The Permanence of Limited Access Highways*

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Almost all studies of urban and state highway needs point out that in general streets and highways are not adequate for present traffic. Furthermore, these studies indicate that future traffic will have greater demands, and unless more action is taken, the highways will deteriorate, structurally and geometrically, at a rate faster than they can be replaced.

The American way of life is dependent upon highways, as exemplified by the rapid development of commercial, industrial, and residential areas along a new highway. In certain cases, this land development has occurred before the highway was opened to traffic. In the development of a new high-type highway, design features are controlled to permit optimum safe speeds, but as soon as some highways are open there is so much of a conflict between the high speed of through traffic and the variable speed of local traffic that control of speed is often a necessity. Soon afterwards, slow signs, blinking lights, and finally stop signs and traffic lights become necessary, thus decreasing the effectiveness in the movement of through traffic. Then it is usually too late and too expensive to rehabilitate the geometric design of the route, and the usual procedure is to leave the existing route to serve adjacent property and to build a new route for the through traffic. However, without protection of the new route from the development of the adjacent property, the strangulation will occur again and the highway, particularly near urban areas, will again become geometrically inadequate for the intended purpose.

The scope of this paper is to present: (1) the historical development of limited access highways including an inventory of limited access highways in the United States and a summary of the limited access laws in the various states; (2) a summary of a field studp[1]†

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† Superscripts refer to the bibliography.

which was conducted to determine the effect of access control on travel times, operating costs, and highway safety; and (3) a study of five Indiana uncontrolled access highways to illustrate the effect of lack of access control on the permanence of the characteristics of these five routes.

Early English Law

In the seventeenth and early eighteenth centuries it was inherent in the law that the abutting property owners had the right of access to roads which abutted their property. In fact the term highway referred to a road to which the public at large had the right of access. The highway was also defined as a strip of land devoted to public travel. At first the privilege of using such a strip of land was called right-of-way, while today the land itself is known as the right-of-way. The method of obtaining right-of-way and maintaining the roads was entirely different from that of today, for then the property owner provided the land for the right-of-way and by law was responsible for maintenance of the road. For this responsibility it seemed justifiable that the abutting property owner should enjoy the right of freedom of access. During this era there was little through traffic, and the prime purpose of the road was to serve the adjacent land.[2, 3]

Early Development of Limited Access Highways in the United States

When America was first settled the waterways and pathways were the predominate means of transportation. As the country grew water transportation was of primary importance, but the method of moving people and goods from one waterway to another and into the interior areas of the colonies where there were no waterways, was by land transportation. Paths were widened and maintained, often by the methods used in England. The abutting property owner provided the right-of-way, maintained it, and enjoyed the right of access. The roads could not be maintained to a high standard in this fashion and thus in the middle of the eighteenth century the colonies passed laws placing the responsibility of obtaining land and maintaining the roads on local government. The important routes were usually placed under the control of the governor. Even this method of maintaining highways was not satisfactory and in the 1790's a turnpike era began, where private individuals or companies were authorized to construct and maintain roads and to charge a toll for their use. With the advent of railroads the travel on highways was curtailed and the highways were neglected until the late 1800's. In 1891, New Jersey set aside state funds for the purpose of developing a highway system and organized

the first state highway department. Massachusetts founded a similar organization in 1892, and in 1893 the Office of Road Inquiry was established in the United States Department of Agriculture. In the years that followed the other states began to assume greater responsibility for financing and maintaining a highway system.[4]

It is important to notice the transition from individual responsibility to provide and to maintain the highways, to that of placing the responsibility of the highways in various levels of governmental organizations. This transition from individual responsibility to governmental responsibility was also affected by changes in the highway function. The highways were no longer only land service roads, for travel became more extensive and involved not only trips from home to town, but from state to state, and from coast to coast. The function of the highway changed, and so the highway itself began to change.

Present Status of Limited Access Highways

The first law pertaining to the control of access to public roads was adopted in 1906 in New York. However, this law applied to parkways only, and not until 1937 was the first legislation for freeways as well as parkways adopted in Rhode Island and New York. By the early part of 1954, 39 states had limited access laws. Table 1 lists the states which have limited or controlled access laws, the dates of their adoptions, and the total number of miles of limited access highways completed or under construction as of January 1954. A form letter was mailed by the author of this report to each state highway department requesting a complete inventory of limited access highways and all states responded by answering either partially or completely the questionnaire. However, New Jersey was unable to furnish any information for tabulation and New York furnished data for tabulation only for the parkways.

There are a great many differences between the limited access laws of the various states. For example, the Delaware limited access law is restricted to a 2-mile section of highway. Minnesota and North Carolina do not have limited access laws as such, but the legal interpretations of their original highway laws have allowed them to build limited access highways. In Arizona, although a limited access law does not exist, a partially limited access highway is under construction. A limited access law passed in New Mexico in 1945 has been repealed, the only state in which a limited access law has been repealed. As the table indicates there were 5,420.7 miles of limited access highways either built or under construction as reported in the questionnaire from the various states. It should be noted however that certain states have

TABLE 1

Status of Limited Access Roads in the Various States
as of January 1954

State	*Highway Access Law*	*Date of Adoption*	*Number of Miles*
ALABAMA	NO		
ARIZONA	NO		6.0[3]
ARKANSAS	YES	1953	3.5
CALIFORNIA	YES	1939	943.4
COLORADO	YES	1941	230.3
CONNECTICUT	YES	1939	137.4
DELAWARE	YES[1]		2.0
FLORIDA	YES	1943	41.0
GEORGIA	YES	1949	20.0
IDAHO	YES	1951	93.5
ILLINOIS	YES	1943	906.9
INDIANA	YES	1945	2.6
IOWA	NO		
KANSAS	YES	1953	3.5
KENTUCKY	YES	1946	10.4
LOUISIANA	YES	1942	11.5
MAINE	YES	1939	20.0
MARYLAND	YES	1941	73.0
MASSACHUSETTS	YES	1943	146.1
MICHIGAN	YES	1941	84.0
MINNESOTA	YES[2]		227.4
MISSISSIPPI	YES	1949	26.0
MISSOURI	YES	1945	236.0
MONTANA	NO		
NEBRASKA	YES	1953	0.0
NEVADA	NO		
NEW HAMPSHIRE	YES	1943	15.0
NEW JERSEY	YES	1945	[4]
NEW MEXICO	NO		
NEW YORK	YES	1937	58.3[5]
NORTH CAROLINA	YES[2]		131.4
NORTH DAKOTA	YES	1953	0.0
OHIO	YES	1941	298.1
OKLAHOMA	YES	1945	26.9
OREGON	YES	1947	640.7

TABLE 1 (Continued)

State	*Highway Access Law*	*Date of Adoption*	*Number of Miles*
PENNSYLVANIA	YES	1945	38.1
RHODE ISLAND	YES	1937	26.2
SOUTH CAROLINA	NO		
SOUTH DAKOTA	YES	1953	7.3
TENNESSEE	NO		
TEXAS	YES	1943	79.0
UTAH	YES	1945	183.5
VERMONT	NO		
VIRGINIA	YES	1942	112.7
WASHINGTON	YES	1947	286.0
WEST VIRGINIA	YES	1939	4.9
WISCONSIN	YES	1949	270.4
WYOMING	YES	1949	17.7
TOTALS AND SUMMARY	YES—39 NO — 9		5420.7[6]

[1] Delaware has a limited access law but it is restricted to one particular section of highway.

[2] Minnesota and North Carolina do not have specific limited access laws, but the interpretation of their basic laws permits the construction of limited access highways.

[3] Arizona does not have a limited access highway, but a partially controlled access highway is being constructed.

[4] New Jersey did not report the mileage of limited access highways in their state.

[5] New York only reported the mileage of limited access parkways.

[6] The total mileage of 5420.7 of limited access highways in the United States does not include mileage in New Jersey, freeways in New York, nor toll roads. This includes 648.7 miles of limited access highways under construction in 1954.

included mileage of 'designated' limited access facilities, which at present do not have the characteristics of limited access highways.

It is of interest to note that of the 39 states having limited access laws, only 14 states have over 100 miles of limited access highways, and only 3 states have over 500 miles of limited access highways. Five states, Arkansas, Kansas, Nebraska, North Dakota, and South Dakota passed laws in 1953 which would indicate a continuing movement toward limited access highways and reports indicate that in the near

future, there are possibilities of limited access laws in five of the nine states without limited access laws.

Of the 5,420.7 miles of limited access highways reported by the various states, 5,346.4 miles were available for tabulation in Table 2 which presents the mileage of limited access highways by state and by length of service. Of the 5,346.4 miles reported, 648.7 miles (12.1%) are under construction, 1,132.8 miles (21.3%) are one year old, 695.5 miles (13.0%) are two years old, 1,363.9 miles (25.5%) are three to five years old, 1,396.5 miles (26.1%) are six to ten years old, and 109.0 miles (2.0%) are eleven to fifteen years old. Referring to Table 2 and Figure 1, the number of miles constructed each year has increased steadily, with an average of 21.8 miles per year during the

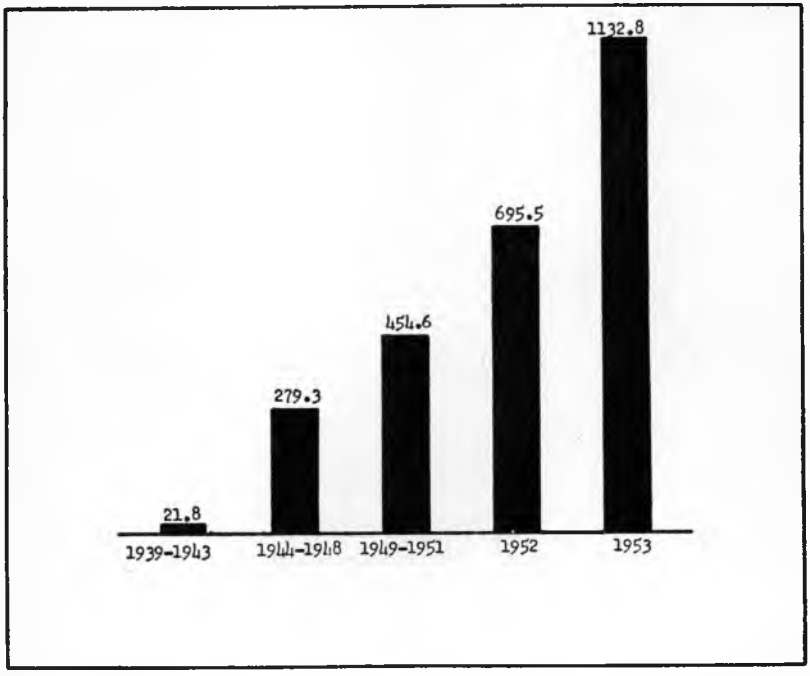

Fig. 1. Annual mileage of limited access highways constructed in the United States, 1939-1953.

period 1939-1943, 279.3 miles per year during the period 1944-1948, 454.6 miles per year during the period 1949-1951, 695.5 miles in 1952, and 1,132.8 miles in 1953.

Some states have converted existing sections of highway into limited access highways, while the more general case is new locations for limited access highways. The first part of Table 3 indicates the

TABLE 2

Classification of Limited Access Highways by State and by Length of Service as of January 1954

State	Under Construction	One Year	Two Years	3-5 Years	6-10 Years	11-15 Years	Total Miles
Alabama							
Arizona	6.0						6.0
Arkansas			3.5				3.5
California	154.4	130.0	65.3	390.4	183.2	20.1	943.4
Colorado			30.0	95.5	21.6	8.9	290.3[1]
Connecticut		6.9	2.5	41.4	47.8	38.8	137.4
Delaware			2.0				2.0
Florida	1.0	40.0					41.0
Georgia	20.0						20.0
Idaho		93.5					93.5
Illinois		58.5	7.7	91.4	749.3		906.9
Indiana					2.6		2.6
Iowa							
Kansas	3.5						3.5
Kentucky	10.4						10.4
Louisiana		2.6	3.5		5.4		11.5
Maine	20.0						20.0
Maryland		19.7	53.3				73.0
Massachusetts	57.5	28.1	60.5				146.1
Michigan	43.0	15.0			26.0		84.0
Minnesota	80.3	9.5	9.3	29.8	78.7	19.8	227.4
Mississippi				26.0			26.0
Missouri	60.8	76.4	56.0	39.5	3.3		236.0
Montana							
Nebraska							0.0
Nevada							
New Hampshire				15.0			15.0
New Jersey							[2]
New Mexico							
New York	37.3	3.4	4.2	9.5		3.9	58.3[3]
North Carolina	81.4	36.8	5.2	8.0			131.4
North Dakota							
Ohio	10.4	49.6	32.5	169.2	27.0	9.4	298.1
Oklahoma		19.3		5.4	2.2		26.9
Oregon		313.5	95.8	113.6	109.7	8.1	640.7
Pennsylvania		4.1	14.1	12.9	7.0		38.1
Rhode Island	20.1	6.1					26.2
South Carolina							
South Dakota		7.3					7.3
Tennessee							
Texas		15.0	30.0	21.0	13.0		79.0

TABLE 2 (Continued)

State	Under Construction	One Year	Two Years	3-5 Years	6-10 Years	11-15 Years	Total Miles
Utah	29.0	26.5	20.9	93.3	13.8		183.5
Vermont							
Virginia		42.3	3.3	6.8	60.3		112.7
Washington		77.8	17.8	144.8	45.6		286.0
West Virginia		0.6	4.3				4.9
Wisconsin		43.9	176.1	50.4			270.4
Wyoming	13.0	2.7	2.0				17.7
Total	648.7	1132.8	695.5	1363.9	1396.5	109.0	5420.7[4]

[1] 74.3 miles of Colorado's 230.3 miles are unclassified.

[2] New Jersey did not report the mileage of limited access highways in their state.

[3] New York only reported the mileage of limited access parkways.

[4] 5346.4 miles of the total of 5420.7 miles of limited access highways were reported by length of service.

TABLE 3

Classification of Limited Access Highways by State and How Designated and Type of Highway Control as of January 1954

State	Originally Built	Converted	Total Miles	Partial Control	Full Control	Total Miles
Alabama						
Arizona	6.0		6.0	6.0		6.0
Arkansas	3.5		3.5	3.5		3.5
California			943.4[1]			943.4[1]
Colorado			230.3[1]			230.3[1]
Connecticut	105.2	32.2	137.4	7.4	130.0	137.4
Delaware	2.0		2.0		2.0	2.0
Florida	41.0		41.0	41.0		41.0
Georgia	20.0		20.0		20.0	20.0
Idaho		93.5	93.5	93.5		93.5
Illinois			906.9[1]			906.9[1]
Indiana	2.6		2.6		2.6	2.6
Iowa						
Kansas	3.5		3.5		3.5	3.5
Kentucky	10.4		10.4	10.4		10.4
Louisiana	11.5		11.5	11.5		11.5
Maine	20.0		20.0	20.0		20.0
Maryland	68.0	5.0	73.0	34.9	38.1	73.0
Massachusetts	107.7	38.4	146.1	28.1	118.0	146.1
Michigan	84.0		84.0	67.0	17.0	84.0
Minnesota	227.4		227.4	227.4		227.4
Mississippi	13.5	12.5	26.0	26.0		26.0
Missouri	184.1	51.9	236.0	236.0		236.0

TABLE 3 (Continued)

State	Originally Built	Converted	Total Miles	Partial Control	Full Control	Total Miles
Montana						
Nebraska			0.0			0.0
Nevada						
New Hampshire	15.0		15.0		15.0	15.0
New Jersey			[2]			[2]
New Mexico						
New York	40.8	17.5	58.3[3]	42.7	15.6	58.3[3]
North Carolina	112.1	19.3	131.4	131.4		131.4
North Dakota			0.0			0.0
Ohio			298.1[1]			298.1[1]
Oklahoma	26.9		26.9	26.9		26.9
Oregon	258.6	382.1	640.7	519.3	121.4	640.7
Pennsylvania	38.1		38.1	8.2	29.9	38.1
Rhode Island	26.2		26.2		26.2	26.2
South Carolina						
South Dakota		7.3	7.3		7.3	7.3
Tennessee						
Texas	79.0		79.0		79.0	79.0
Utah	183.5		183.5	183.5		183.5
Vermont						
Virginia	32.6	80.1	112.7	96.1	16.6	112.7
Washington	259.2	26.8	286.0	255.5	30.5	286.0
West Virginia	3.9	1.0	4.9	3.3	1.6	4.9
Wisconsin	115.1	155.3	270.4	270.4		270.4
Wyoming	17.7		17.7	2.0	15.7	17.7
Total	2119.1	922.9	5420.7	2352.0	690.0	5420.7

[1] California, Colorado, Illinois, and Ohio did not report as to the designation or the type of highway control on their limited access highways.

[2] New Jersey did not report the mileage of limited access highways in the state.

[3] New York only reported the mileage of limited access parkways.

[4] 3042.0 miles of the 5420.7 miles of limited access highways originally reported, were designated as originally built or converted limited access highways.

[5] 3042.0 miles of the 5420.7 miles of limited access highways originally reported, were designated as partially or fully controlled limited access highways.

mileage by state of originally built limited access highways and that portion of the existing highway system which has been converted to limited access. It is of interest to note that of the 3,042.0 miles reported for this tabulation, that only 922.9 miles (30.3%) of the limited access highways were existing highways which were converted to limited access highways. Two reasons for this are that all states do not have

the legal authority to convert existing highways to limited access, and generally it is more expensive to control the access on an existing highway than on a newly located highway. The mileage of limited access highways by type of highway control is given in the second portion of Table 3. Of the 3,042.0 miles reported for this tabulation, 690.0 miles (22.6%) are full controlled limited access highways, and these sections are generally located in or near urban areas where additional costs of right-of-way protection and separation of grades are justifiable.

Table 4 and Figure 2 present the classification of limited access highways by state and by width design. Sub-classification by number of lanes, width of lanes, and if multi-laned whether or not the opposing roadways are divided is available from this table. Of the 4,263.5 miles reported for this tabulation, 1,700.2 miles (39.9%) are two-lane highways, 13.7 miles (0.3%) are three-lane highways, 55.9 miles (1.3%) are four-lane undivided highways, 2,314.7 miles (54.3%) are four-lane divided highways, and 179.0 miles (4.2%) are six or more lane highways. The tabulation reveals that the most widely used geometric design of limited access highways is a four-lane divided 48 foot pavement. This constitutes 2,143.5 miles or 50.3% of all the mileage of limited access highways reported.

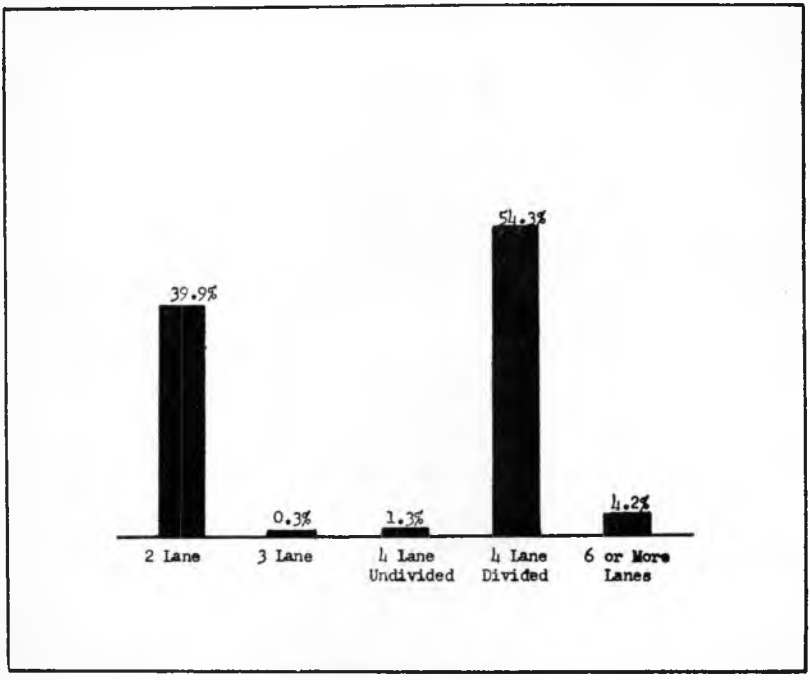

Fig. 2. Geometric design of limited access highways.

TABLE 4

Classification of Limited Access Highways by State, Number of Lanes, and Width of Pavement, as of January 1954

State	Two Lanes				Three Lanes			Four Lanes Undivided				Four Lanes Divided				Six or More Lanes	Grand Total
	20—	22	24+	Sub-total	30—	36+	Sub-total	40—	41—47	48+	Sub-total	40—	41—47	48+	Sub-total		
Alabama																	
Arizona														6.0	6.0		6.0
Arkansas			3.5	3.5													3.5
California														877.0	877.9	65.5	943.4
Colorado																	230.3[1]
Connecticut		13.8	24.2	38.0									3.0	96.4	99.4		137.4
Delaware														2.0	2.0		2.0
Florida										1.0	1.0			40.0	40.0		41.0
Georgia														10.0	10.0	10.0	20.0
Idaho			52.1	52.1				19.3			19.3	22.1			22.1		93.5
Illinois																	906.9[1]
Indiana														2.6	2.6		2.6
Iowa																	
Kansas			1.5	1.5									2.0		2.0		3.5
Kentucky			4.3	4.3										6.1	6.1		10.4
Louisiana			2.6	2.6										8.9	8.9		11.5
Maine														20.0	20.0		20.0
Maryland			73.0	73.0													73.0

TABLE 4 (Continued)

Classification of Limited Access Highways by State, Number of Lanes, and Width of Pavement, as of January 1954

State	Two Lanes				Three Lanes			Four Lanes Undivided				Four Lanes Divided				Six or More Lanes	Grand Total
	20—	22	24+	Subtotal	30—	36+	Subtotal	40—	41—47	48+	Subtotal	40—	41—47	48+	Subtotal		
Massachusetts														136.1	136.1	10.0	146.1
Michigan			26.0	26.0									36.0	5.0	41.0	17.0	84.0
Minnesota			65.8	65.8						4.3	4.3			157.3	157.3		227.4
Mississippi												18.5	7.5		26.0		26.0
Missouri		0.8	143.9	144.7					0.4	0.1	0.5		27.9	62.2	90.1	0.7	236.0
Montana																	
Nebraska																	0.0
Nevada																	
New Hampshire														15.0	15.0		15.0
New Jersey																	[2]
New Mexico																	
New York	8.2			8.2	9.2		9.2						12.5	20.0	32.5	8.4	58.3[3]
North Carolina		10.2	62.7	72.9						0.7	0.7		6.7	51.1	57.8		131.4
North Dakota																	0.0
Ohio			132.9	132.9									1.6	155.0	156.6	8.6	298.1
Oklahoma														26.9	26.9		26.9
Oregon	75.4	137.2	323.3	535.8				1.2	4.8	1.0	7.0		11.5	86.4	97.9		640.7
Pennsylvania														38.1	38.1		38.1

TABLE 4 (Continued)

Classification of Limited Access Highways by State, Number of Lanes, and Width of Pavement, as of January 1954

State	Two Lanes				Three Lanes			Four Lanes Undivided				Four Lanes Divided				Six or More Lanes	Grand Total
	20—	22	24+	Sub-total	30—	36+	Sub-total	40—	41—47	48+	Sub-total	40—	41—47	48+	Sub-total		
Rhode Island														26.2	26.2		26.2
South Carolina																	
South Dakota														7.3	7.3		7.3
Tennessee																	
Texas														47.0	47.0	32.0	79.0
Utah			156.5	156.5						9.8	9.8			17.2	17.2		183.5
Vermont																	
Virginia		7.5	43.2	50.7				12.3			12.3		16.7	33.0	49.7		112.7
Washington		55.2	20.2	75.4										185.9	185.9	24.7	286.0
West Virginia			0.6	0.6					1.0		1.0			1.2	1.2	2.1	4.9
Wisconsin	9.3	95.2	138.2	242.7	1.8	2.7	4.5						5.2	18.0	23.2		270.4
Wyoming			13.0	13.0										4.7	4.7		17.7
Total	92.9	319.9	1287.4	1700.2	11.0	2.7	13.7	32.8	6.2	16.9	55.9	40.6	130.6	2143.5	2314.7	179.0	5420.7

[1] Colorado and Illinois did not report the geometric design of their limited access highways.

[2] New Jersey did not report the mileage of their limited access highways.

[3] New York only reported the mileage of limited access parkways.

[4] 4263.5 miles of the 5420.7 miles of limited access highways originally reported, were classified as to their geometric design.

Interpretation of Limited Access Laws

As presented previously, thirty-nine states have limited access laws, two states by interpretation of their basic highway laws have constructed limited access highways and the remaining thirty-seven states by specific limited access highway laws. A model limited access law was presented in a booklet entitled, "Public Control of Highway Access and Roadside Development" and in general contained the following provisions:

1. Designation of facility, name such as controlled access, limited access, expressway, etc.
2. Definition of facility.
3. Allowance for the construction of limited access highways with commercial traffic (freeways) and limited access highways without commercial traffic (parkways).
4. Designation for authority for limited access highways vested in the state, counties, and municipalities.
5. Necessary consent of counties and municipalities if limited access highway is to be built inside their legal jurisdiction.
6. Permision to construct high type geometric design features, such as median strips, wide lanes, shoulders, right-of-way, etc. way, etc.
7. Permission for marginal land acquisition even when land may not be immediately or directly used as part of the highway.
8. Section giving jurisdiction for the construction of new limited access highways, as well as converting existing routes to limited access.
9. Section covering the expediting of legal cases, such as giving priority to the settlement of damage suits when they pertain to limited access highways.
10. Permission to eliminate grade intersections, and to construct grade separations of highways and railroads.
11. Closing of roads when it is to the benefit of the general public.
12. Construction of service or frontage roads.
13. Penalties for illegal uses of limited access highways.
14. Section on severability, that is if part of the limited access law is declared invalid by the courts, the remaining portions of the law are still in force.

Table 5 was constructed in order to compare the limited access laws of the various states with the model limited access law. A summary of this table is of particular interest in order to see the variations in the highway laws between the states, and to compare each state with the model law. Limited access laws from Delaware, Mississippi,

TABLE 5

Summary of Limited Access Laws in the United States as of January 1954

State	Year Enacted	Year Revised	Designated Facility	Definition	Parkways and Freeways	Authority Vested in		Consent of Municipality
						County	Municipality	
Alabama								
Arizona								
Arkansas	1953		Controlled Access	X	X	X	X	X
California	1939	1945	Freeway	X		X	X	X
Colorado	1941		Freeway					
Connecticut	1939	1945	Parkway, Freeway	X	X			
Delaware#								
Florida	1943		Limited Access	X	X	X	X	X
Georgia	1949		Limited Access	X		X	X	X
Idaho	1951		Controlled Access	X	X			
Illinois	1943		Freeway	X		X	X	X
Indiana	1945		Limited Access	X	X	X	X	X
Iowa								
Kansas	1953		Controlled Access	X	X	X	X	
Kentucky	1946	1950	Limited Access	X	X	X	X	X
Louisiana	1942	1944	Limited Access	X	X			X
Maine	1939	1949	Controlled Access	X				X
Maryland	1941		Parkway, Freeway		X			
Massachusetts	1943		Limited Access Way	X				
Michigan	1941		Limited Access	X	X	X	X	X
Minnesota								
Mississippi#	1949							
Missouri#	1945							
Montana								
Nebraska	1953		Access Highway					

Laws from Delaware, Mississippi and Missouri not available.

Blank spaces indicate that the particular law does not contain this provision.

TABLE 5 (Continued)
Summary of Limited Access Laws in the United States as of January 1954

State	Year Enacted	Year Revised	Designated Facility	Definition	Parkways and Freeways	Authority Vested in		Consent of Municipality
						County	Municipality	
Nevada								
New Hampshire	1943	1945	Limited Access	X	X			
New Jersey	1945		Parkway, Freeway					
New Mexico								
New York	1937		Controlled Access	X	X	X		X
North Carolina								
North Dakota	1953		Controlled Access		X	X	X	X
Ohio	1941		Limited Access	X		X	X	
Oklahoma	1945	'55, '53	Limited Access	X	X	X	X	X
Oregon	1947	'49, '51	Throughway	X				
Pennsylvania	1945	1947	Limited Access	X	X	X	X	X
Rhode Island	1937		Freeways	X				
South Carolina								
South Dakota	1953		Controlled Access	X	X	X	X	X
Tennessee								
Texas	1943	'45, '51	Freeway	X		X	X	
Utah	1945		Limited Access	X	X	X	X	X
Vermont								
Virginia	1942	1950	Limited Access	X				
Washington	1947	1951	Limited Access	X	X	X	X	
West Virginia	1939		Freeway	X	X			
Wisconsin	1949		Controlled Access	X				
Wyoming	1949		Access Facility	X	X	X	X	X

TABLE 5 (Continued)

Summary of Limited Access Laws in the United States as of January 1954

State	Design Features	Acquire Marginal Land	Expedite Legal Cases	Jurisdiction		Closing Intersections	Closing Roads	Service Roads	Penalties	Severability
				New Routes	Old Routes					
Alabama										
Arizona										
Arkansas	X	X	X	X	X	X	X	X	X	X
California	X			X	X	X	X	X	X	
Colorado	X			X	X	X	X	X	X	
Connecticut				X		X	X	X		
Delaware										
Florida	X	X		X	X	X	X	X	X	
Georgia	X			X		X	X	X		X
Idaho				X						
Illinois				X	X	X	X	X		
Indiana	X	X	X	X	X	X	X	X	X	
Iowa										
Kansas				X	X	X	X	X	X	
Kentucky	X	X		X	X	X		X	X	
Louisiana	X	X	X	X	X	X	X	X	X	X
Maine			X	X		X				
Maryland				X	X	X	X	X		
Massachusetts				X	X					
Michigan		X		X		X	X	X		X
Minnesota										
Mississippi										
Missouri										
Montana										
Nebraska				X	X					

TABLE 5 (Continued)

Summary of Limited Access Laws in the United States as of January 1954

State	Design Features	Acquire Marginal Land	Expedite Legal Cases	Jurisdiction		Closing Intersections	Closing Roads	Service Roads	Penalties	Severability
				New Routes	Old Routes					
Nevada										
New Hampshire	X	X		X	X	X	X	X	X	
New Jersey				X	X		X	X		
New Mexico										
New York				X	X			X		
North Carolina										
North Dakota	X	X		X	X	X	X	X		
Ohio				X	X			X		
Oklahoma				X	X	X		X	X	X
Oregon	X	X		X	X	X	X	X		
Pennsylvania	X			X	X	X	X	X	X	X
Rhode Island				X	X		X			
South Carolina										
South Dakota	X	X	X	X	X	X	X	X	X	X
Tennessee										
Texas				X	X	X	X			X
Utah	X	X		X	X	X	X	X	X	
Vermont										
Virginia				X	X		X	X		
Washington	X	X		X	X			X	X	
West Virginia				X	X					
Wisconsin				X	X	X	X			
Wyoming	X			X	X	X	X	X	X	X

and Missouri were not available for this tabulation. The limited access highway laws have been revised in twelve states, and in three of the twelve states there have been two revisions. The limited access facility is designated as a limited access highway in 14 states, freeway and parkway in 9 states, controlled access highway in 8 states, and the remaining states have various designations of their own, and almost all states include a definition in the law. Twenty-one of the thirty-four laws available contain provision for the construction of parkways as well as freeways. Authority is vested in counties and municipalities in nineteen of the 34 laws studied, while in seventeen of the states, if the highway is constructed within the municipality, the municipality must give its consent. Sixteen of the laws analysed contain a provision for the construction of high type geometric design, while twelve state laws include a section for the acquisition of marginal land. Thirty of the thirty-four laws available include a provision for converting existing highways to limited access highways. Elimination of intersections and the closing of roads are legal in 23 and 25 of the laws respectively. Service roads can be constructed in 26 of the states, and special sections pertaining to penalties and severability are included in 15 and 10 of the state laws respectively.

It is interesting to note that the nine states, Alabama, Arizona, Iowa, Montana, Nevada, New Mexico, South Carolina, Tennessee, and Vermont which do not have limited access laws at present have certain similar characteristics. Generally they are predominately agricultural states, with lower than average population densities, and with less miles of high volume traffic roads.

EFFECT OF ACCESS CONTROL ON TRAVEL TIME, OPERATING COSTS, AND HIGHWAY SAFETY

The operating characteristics on several controlled and uncontrolled access highways were obtained to determine the effect of access control on travel time, operating costs, and highway safety. The case study approach was used in the comparison study, and each study included two abutting or nearby sections of highway which were similar with the exception of access control. Twelve case studies were included and are listed in Table 6.

Travel Time

The average speeds for the twelve case studies are summarized in Table 7 by type of access control and degree of urbanization. The data in this figure may not be adapted to all highways because of the

TABLE 6
Comparative Routes in Limited Access Field Study

Study Number	State	Route	Location	Access Control	Geometric Design
1	Connecticut	Connecticut 15	NE of Hartford	Full	4-Lane Divided
	Connecticut	Connecticut 15	SW of Hartford	None	4-Lane Divided
2	Georgia	Atlanta Expressway	In Atlanta	Full	6-Lane Divided
	Georgia	Atlanta Bypass	In Atlanta	None	6-Lane Divided
3	Georgia	U.S. 41	North of Marietta	Partial	4-Lane Divided
	Georgia	U.S. 41	Around Marietta	None	4-Lane Divided
4	Indiana	Tri-State Expressway	In Hammond	Full	4-Lane Divided
	Indiana	U.S. 20	In Gary	None	4-Lane Divided
5	Louisiana	U.S. 71	Alexandria Bypass	Partial	4-Lane Divided
	Louisiana	U.S. 190	Baton Rouge Bypass	None	4-Lane Divided
6	Maine	U.S. 1	Freeport Cutoff	Partial	2-Lane
	Maine	U.S. 201	North of Augusta	None	2-Lane
7	Massachusetts	Massachusetts 128	Around Boston	Full	4-Lane Divided
	Massachusetts	U.S. 9	West of Boston	None	4-Lane Divided
8	Massachusetts	Massachusetts 128	Around Boston	Partial	4-Lane Divided
	Massachusetts	U.S. 1	North of Boston	None	6-Lane Divided
9	Michigan	Michigan 112	West of Detroit	Full	4-Lane Divided
	Michigan	U.S. 112	West of Detroit	None	4-Lane Divided
10	Ohio	U.S. 40	East of Springfield	Partial	4-Lane Divided
	Ohio	U.S. 40	West of Columbus	None	4-Lane Divided
11	Ohio	U.S. 22	Around Clarksville	Partial	2-Lane
	Ohio	U.S. 22	North of Clarksville	None	2-Lane
12	Rhode Island	R.I. 147	South of Uncontrolled Section	Full	4-Lane Divided
	Rhode Island	R.I. 147	South of Woonsocket	None	4-Lane Divided

relatively small number of test sections. However, the table does give an indication of the approximate average speeds under various highway conditions. The number in parentheses indicates the number of test sections included in the average speed.

Average speeds on the fully controlled access highways appear to be only slightly affected by degree of urbanization, whereas average speeds on partially controlled and uncontrolled sections appear to decrease with increased urbanization. In rural areas there appears to be little differnce between the average speeds on full and partially controlled access highways whereas in suburban, and probably more so in urban areas, the average speed on fully controlled access sections is greater than on partially controlled sections. The difference in average speeds between full controlled and uncontrolled sections in rural, suburban, and urban areas is 2.5, 10.3, and 20.9 miles per hour respectively. Assuming these speed differences at the average speeds, there would be a time savings of 0.07, 0.32 and 1.00 minutes per vehicle-mile of travel.

TABLE 7

Average Speed in Miles per Hour by Type of Access Control and Degree of Urbanization for the Twelve Case Studies

	Urban	Suburban	Rural
Full Control	47.3(2)#	49.2(2)	47.4(2)
Partial Control	.....	42.3(1)	49.5(5)
No Control	26.4(2)#	38.9(7)	44.9(3)

Numbers in parentheses indicate the numbers of test sections included in the average speeds.

In other words it takes 8, 26, and 79 per cent more time respectively to travel one mile on the uncontrolled access highway than on the controlled access highway.

If the value of time for passenger cars and commercial vehicles is taken as $1.35 per hour (2.25 cents per minute) and $3.00 per hour (5.00 cents per minute) for a highway carrying 80 per cent passenger cars and 20 per cent commercial vehicles, the composite value of time would be $1.68 per hour (2.80 cents per minute). The monetary time savings on fully controlled access highways in rural, suburban, and urban areas would be 0.2 cent, 0.9 cent and 2.8 cents per vehicle-mile. As a further example if the access to a highway carrying 10,000 vehicles per day was fully controlled, the monetary time savings per mile would amount to $7,200, $32,800, and $102,000 per year.

The difference in average speeds between partially controlled and uncontrolled sections in rural and suburban areas is 4.6 and 3.4 miles

per hour respectively. The average speed in urban areas on partially controlled access highways would probably have a great variation depending upon the degree of access control. Assuming these speed differences at the average speeds, there would be a time savings of 0.13 and 0.12 minutes per vehicle-mile of travel. Again using the value of time indicated in the previous paragraph, the monetary time savings on partially controlled access highways in rural and suburban areas would be 0.4 and 0.3 cent per vehicle-mile. If the access to a highway carrying 10,000 vehicles per day was partially controlled, the monetary savings per mile would amount to $13,200 and $12,300 per year.

Operating Costs

The average gasoline consumption for the twelve case studies is summarized in Table 8 by type of access control and by degree of

TABLE 8

Average Gasoline Consumption by Type of Access Control and Degree of Urbanization

	Urban	Suburban	Rural
Full Control	18.8(2)#	19.4(2)	18.8(2)
Partial Control	.....	19.8(1)	18.5(5)
No Control	17.7(2)#	19.9(7)	18.4(3)

Numbers in parentheses indicate the numbers of test sections included in the average gasoline consumption.

urbanization. As pointed out in the discussion of average speeds the size of the sample is rather small, and there appears to be certain relationships that do not seem plausible at first glance. Further investigation revealed that average speed appeared to have as great an influence on gasoline consumption as either access control or degree of urbanization. The relationship between gasoline consumption and average speed is plotted on Figure 3 for the controlled and uncontrolled access sections. The points on the curve were established by averaging the average speeds and their gasoline consumption on the test sections in groups of 30-35, 35-40, 40-45, 45-50, and 50-56 miles per hour. The curve established with the same equipment on a 1951 Pontiac by Professor A. J. Bone is superimposed on the graph.[5] Some of the points on Bone's curve, particularly the points at the higher speeds, were determined by test runs on the test sections given in Case Study No. 7 of this report. The other points on Professor Bone's curve were obtained from routes different from the ones this author selected and the test vehicles were not the same. This would have some bearing on the

differences in the two studies in relationship to gasoline consumption and speed.

This graph indicates that gasoline consumption is dependent upon the speed the vehicle operator desires to drive. If the vehicle operator would drive at the speed of optimum gasoline consumption (30 to 40 miles per hour) on the average controlled access sections, the gasoline consumption of the test vehicle would be approximately 20.1 miles per gallon. This choice of speed on the controlled access highway is the

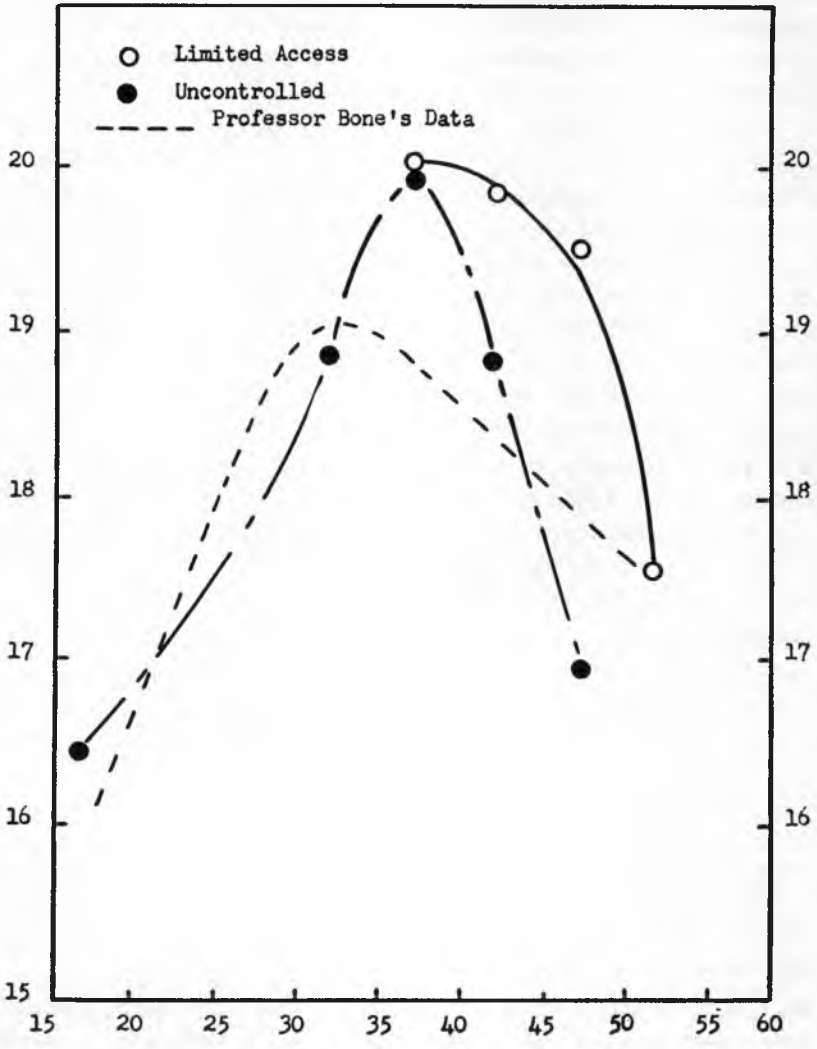

Fig. 3. Gasoline consumption related to speed.

drivers' and generally not dependent upon road and traffic conditions which do determine the speed on the uncontrolled sections.

The conclusion from the gasoline consumption data is that gasoline consumption could be lower on the controlled access sections if the vehicle operator would drive 30 to 40 miles per hour. Time savings on the controlled access sections, of course, would thereby be reduced. However under existing driver behavior, gasoline consumption on the rural and suburban sections of highway is not appreciably different. On urban sections of highway, the decrease in miles per gallon of gasoline consumption is due to greater congestion and traffic friction than the decrease due to above optimum speeds. This results in better gasoline consumption on the controlled access sections.

The length of time (seconds) of brake application per mile of travel is presented in Table 9 by type of access control and degree of urbanization. Application of brakes on full controlled access highways is rarely needed whereas brakes are applied on the average of 0.21, 1.70, and 5.74 seconds for each mile of travel on uncontrolled sections in rural, suburban, and urban areas respectively. In rural areas, the brakes were applied for a greater length of time on partially controlled access sections than for the fully controlled or uncontrolled access sections. This is probably due to higher speeds with an occasional unexpected sudden slowing down or stopping.

The utilization of the brakes is reduced when access is fully controlled by 0.17, 1.70 and 5.74 seconds per mile of travel on rural, suburban, and urban areas respectively. Applying the above values to a highway carrying 10,000 vehicles per day, the reduction in length of time of brake application would amount to 172, 1,720, and 5,820 hours per mile per year.

TABLE 9

Average Length of Time of Brake Application per Mile by Type of Access Control and Degree of Urbanization for the Twelve Case Studies

	Urban	Suburban	Rural
Full Control	0.00(2)#	0.00(2)	0.04(2)
Partial Control	.....	0.00(1)	0.42(5)
No Control	5.74(2)#	1.70(7)	0.21(3)

The unit of duration of brake application is seconds per mile and the numbers in parentheses indicate the number of test sections included in the average brake application.

Highway Safety

Table 10 summarizes the accident rates by type of access control and degree of urbanization. The accident rate decreases with an increase in control of access and with degree of urbanization. However even on the best designed full controlled access highways where marginal, intersectional, medial, and internal frictions are almost eliminated, accidents and loss of lives continue to occur. The question is obviously what kind of accidents and fatalities still occur and what causes them. In order to make this analysis, accidents on the test sections were combined as related to access control. Then the accidents and fatalities were summarized on the basis of 100 million vehicle-miles, as shown in Table 11. Sixty (60) per cent of the accidents on the fully controlled sections were of the rear-end or side-swipe type, twenty per cent of the non-collision type, and twelve per cent of the total were other collision. Sixty per cent of the fatalities on the fully controlled access sections occurred in rear-end or side-swipe accidents.

Another approach to the accident problem is to determine the per cent difference of accidents as access is controlled and a summary of this analysis is shown in Table 12. The greatest difference in accidents and fatalities on partially and fully controlled sections is for angle collisions and collisions with pedestrians. The smallest difference as access control increased is in rear-end or side-swipe and non-collision accidents.

The State of Connecticut[6] and the Bureau of Public Roads[7] have made similar studies attempting to determine the effect of access control on the accident rate. A comparison of the results of the three studies is shown in Table 13.

TABLE 10

Accident and Fatality Rates by Type of Access Control and Degree of Urbanization for the Twelve Case Studies#

	Urban	Suburban	Rural
Full Control	247(2)#	141(2)	49(2)
Partial Control	.....	320(1)	200(5)
No Control	443(2)	330(7)	236(3)

The values in the table are the number of accidents and fatalities per 100 million vehicle-miles and the numbers in parentheses indicate the numbers of test sections included in the average speeds.

Accident and fatality rates are only for one year for each test section and because of the relatively short length of the test sections, the accident and fatality rates may vary considerably from year to year.

TABLE 11

Types of Highway Accidents as Related to Access Control

Accident Record		Manner of Accident						
		Rear-end or sideswipe	Head-on or sideswipe	Angle Collision	Collision with Ped.	Other Collision	Non-Collision	Total Accidents
All	F	82	4	6	1	16	27	136
Accidents	P	92	9	55	6	66	81	309
	N	197	12	108	12	73	34	436
Fatal	F	2			1	1		4
Accidents	P	2		3				5
	N	1		1	4	1		7
Injury	F	33		1		5	16	55
Accidents	P	27	2	12	6	19	34	100
	N	66	3	32	5	25	16	147
Property	F	46	4	5		11	11	77
Damage	P	64	8	38		47	47	204
	N	131	9	75		48	18	281
Persons	F	3			1	1		5
Killed	P	1		8				9
	N	2		1	4	2		9
Persons	F	70		1		6	20	97
Injured	P	48	2	23	16	36	62	187
	N	112	9	67	7	38	23	256

F indicates Full Control
P indicates Partial Control
N indicates No Control
All values in table are the number of accidents per 100 million vehicle-miles, and accidents of case studies 3, 6, 7, and 8 are not included.

TABLE 12

Reduction of Accidents and Fatalities by Access Control

Accident Record		Manner of Accident						
		Rear-end or Sideswipe	Head-on or Sideswipe	Angle Collision	Collision with Ped.	Other Collision	Non-Collision	Total Accidents
All Accidents	F	58%	67%	94%	92%	78%	21%	69%
	P	53%	25%	49%	50%	10%	#	29%
Fatal Accidents	F	#		100%	75%	0%		43%
	P	#		#	100%	100%		29%
Injury Accidents	F	50%	100%	97%	100%	80%	0%	63%
	P	59%	33%	62%	#	24%	#	32%
Property Damage Accidents	F	65%	56%	93%		77%	39%	73%
	P	51%	11%	49%		2%	#	27%
Persons Killed	F	#		100%	75%	50%		44%
	P	50%		#	100%	100%		6%
Persons Injured	F	37%	100%	99%	100%	84%	7%	72%
	P	57%	78%	65%	#	53%	#	27%

F indicates Full Control
P indicates Partial Control
Actually an increase

TABLE 13

Comparison of Accident Rates as Related to Access Control

Type of Access Control	Urban	Rural
Full Access Control		
Twelve Case Studies	247	49
Connecticut Study	261	221
Bureau of Public Roads Study#	146	210
Partial Access Control		
Twelve Case Studies	.....	200
Connecticut Study	180	250
Bureau of Public Roads Study	790	227
No Access Control		
Twelve Case Studies	443	236
Connecticut Study	725	313
Bureau of Public Roads Study	966	407

The values in the table represent the number of accidents per 100 million vehicle-miles of travel.

Tentative results of preliminary study by Bureau of Public Roads.

PERMANENCE OF CHARACTERISTICS

Controlled access highways appear to be more economical than uncontrolled access highways in that the characteristics of travel time, highway safety, and capacity are relatively permanent, while these characteristics on uncontrolled access highways deteriorate rapidly.

A study of the following uncontrolled access bypasses in Indiana clearly indicate this deterioration:

U. S. Route No. 52 at Lebanon

U. S. Route No. 31 at Kokomo

Indiana Route No. 100 at Indianapolis, two lane portion

Indiana Route No. 100 at Indianapolis, four lane portion

U. S. Route No. 52 at Lafayette

The age of these routes varies from 3 to 16 years and their length varies from 3.9 to 19.9 miles.

Travel Time

Travel time studies were conducted on the five routes in 1954, the amount and type of roadside development were obtained, and these data are presented in Table 14. The average speed on each of the five uncontrolled bypasses was 44, 46, 32, 42, and 36 miles per hour respectively. Speed studies conducted during 1954 by the Joint Highway Research Project at Purdue University showed an average speed of 53 miles per hour on rural Indiana highways which have little roadside development. (See Figure 4)

Since the five bypass routes were originally constructed in rural areas, it is reasonable to assume that any speed less than 53 miles per hour on these routes in 1954 is due to lack of access control.

The average speed on the Lebanon and Kokomo bypasses[8] when first opened to traffic was 52 and 49 miles per hour, while at the same time the speed on Indiana highways with little roadside development was 51 miles per hour. This would further indicate that when these two uncontrolled access highways were first built, the speeds were comparable with rural highways. Therefore lack of access control has resulted in a reduction in the average speed on the five routes of 9, 7, 21, 11 and 17 miles per hour respectively.

The speed studies on these five routes indicate also that the average speed on the newer routes is higher than the average speed on the older routes. An exception to this is the relatively new four-lane portion of Indiana Route No. 100 which, due to a more rapid growth of

TABLE 14

Average Speeds and Roadside Development on Certain Indiana Highways

Route	Length of Service	Average Speed in 1954#	Length of Route	Average Roadside Development per mile			Traffic Lights
				Residences	Commercial Businesses	Intersections	
Lebanon Bypass	3	44	5.1	1.2	2.7	1.8	1.4
Kokomo Bypass	4	46	7.1	3.8	1.0	3.0	0.1
Route 100 around Indianapolis four lanes	6	32	3.9	16.4	5.1	4.5	1.5
Route 100 around Indianapolis two lanes	8	42	19.9	9.2	1.5	3.5	0.3
Lafayette Bypass	16	36	6.7	3.3	10.1	3.6	0.3

Average speed on Indiana Highways in 1954 with little roadside development is 53 miles per hour.

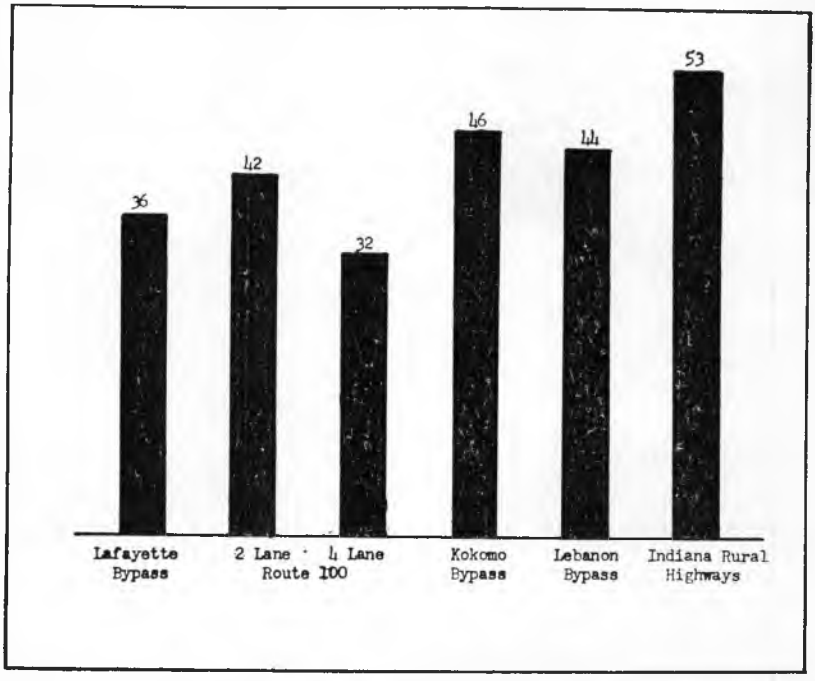

Fig. 4. Comparison of average speed on five selected routes with average speed on Indiana highways.

roadside development, has an average speed lower than that for the older highways. In general, the amount of roadside development and points of access contributed most to a reduction in speed.

Because of this relationship of decreased speed with additional roadside development, the speeds and resulting operating efficiency on these routes will continue to decrease.

Highway Safety

The average accident rate for the period 1948-1953 for each of the five routes and for the average rural highway in Indiana are shown in Table 15 and Figure 5. The accident rates for the years 1951-1953 for each route were averaged and are shown in the last column. The accident rate for each route was greater than the average accident rate on Indiana rural highways for a similar period of time. The accident rate for the three older routes was less in 1948 than in 1953. Generally the routes with the greatest amount of roadside development and the most access points had the greatest accident rate. Consequently with additional roadside development, the average speed will not only be less, but it is very probable that the accident rate will increase.

TABLE 15

Accident Rates on Certain Indiana Highways

Route	Number of Accidents per 100 Million Vehicle-Miles						
	1948	1949	1950	1951	1952	1953	1951-1953 (Average)
Lebanon Bypass	#	#	NA##	352	500	292	381
Kokomo Bypass	#	#	NA	723	420	660	601
Route 100 around Indianapolis, four lanes	267	465	NA	1060	625	578	754
Route 100 around Indianapolis, two lanes	143	193	NA	540	415	310	422
Lafayette Bypass	345	538	NA	600	555	404	520
Average Accident Rate on Indiana Highways	NA	NA	328	350	314	272	313

Highway was not open to traffic in that particular year.

Accident rates not available.

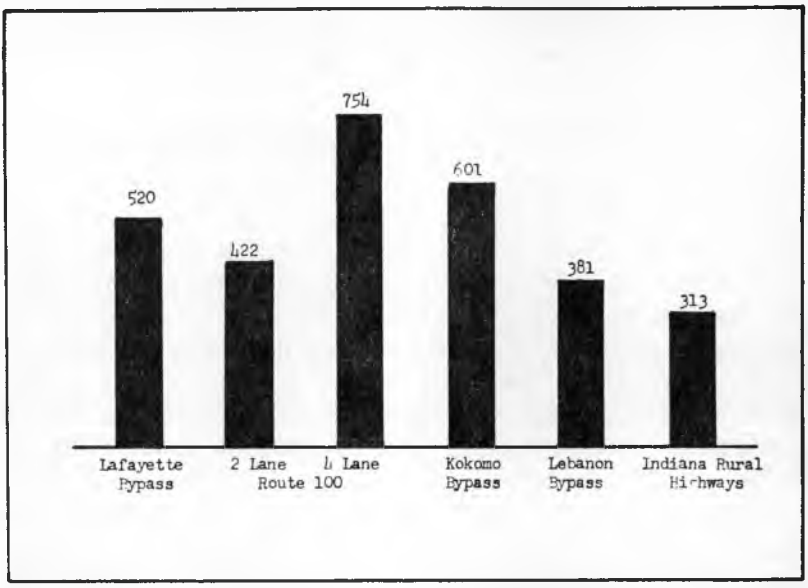

Fig. 5. Comparison of accident rate of five selected routes with average rate on Indiana highways.

Highway Capacity

Several studies have shown that where roadside development is not controlled, the capacity of a highway may be reduced fifty to seventy-five per cent.[9, 10] According to the design standards included in the *Policy of the American Association of State Highway Officials, 1954,* the design capacity in passenger vehicles per hour per 12 foot lane on highways with full control of access, on major highways with moderate roadside interference, and on major highways with considerable roadside interference is 1000-1200, 700-900, and 500-700 respectively.[11] Examples may be found in almost every state showing that capacity of a highway decreases with an increase in roadside interference.

Sufficient information for the five previously mentioned routes could not be obtained in order to attempt to determine the effect of roadside development on highway capacity quantitatively. The following hypothetical example is presented to give a qualitative illustration of the effect of uncontrolled access on highway capacity.

A highway is constructed on a new location where the access is not controlled. As in the normal case, the highway is designed for future traffic demand, and when the road is opened to traffic the capacity exceeds the current traffic volume. With time the volume of traffic increases, but concurrently roadside development reduces the capacity

of the highway. After a few years, but before the highway is structurally inadequate, the traffic demand exceeds the capacity, and either additional lanes or a parallel route is needed. In many cases where adequate right-of-way had not been acquired, it probably would be less expensive to build an entirely new parallel route than to purchase additional right-of-way along the old route and construct additional lanes. It is obvious that if the access on the new route is not controlled, the same cycle will be repeated. Figure 6 is a pictorial presentation of the above discussion. Line DEC signifies the growth of the traffic demand with time. Line AE represents the reduction of capacity on the uncontrolled access section, BE indicates the increased capacity due to the construction of additional lanes or construction of a parallel route, and BC represents the reduction in capacity with time on both uncontrolled access sections. Line AC signifies the constant capacity if built as a fully controlled access highway.

The five routes studied generally are similar to the example mentioned above, and the capacity is decreasing on all of them. Plans are under way to bypass the bypass around Lafayette, the oldest of the five routes, and additional lanes are being constructed on the Lebanon bypass. Such steps are only temporary cures, and unless the access is controlled on future construction of similar routes, optimum capacities can not be maintained during the life of the facilities.

Protection of the Initial Investment

The construction of highways to handle substantial volumes of traffic at relatively high speeds is expensive. Since the beginning of the era of modern highways, the highway engineer has stressed the importance of wider lanes, increased number of lanes, better horizontal alignment, greater vertical control, and improved procedures for constructing the foundation and the pavement. These improvements for large volumes of traffic are generally worthwhile, but the investment of providing the highway and the desirable design features should be protected.

The value that the public places upon a highway is, in a sense, not how much it costs, but how well it serves. An uncontrolled access highway constructed in areas which are conducive to roadside development, even though considerable expense has provided many well designed features, will not continue to serve traffic efficiently. It is appalling how many miles of well designed highways, such as the five routes previously mentioned, which because of lack of roadside control, result in high operating costs, low speeds, poor safety, reduced capacity and obsolesence.

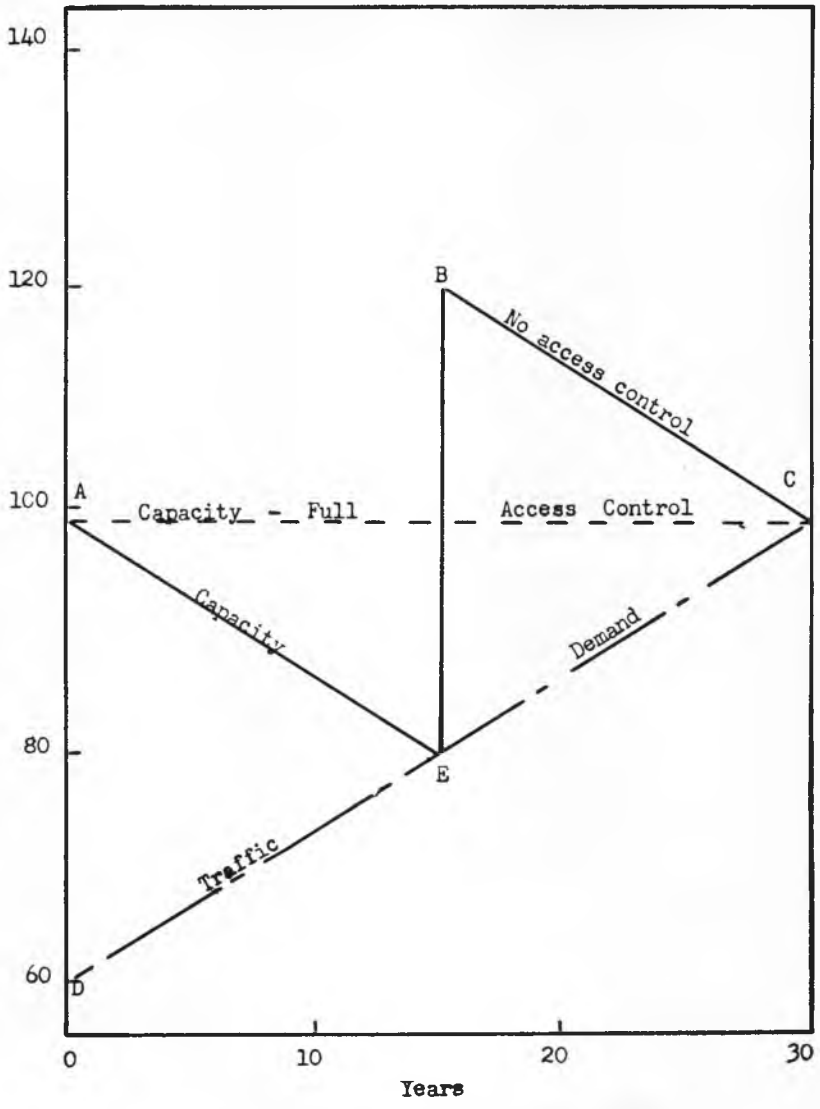

Fig. 6. Highway capacity related to roadside development.

These five routes are good examples of portraying the need for protecting the highway development. The five routes were built around urban developments through relatively rural areas. The costs of the right-of-way and access rights at the time of construction were generally small, but today the cost of additional right-of-way and access control would be excessive.

The intended purpose of the routes was to provide a rapid, economic, and safe means of travel for traffic to bypass these urban areas. In a short period of time these bypasses have rapidly become less effective as business concerns and residential subdivisions destroyed their use as traffic arteries. Cross traffic increased until stop signs and traffic lights are prevalent, and the term "bypass" has become a misnomer. Now, as pointed out in the previous section, a parallel route is planned to replace the Lafayette bypass, and additional lanes are being constructed on the Lebanon facility. This cycle will continue on these routes and on similar routes until such time as the access is controlled.

SUMMARY OF RESULTS AND CONCLUSIONS

Summary of Results

1. Thirty-nine states have the legal authority to construct limited access highways, and of the remaining nine states, limited access laws are being seriously contemplated in five at the present time.
2. There is a great variation between the limited access highway laws of the various states, and their effectiveness. Revisions have been made in twelve of the limited access laws, and several states have revised their limited access laws more than once.
3. There are 5,420.7 miles of publicly owned limited access highways either under construction or in operation in the United States as reported by the various states in 1954. (Two states reported incomplete information).
4. Twenty states, over one-half of the states having limited access laws, have less than twenty-five miles of limited access highways. Only nine states have over two hundred miles, and almost one-half of the limited access highway mileage is located in three states.
5. There has been a continuous increase in the number of miles of limited access highways built each year from an average of 21.8 miles per year during 1939-1943 to 1,132.8 miles built in 1953.
6. Of the limited access highways reported, thirty-three per cent of the highways had existed as uncontrolled access highways before they were designated as limited access highways. The remaining sixty-seven per cent were originally built as limited access highways.
7. Of the limited access highways reported, twenty-three per cent are fully controlled access highways, while seventy-seven per cent are partially controlled access highways.

8. Limited access highways are predominately either two lane 24 foot pavements (30.2% of the reported total miles) or four lane divided 48 foot pavements (50.3% of the reported total miles).
9. The data of this study indicate that fully and partially controlled access highways carrying substantial volumes of through traffic result in:
   (a) a significant savings in time, a reduction in gasoline consumption, and a decrease in the number of accidents and fatalities in urban areas.
   (b) a significant savings in time and a decrease in the number of accidents and fatalities, but no significant reduction in gasoline consumption in suburban areas.
   (c) a significant decrease in the number of accidents and fatalities, but no significant savings in time nor a reduction in gasoline consumption in rural areas.
10. The average speed on the five Indiana uncontrolled bypasses was 13 to 40 per cent lower than speeds on rural Indiana highways which have little roadside development.
11. The accident rate on the five Indiana uncontrolled bypasses was 22 to 141 per cent greater than the average accident rate on Indiana highways.

Conclusions

Highways carrying substantial volumes of through traffic in areas conducive to roadside development will have a continuing reduction in speed, safety, and capacity and will become functionally obsolete unless the access is controlled. Controlling the access to these highways will protect the initial investment and will result in a more permanent improvement.

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