concessions in the provision of road-user services, and techniques for encouraging free competition in the development of user services on cross-routes and frontage roads at highway interchanges.

POORMAN, F. S., and CHAMBERLIN, R. E., "Suggested Activities for Future Roadside Development Research." *Hwy. Res. Record No. 23* (1963) pp. 39-42.
Taking issue with the federal prohibition of service stations and restaurants with direct access from Interstate highways, this article considers safety rest areas which allow for limited provision of these facilities.

TAYLOR, M. C., "Services on Limited-Access Highways: Organized Pressures and the Public Interest." *Land Econ.* (Feb. 1959) pp. 24-34.
This article presents an analysis of the issues involved in the provision of road-user services. It notes that three different interest groups are involved—the users of the highway, the suppliers of services, and the public road-building agencies—and that the overriding consideration in the construction of limited-access highways is the maximum satisfaction of the highway user in terms of convenient, fast, and safe travel. The study concludes that toll highway experience and practice in providing road-user services has not been adequately evaluated, and that at the very least a second look at the problem appears warranted.

BILLINGS, C. H., and SANDER, I. P., "Determining the Future Needs of Highway Rest Areas." *Pub. Works* (Oct. 1966) pp. 108-111.

FELTY, F. J., "Location and Establishment of Road User Service Areas." *Proc. Amer. Assn. of State Highway Officials* (1956) pp. 47-60.

HARTFORD, C. W., and HOTTENSTEIN, W. L., "Motorists' Needs on Rural Freeways." *Roadside Development—1961,* Hwy. Res. Board, pp. 46-48.

KOHN, M. J., "Motorists' Services on Limited-Access Highways." *Traffic Eng.* (Mar. 1964), pp. 14-16.

MCKEEVER, H. J., "What the Public Should Expect of the New Freeways." *Roads and Streets* (May 1959) pp. 110-112.

NOBLE, C. M., "Service Areas on Controlled-Access Highways." *Proc. Amer. Assn. of State Highway Officials* (1956) pp. 61-65.

TRUCK WEIGHT STATIONS

BLYTHE, D. K., DEARINGER, J. A., and PUCKETT, R. E., "Research Report on Electronic Highway Scales for Weighing Trucks in Motion." *Hwy. Res. Record No. 100* (1965) pp. 55-57.

SCHIMPELER, C. C., and DEARINGER, J. A., "Dynamic Vehicle Weighing: An Analysis of the Broken Bridge Electronic Scale." *Traffic Quar.* (Jan. 1966). pp. 71-93.

"Weighing Trucks at Highway Speeds." *Fleet Owner* (Apr. 1966) pp. 118-123.

TANDEM TRAILER AREAS

Policy on Maximum Dimensions and Weights of Motor Vehicles to Be Operated over the Highways of the United States. Amer. Assn. of State Highway Officials (1964) 20 pp.
Recommended maximum limits on vehicular width, height, length, axle weight, and gross weight which have been established to promote safety, efficiency, and economy in both the interstate and intrastate operation of motor vehicles. A maximum length of 65 ft is recommended for truck combinations.

Vehicle Sizes and Weights: Highway Transportation and the Nation's Economy. Amer. Trucking Assns. (1962) 16 pp.

Recommendations for Commercial Vehicle Sizes and Weights. Industry Advisory Comm. (1963) 16 pp.
This and the preceding booklet represent policy statements on behalf of the trucking industry. Maximum truck combination lengths of 70 ft on primary routes and 110 ft on Interstate routes are suggested, with the larger combinations permitted "on highways where designated by the proper authorities as safe and operational."

REMSBERG, O. Z., "The Case for Double Bottoms." *Traffic Safety* (June 1965) pp. 22-24.

SWART, B., "Coast-to-Coast Double Bottoms Loom." *Fleet Owner* (July 1965) pp. 84-85.
This and the preceding article discuss the gradual adoption of 65-ft length standards for truck combinations by various states, the experience of trucking firms with several trailer sizes (22 to 45 ft in length), and such operating characteristics as cargo capacity, weight distribution, maneuverability, stopping ability, and other safety aspects.

"Motor Vehicle Size and Weight Limits." *Pub. Roads* (Aug. 1965) pp. 192-193.

Thruway Tandem Operations. New York State Thruway Auth. (1966) 44 pp.

"Maximum Desirable Dimensions and Weights of Vehicles Operated on the Federal-Aid Systems." U. S. Department of Commerce, Bur. of Public Roads, *House Doc. No. 354* (Aug. 1964) 172 pp.

WHEELER, D. B., "Sizes and Weights Today and Tomorrow." *Trucking Bus.* (May 1965) pp. 41-43.

CLAUSON, L. M., "Policy on Maximum Dimensions and Weights of Motor Vehicles to Be Operated over the Highways of the United States." *Amer. Highways* (July 1965) pp. 8-15.

PUBLIC TRANSIT FACILITIES

A Policy on Arterial Highways in Urban Areas. Amer. Assn. of State Highways Officials (1957) pp. 139-172, 435-437.
A thorough review of the design requirements of public transit facilities operating on urban freeways, detailing actual and proposed layouts of bus stops for vehicles operating in the mixed traffic stream. Various ramp and turnout arrangements are considered for diamond and cloverleaf interchanges, and some attention is also given to median strip rail transit facilities. Extensively illustrated.

HOMBURGER, W. S., and KENNEDY, N., "Provision of Bus Loading Facilities on Urban Freeways." *Proc. HRB,* Vol. 38 (1959) pp. 530-546.
A discussion of the need to provide loading facilities adjacent to or within the freeway right-of-way where trunk-line bus service is under consideration, and a review of possible bus stop designs at diamond and cloverleaf interchanges. The integration of parking facilities and auto drop-off areas with freeway bus stops is also considered. Well illustrated.

HOMBURGER, W. S., and KENNEDY, N., "The Utilization of Freeways by Urban Transit Buses: A Nationwide Study. *Res. Rep. No. 28,* Inst. of Transportation and Traffic Eng., Univ. of California (1958) 67 pp.
A review of freeway bus operations in nine major cities concerned with (1) the extent to which urban freeways are used by transit companies, (2) the conditions that may determine the feasibility of freeway express bus service, and (3) the nature of requirements for bus-loading facilities within freeway rights-of-way.

New Horizons for Chicago Metropolitan Area. Chicago Transit Auth. (1958) 30 pp.

HEIER, J. J., and GLANCY, D. M., "Modern Expressways and Public Transportation." *Traffic Quart.* (Jan. 1963) pp. 124-132.

MCCONOCHIE, W. R., "Facilities for Express Bus Operation on Freeways." *Proc. Inst. of Traffic Eng.* (1959) pp. 221-227.

RAINVILLE, W. S., *Expressway Bus Operations.* Amer. Transit. Assn. (1963) 96 pp.

PARKS AND RECREATIONAL AREAS

CLAWSON, M., "Implications of Recreational Needs for Highway Improvements." *HRB Bull. 311* (1962) pp. 31-38.
In evaluating the factors involved in the steadily increasing demand for outdoor recreation, this paper concludes in part that highways and freeways should be better suited to moving people for recreation, and implies that recreational-educational-cultural facilities should be integrated with freeway development.

DISQUE, E. A., "Symposium on Parkway Concepts and Design." *Roadside Development—1961.* Hwy. Res. Board, pp. 59-76.

LOVELACE, E., "The Automobile and Recreation." *Traffic Quart.* (Oct. 1966) pp. 525-540.

OPPERMAN, P., and ROCKWELL, M., "A Design Project for the Northeastern Illinois Metropolitan Area." Northeastern Illinois Metropolitan Area Planning Comm. (July 1963) 4 pp.
This memorandum proposes uses for the "hundreds of acres of dead land" at the interchange of the Congress and Tri-State Expressways, including: (1) a drainage, flood control, and water storage area; (2) a recreational area with fishing, swimming, boating and/or other facilities such as an outdoor amphitheater; (3) a park-and-ride terminal for the Congress Expressway median strip transit system. Highway right-of-way is partially involved in the proposals.

PUSHKAREV, B., "Highway Location as a Problem of Urban and Landscape Design." *Hwy. Res. Record No. 23* (1963) pp. 7-19.
Mentioned in this discussion of freeway aesthetics are widened rights-of-way for depressed urban freeways, properly landscaped and integrated with parks and playgrounds, where local area recreational access is provided to excess right-of-way land.

TUNNARD, C., and PUSHKAREV, B., *Man-Made America: Chaos or Control?* (1963) pp. 206-276.
Part three of this volume—"The Paved Ribbon: The Esthetic of Freeway Design"—deals in part with the external harmony of freeways, and considers such multiple uses as large-scale roadside sculpture display, scenic overlooks, median strip artificial lakes, and the integration of the freeway with recreational facilities. Extensively illustrated.

VOLLMER OSTROWER ASSOC., *Recommendations for Highway Beautification and Related Recreation: Interstate 81 Near Binghamton, N.Y.* (Sept. 1966) 19 pp.

VEHICULAR PARKING

Freeway-Parking Developments. Automotive Safety Foundation (1964) 73 pp.
This study investigates the location, design, economic, and legal possibilities for developing integrated and coordinated freeway-parking facilities in urban areas, with principal focus on air rights both above and below depressed, at-grade, or elevated freeways. Attention is also given to coordinated developments where parking is provided off the right-of-way with high-quality access.

FAUSTMAN, D. J., "Integrated Parking and Expressway Planning." *Jour. Highway Div., Proc. ASCE* (June 1961) pp. 1-13.
An exploration of various facets of the demand for parking in urban central areas which considers in part the desirability of using areas over or under expressways for parking, outlining the experiences of several cities in this regard.

GRUENBAUM, M. T., and HALE, P. P., "Parking Conditions and Habits Near Expressway Interchanges." *Traffic Eng.* (June 1960) pp. 18-21.
A study of 11 interchanges along the Merritt Parkway in Connecticut which points up the need for parking facilities to accommodate car pooling.

RANKIN, W. W., "Correlation of Freeway Design and Parking Facilities." *Proc. Inst. Traffic Eng.* (1964) pp. 119-123.
Where possible and practical, joint land-use should be achieved through freeway air-rights parking facilities, although adequate freeway proximity to CBD parking demand may present problems. Preferential route links between freeway ramps and other parking facilities are also discussed.

"Terminal Planning for Future Highways." *Jour. Highway Div., Proc. ASCE* (Oct. 1966) pp. 61-74.

LEVIN, D., "The Coordination of Expressways and Parking Facilities." *Proc. Inst. Traffic Eng.* (1960) pp. 226-232.

LEVY, M. J., "Garden State Parkway Reports Interchange Parking Experience." *Traffic Eng.* (May 1966) pp. 14-15.

AIR-RIGHTS DEVELOPMENT

KUEHNLE, W. R., ET AL., *Case Studies in Air Rights and Sub-Surface Tunnel Road Easements.* Amer. Inst. of Real Estate Appraisers (1965) 39 pp.
Techniques are developed for estimating the economic value of potential air-rights developments, and are applied in detail to three examples: Cobo Hall (Detroit), Lytle Park (Cincinnati), and George Washington Bridge Approach (New York).

LOW, D. E., "Air Rights and Urban Expressways." *Traffic Quart.* (Oct. 1966) pp. 467-482.
A survey of the various types of air-rights development which have been made over railroad properties and over streets and highways, with a wide variety of examples cited. Implications of the 1961 Federal-Aid Highway Act, permitting the use of air space above and below Interstate highways for virtually any purpose compatible with highway operations, are discussed. Air-rights development over expressways is explored as a possible tool for accomplishing simultaneous linear urban redevelopment.

An Informational Guide on Air Rights Above and Below Interstate Highways. Amer. Assn. of State Highway Officials (1961) 6 pp.

BERNARD, M. M., "Airspace in Urban Development: Emergent Concepts." *Tech. Bull. 46,* Urban Land Inst. (1963) 20 pp.

"Is Airspace Use the Answer?" *Better Roads* (June 1962) p. 34.

MCGRATH, W. R., "Multiple Use of Highway Rights of Way." *Proc. Inst. Traffic Eng.* (1965).

MINO, S., "Multiple Use of Highway Rights-of-Way." *Proc. Inst. Traffic Eng.* (1965).

O'CARROLL, B. P., "Thin Air." *The Past Presidents' Award-1965,* International Bridge, Tunnel and Turnpike Assn., pp. 12-23.

"Use of Airspace on the Interstate System." *Instructional Memorandum 21-3-62.* U. S. Bur. of Public Roads (1962) 6 pp.

VAUGHAN, H., "Air Rights." *Nation's Cities* (Aug. 1966) pp. 12-14.

MISCELLANEOUS

A Guide for the Application of Frontage Roads on the National System of Interstate and Defense Highways. Amer. Assn. of State Highway Officials (1963) 24 pp.

A Policy on Locating Police Stations and Maintenance Yards Serving Interstate Highways. Amer. Assn. of State Highway Officials (1959) 5 pp.

ASHLEY, R. H., and BERARD, W. F., "Interchange Development Along 180 Miles of I-94." *Hwy. Res. Record No. 96* (1965) pp. 46-58.

BARTON-ASCHMAN ASSOC., *Final Report: Highway and Land-Use Relationships in Interchange Areas.* Illinois Div. of Highways (1967) 50 pp.

BARTON-ASCHMAN ASSOC., *Highway and Land-Use Relationships in Interchange Areas, Supplementary Report No. 2: Interchange Area Development in Illinois.* Illinois Div. of Highways (1966) 20 pp.

BARTON-ASCHMAN ASSOC., *Highway and Land-use Relationships in Interchange Areas, Supplementary Report*

No. 3: Case Studies of Selected Interchange Areas. Illinois Div. of Highways (Aug. 1966) 82 pp.

BARTON-ASCHMAN ASSOC., *Needs and Opportunities for Coordinating Renewal and Transportation Improvement.* City of Chicago Community Renewal Program (1963) pp. 56-62.

BERRY, D. S., ROSS, G. L. D., and PFEFER, R. C., "A Study of Left-Hand Exit Ramps on Freeways." *Hwy. Res. Record No. 21* (1963) pp. 1-16.

Roadside Development: A Selected Bibliography. HRB Bibl. 26 (1960) 44 pp.

MCGARRY, T. F., "On the Joint Development of Urban Housing and Urban Freeways." *Appraisal Jour.* (Jan. 1967) pp. 119-122.

MUSICK, J. V., "Serving Motorists on the Interstate System of Ohio." *Traffic Quart.* (July 1961) pp. 419-428.

NOBLE, C. M., "Special Services for Motorists Using the Interstate Highway System." *Proc. Amer. Assn. of State Highway Officials* (1959) pp. 360-366.

SILBER, H., "Elevated Freeway Gives City Chance to Use Imagination." *Omaha World-Herald* (Feb. 7, 1967).

THIEL, F. I., "Highway Interchange Area Development." *Pub. Roads* (June 1965) pp. 153-166.

WAGNER, L. G., and HARDER, V. E., "Methods of Providing Information to Motorist on the Interstate System. *Traffic Quart.* (Oct. 1965) pp. 504-519.

LEGAL CONSIDERATIONS

BARTON-ASCHMAN ASSOC., *Highway and Land-Use Relationships in Interchange Areas, Supplementary Report No. 1: Current Laws and Practices Affecting Interchange Area Planning.* Illinois Div. of Highways (Aug. 1966) 19 pp.

FENTON, H. S., "Legal Aspects of the Utilization and Development of Airspace Over and Under Freeways." *Hwy. Res. Record No. 78* (1965) pp. 52-64.

GOLDSCHMIDT, L. A., "Air Rights." *Information Rep. No. 186,* ASPO Planning Advisory Serv. (May 1964).

HAAR, C. M., *Land-Use Planning: A Casebook of the Use, Misuse, and Re-Use of Urban Land* (1959) 764 pp.

"Acquisition of Land for Future Highway Use." *HRB Spec. Rep. 27* (1957) 80 pp.

"Reservation and Acquisition of Highway Rights-of-Way" (Part II). *Hwy. Res. Record No. 8* (1963) pp. 29-106.

MANDELKER, D., *Managing Our Urban Environment: Cases, Texts and Problems.* (1966) pp. 937-990.

NETHERTON, R. D. *Control of Highway Access.* (1963) 416 pp.

NETHERTON, R. D., and MARKHAM, M., *Roadside Development and Beautification: Legal Authority and Methods: Part I.* Hwy. Res. Board (1965) 93 pp.

NETHERTON, R. D., and MARKHAM, M., *Roadside Development and Beautification: Legal Authority and Methods: Part II.* Hwy. Res. Board (1966) 159 pp.

APPENDIX B

INTERCHANGE SPACING ALONG SELECTED INTERSTATE HIGHWAYS[a, b]

		RURAL			URBAN			
			INTER-CHANGES			INTER-CHANGES		
INTER-STATE ROUTE	LOCATION	MILEAGE	NUMBER	SPACING (MILES)	MILEAGE	NUMBER	SPACING (MILES)	URBAN AREAS INCLUDED
I-75	Macon, Ga. to Wildwood, Fla. (junction Sunshine State Parkway)	304	51	6.0	—	—	—	—
I-5	Portland, Ore. to California Border (omitting 28-mile incomplete gap)	258	53	4.9	12	12	1.0	Portland
I-80, I-35	I-80 Davenport to Des Moines, Iowa; I-35 Ames-Des Moines-Osceola, Iowa	222	45	4.9	30	11	2.7	Des Moines
I-94	Port Huron-Detroit-Kalamazoo-Benton Harbor, Mich. (to Indiana border)	244	65	3.8	26	12	2.2	Detroit
I-71	Junction Ohio Turnpike to Junction I-275, Cincinnati, Ohio	202	32	6.3	27	19	1.4	Columbus
I-75	Cygnet-Findlay-Lima-Cincinnati, Ohio to Richmond, Ky. (excluding 20-mile Dayton gap, I-70 to I-675)	244	59	4.1	19	12	1.6	Cincinnati
I-85	Charlotte, N. C. to Atlanta, Ga. (through Atlanta to I-285)	219	55	5.0	10 26	6 19	1.7 1.4	Charlotte Atlanta
I-90, I-94	Tomah-Madison-Beloit-Waukesha-Milwaukee (I-894), Wis.	185	35	5.3	10 12	4 8	2.5 1.5	Madison Waukesha
I-26	Landrum-Spartanburg-Columbia-Charleston (Route 7), S. C.	206	39	5.3	8	6	1.3	Columbia
I-40, I-55	I-40 Nashville (Route 70) to Memphis (to I-55 via I-240); I-55 Arkansas-Missouri border-Memphis-Grenada, Miss. (excluding 8-mile Memphis gap, river to I-255)	355	59	6.0	12	6	2.0	Memphis
	Total:	2,439	493	4.9	192	115	1.7	

[a] Source: *Rand-McNally Road Atlas*, 42nd Ed. (1966).
[b] These ten sections of Interstate represented, as of early 1966, all completed, continuous sections of Interstate over 200 miles in length Other completed route sections of sizeable length included major gaps which may have been under construction, or which had not been brought up to full Interstate standards

APPENDIX C

URBAN CENTERS CONNECTED BY INTERSTATE HIGHWAYS AND TOLL ROADS

NOTE: See U.S. Bureau of the Census, *County and City Data Book, 1962*, U S. Government Printing Office (1962) for complete listing and location of all 212 urbanized areas and 237 urban places Only those connected by Interstate highways and toll roads are listed here. Cities served by more than one Interstate route are followed by the total number of routes in parentheses Cities also lying along toll roads are followed by an asterisk Cities enclosed by parentheses, with asterisk following, lie *only* along toll roads Cities lying at the border of two regions, indicated by "half," have been divided equally between the two regions. Major toll roads which have been included in the Interstate System, as indicated in Table 10, have been treated separately here.

REGION	URBANIZED AREAS		URBAN PLACES
New England	Portland*		Bangor
	Manchester*		Concord*
	Lowell-Lawrence-Haverhill		Nashua*
	Springfield-Chicopee-Holyoke*		Portsmouth*
	Worcester*		Burlington
	Boston-Brockton (2)*		Bristol
	Providence-Pawtucket		Middletown
	New Bedford-Fall River		(Augusta)*
	Hartford-New Britain (2)		
	Waterbury-Meriden*		
	Stamford-Norwalk*		
	Bridgeport*		
	New Haven*		
	New London-Norwich*		
	(Lewiston-Auburn)*		
Middle Atlantic	New York-N.E. New Jersey (3)****		Watertown
	Philadelphia-Trenton***		Ridgewood*
	Harrisburg (2)*		Delaware*
	York		Wayne
	Allentown-Bethlehem*		Lebanon*
	Scranton-Wilkes Barre (2)*		Sharon
	Pittsburgh (2)*		Hempfield*
	Erie		(Amsterdam)*
	Binghamton		(Auburn)*
	Syracuse*		(Kingston)*
	Albany-Schenectady-Troy*		(Newburgh)*
	(Reading)*		(Poughkeepsie)*
	(Buffalo)*		(New Hanover)*
	(Rochester)*		(New Castle)*
	(Utica)*		(New Brunswick-Edison)**
	(Atlantic City)**		(Perth Amboy)**
East North Central	Fort Wayne	St. Louis (3), half	Beloit
	Indianapolis (4)	Milwaukee	Eau Claire
	Terre Haute	Racine	Janesville
	Louisville (2), half	Kenosha	La Crosse
	Toledo*	Madison (2)	Battle Creek
	Cleveland (3)*	Chicago-Gary-Hammond (4)*	Port Huron
	Akron (2)*	Joliet (2)	Bloomington (2)
	Canton	Peoria	Danville
	Lima	Champaign-Urbana (2)	Galesburg
	Springfield	Springfield	Kankakee
	Columbus (2)	Bay City-Saginaw	Anderson
	Dayton (2)	Muskegon	Elkhart*
	Cincinnati (2), half	Lansing	Lafayette
	Youngstown-Warren *	Flint	Marion
	Wheeling, half	Grand Rapids (2)	Michigan City*
	Huntington-Ashland, half	Jackson	Richmond
	Minneapolis-St. Paul (2), half	Kalamazoo	Findlay
	Duluth, half	Ann Arbor	Mansfield
	Rock Island-Davenport-Moline, (2), half	Detroit (4)	Sandusky*
		(South Bend)*	Zanesville
		(Lorain-Elyria)*	
		(Rockford)*	
		(Aurora)*	
West North Central	Fargo-Moorhead (2)		Grand Forks
	Duluth, half		Bismarck
	Minneapolis-St. Paul (2), half		Rapid City
	Sioux Falls (2)		Lincoln
	Sioux City		Grand Island
	Omaha (2)		Salina (2)
	Lincoln		St. Cloud
	St. Joseph		Rochester
	Kansas City (2)*		Austin
	Topeka*		Ames
	Wichita*		Iowa City
	Springfield		Columbia
	St. Louis (3), half		Joplin
	Rock Island-Davenport-Moline (2), half		(Lawrence)*
	Des Moines (2)		
South Atlantic	Jacksonville (2)		Daytona Beach (2)
	Orlando*		Ft. Pierce*
	St. Petersburg-Tampa (2)		Gainesville
	West Palm Beach*		Lakeland
	Ft. Lauderdale*		Tallahassee
	Miami*		Hagerstown (2)
	Wheeling, half		Clarksburg
	Baltimore (2)		Fairmont
	Washington (2)		Parkersburg
	Richmond (2)		Charlottesville
	Roanoke		Petersburg (2)
	Newport News		Burlington
	Norfolk		Fayetteville
	Charleston (2)		Gastonia
	Greensboro-High Point (2)		Kannapolis
	Winston-Salem		Rocky Mount
	Durham		Wilson
	Asheville (2)		Anderson
	Charlotte (2)		Spartanburg (2)
	Wilmington		Valdosta
	Greenville		
	Columbia (2)		
	Charleston		
	Augusta		
	Atlanta (3)		
	Macon (2)		
	Savannah (2)		
	Chattanooga (2), half		
	Pensacola, half		
East South Central	Louisville (2), half		Bowling Green
	Huntington-Ashland, half		Paducah
	Lexington (2)		Jackson
	Cincinnati (2), half		Kingsport
	Memphis (2), half		Biloxi
	Pensacola, half		Gulfport
	Mobile (2)		Hattiesburg
	Jackson (2)		Laurel
	Montgomery (2)		Meridian
	Tuscaloosa		Vicksburg
	Birmingham (3)		Anniston
	Gadsden		Decatur
	Chattanooga (2), half		
	Knoxville (2)		
	Nashville (3)		
West South Central	Oklahoma City (2)*	San Antonio (3)	Big Spring
	Ft. Smith	Corpus Christi	Longview
	Little Rock (2)	Laredo	Temple
	Memphis (2), half	Texarkana	Lafayette
	Shreveport	Tyler	
	Monroe	Dallas (3)*	
	Lake Charles	Ft Worth (2)*	
	Baton Rouge (2)	Amarillo	
	New Orleans	El Paso, half	
	Beaumont-Port Arthur	Abilene	
	Houston (2)	Odessa-Midland	
	Galveston	(Tulsa)*	
	Waco	(Lawton)*	
	Austin	(Wichita Falls)*	
		(Joplin)*	
Mountain	Great Falls	Pueblo	Butte (2)
	Billings (2)	Albuquerque (2)	Missoula
	Ogden	El Paso, half	Boise City
	Salt Lake City (2)	Phoenix (2)	Idaho Falls
	Provo	Tucson (2)	Pocatello (2)
	Denver (3)	Las Vegas	Casper
	Colorado Springs	Reno, half	Cheyenne (2)
			Ft. Collins
			Las Cruces (2)
			Santa Fe
Pacific	Portland (2)	San Francisco-Oakland	Salem
	Spokane	San Jose	Bellingham
	Seattle (2)	Los Angeles-Long Beach (2)	Yakima
	Tacoma	San Bernardino-Riverside (2)	
	Eugene	San Diego	
	Reno, half		
	Sacramento (2)		
	Stockton		

Published reports of the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

are available from:

Highway Research Board
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

Rep. No.	*Title*
—*	A Critical Review of Literature Treating Methods of Identifying Aggregates Subject to Destructive Volume Change When Frozen in Concrete and a Proposed Program of Research—Intermediate Report (Proj. 4-3(2)), 81 p., $1.80
1	Evaluation of Methods of Replacement of Deteriorated Concrete in Structures (Proj. 6-8), 56 p., $2.80
2	An Introduction to Guidelines for Satellite Studies of Pavement Performance (Proj. 1-1), 19 p., $1.80
2A	Guidelines for Satellite Studies of Pavement Performance, 85 p.+9 figs., 26 tables, 4 app., $3.00
3	Improved Criteria for Traffic Signals at Individual Intersections—Interim Report (Proj. 3-5), 36 p., $1.60
4	Non-Chemical Methods of Snow and Ice Control on Highway Structures (Proj. 6-2), 74 p., $3.20
5	Effects of Different Methods of Stockpiling Aggregates—Interim Report (Proj. 10-3), 48 p., $2.00
6	Means of Locating and Communicating with Disabled Vehicles—Interim Report (Proj. 3-4), 56 p. $3.20
7	Comparison of Different Methods of Measuring Pavement Condition—Interim Report (Proj. 1-2), 29 p., $1.80
8	Synthetic Aggregates for Highway Construction (Proj. 4-4), 13 p., $1.00
9	Traffic Surveillance and Means of Communicating with Drivers—Interim Report (Proj. 3-2), 28 p., $1.60
10	Theoretical Analysis of Structural Behavior of Road Test Flexible Pavements (Proj. 1-4), 31 p., $2.80
11	Effect of Control Devices on Traffic Operations—Interim Report (Proj. 3-6), 107 p., $5.80
12	Identification of Aggregates Causing Poor Concrete Performance When Frozen—Interim Report (Proj. 4-3(1)), 47 p., $3.00
13	Running Cost of Motor Vehicles as Affected by Highway Design—Interim Report (Proj. 2-5), 43 p., $2.80
14	Density and Moisture Content Measurements by Nuclear Methods—Interim Report (Proj. 10-5), 32 p., $3.00
15	Identification of Concrete Aggregates Exhibiting Frost Susceptibility—Interim Report (Proj. 4-3(2)), 66 p., $4.00
16	Protective Coatings to Prevent Deterioration of Concrete by Deicing Chemicals (Proj. 6-3), 21 p., $1.60
17	Development of Guidelines for Practical and Realistic Construction Specifications (Proj. 10-1,) 109 p., $6.00
18	Community Consequences of Highway Improvement (Proj. 2-2), 37 p., $2.80
19	Economical and Effective Deicing Agents for Use on Highway Structures (Proj. 6-1), 19 p., $1.20
20	Economic Study of Roadway Lighting (Proj. 5-4), 77 p., $3.20
21	Detecting Variations in Load-Carrying Capacity of Flexible Pavements (Proj. 1-5), 30 p., $1.40
22	Factors Influencing Flexible Pavement Performance (Proj. 1-3(2)), 69 p., $2.60
23	Methods for Reducing Corrosion of Reinforcing Steel (Proj. 6-4), 22 p., $1.40
24	Urban Travel Patterns for Airports, Shopping Centers, and Industrial Plants (Proj. 7-1), 116 p., $5.20
25	Potential Uses of Sonic and Ultrasonic Devices in Highway Construction (Proj. 10-7), 48 p., $2.00
26	Development of Uniform Procedures for Establishing Construction Equipment Rental Rates (Proj. 13-1), 33 p., $1.60
27	Physical Factors Influencing Resistance of Concrete to Deicing Agents (Proj. 6-5), 41 p., $2.00
28	Surveillance Methods and Ways and Means of Communicating with Drivers (Proj. 3-2), 66 p., $2.60
29	Digital-Computer-Controlled Traffic Signal System for a Small City (Proj. 3-2), 82 p., $4.00
30	Extension of AASHO Road Test Performance Concepts (Proj. 1-4(2)), 33 p., $1.60
31	A Review of Transportation Aspects of Land-Use Control (Proj. 8-5), 41 p., $2.00
32	Improved Criteria for Traffic Signals at Individual Intersections (Proj. 3-5), 134 p., $5.00
33	Values of Time Savings of Commercial Vehicles (Proj. 2-4), 74 p., $3.60
34	Evaluation of Construction Control Procedures—Interim Report (Proj. 10-2), 117 p., $5.00
35	Prediction of Flexible Pavement Deflections from Laboratory Repeated-Load Tests (Proj. 1-3(3)), 117 p., $5.00
36	Highway Guardrails—A Review of Current Practice (Proj. 15-1), 33 p., $1.60
37	Tentative Skid-Resistance Requirements for Main Rural Highways (Proj. 1-7), 80 p., $3.60
38	Evaluation of Pavement Joint and Crack Sealing Materials and Practices (Proj. 9-3), 40 p., $2.00
39	Factors Involved in the Design of Asphaltic Pavement Surfaces (Proj. 1-8), 112 p., $5.00
40	Means of Locating Disabled or Stopped Vehicles (Proj. 3-4(1)), 40 p., $2.00
41	Effect of Control Devices on Traffic Operations (Proj. 3-6), 83 p., $3.60

* Highway Research Board Special Report 80.