An Economic Study

of

Interior Block Parking Facilities

by

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A Thesis

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PREFACE

As a part of the graduate course in Traffic Engineering of the Bureau of Highway Traffic at Yale University, each student is required to develop a thesis based on individual investigations. While there are severe limitations on time and resources, it is felt many of these theses are of sufficient interest and value to warrant their publication and distribution to those concerned with highway traffic.

In this thesis the author, Mr. Charles S. LeCraw, has dealt with some of the economic aspects pertinent to off-street parking facilities in the interior of urban business blocks. In light of the present extreme shortage of off-street parking facilities this study is felt especially timely. It may suggest practical approaches to the improvement of parking conditions in those cities where land development lends itself to utilization of interior-block areas for private vehicle storage.

This is the third of a series of technical reports being issued by the Bureau of Highway Traffic. The preceding reports were:

Technical Report 1—Traffic Performance at Urban Street Intersections by Bruce D. Greenshields and Donald Schapiro.

Technical Report 2—Toll Bridge Influence on Highway Traffic Operation by M. Earl Campbell.

The Bureau of Highway Traffic is indebted to the Eno Foundation for Highway Traffic Control, Inc., for furnishing funds for this and other publications of the technical series. It is a further demonstration of the close working relationship maintained by these two organizations.

Theodore M. Matson, *Director*
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Charles S. LeCraw, Jr.

New Haven, Connecticut
May 15, 1946.

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CHAPTER I

THE PARKING PROBLEM

The first recorded instance of a parking problem is found in the Book of Genesis in the Bible where it is related that Noah, after a long journey, found himself without terminal facilities.[1] After much hunting around for a convenient parking place, he finally grounded his vehicle on Mount Ararat.

The number of motor vehicles in the United States is in the neighborhood of thirty million. This universal ownership of vehicles has created a demand for terminal facilities in central business districts that is of great concern not only to municipal officials but to business interests and above all to the drivers of motor vehicles.

1. Shortage of Terminal Facilities.

It is easier in these days of heavy traffic volumes to get to where you are going than to dispose of your automobile when you get there—if your terminal point is in the central business district of practically any city in the United States. This acute shortage of terminal facilities stems from the history of highway transportation. During the early road building era, efforts to provide highway transportation service were directed exclusively to the vehicle in motion on the assumption that the vehicle at rest could take care of itself. This assumption at one time was generally valid, for parking at the curb furnished adequate terminal facilities for the motor vehicle, as it had for the horse. Today, however, the growth and concentration of motor vehicle ownership and use have created a demand for parking spaces which greatly exceeds the supply in downtown areas.

This need for mid-town parking facilities is further emphasized by the great number of miles of vehicular travel within city limits. The U. S. Public Roads Administration reports that of the total miles covered by all vehicles 30 per cent are on urban streets, and of the total miles covered by all vehicles registered in cities of 100,000 population or over, approximately 60 per cent are on urban streets.[2] Furthermore, trips outside of cities are predominately short. Public Roads Administration reports on this by saying that results of highway planning surveys in eleven representative states indicate that the average of all trip lengths outside of city limits ranges from 11.7 to 18.7 miles.

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[1]D. Grant Mickle, *Attacking the Parking Problem*, Proceedings, First Southeastern Traffic Engineering Conference (South Carolina State Highway Department and Clemson College), 1941, page 98.

[2]*Toll Roads and Free Roads*, House Document No. 272, 76th Congress, 1st Session, (U. S. Government Printing Office), 1939, page 111.

Since the average motor car travels nearly 9,000 miles per year,[3] and it has been shown that trip lengths are short, the need for terminal facilities in cities becomes even more apparent.

2. Economic Effect of Terminal Shortage.

This acute shortage of terminals in most cities has a direct economic effect in two ways:

1. A loss to the vehicle driver and his passengers due to time lost.
2. A loss to the city in a decrease in city tax revenues.

As a part of a study made by Public Roads Administration included in a report on "Intangible Economics of Highway Transportation"[4] presented at the 1933 annual meeting of the Highway Research Board, the effects of inadequate parking facilities on total trip time were investigated. "Runs" were made from three points approximately six miles from a central business district destination in Washington, D. C. during the rush hour; and travel time, time spent finding a parking space, and time spent walking from parking space to destination accurately measured.

The average driving speed for all "runs" for the six miles was 14.2 miles per hour. After spending 7.5 minutes finding a parking space at the curb, the over-all average speed dropped to 10.8 miles per hour. After an additional 8.3 minutes spent in walking from parking space to ultimate destination, the average over-all speed was brought down to 8.5 miles per hour. Thus, the reduction in speed was about 40 per cent because of time lost due to parking difficulties, or a loss of nearly 17 minutes for each six-mile trip.

Secondly, the acute shortage of terminal facilities has also manifested itself in a decrease in city tax revenues. When property values in a business district decline and the tax rate remains the same, it is obvious that tax revenues collected by the city must also decline. Numerous reports indicate that this situation is prevalent throughout many cities of the United States at the present time. All of these reports, according to information from answers to questionnaires sent out to various cities and towns by the American Automobile Association,[5] list inaccessibility due to inadequate parking and terminal facilities as one of the factors which has contributed to decentralization of business and a resultant decline in property values.

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[3] *Automobile Facts and Figures,* 24th Edition (Automobile Manufacturers Association), 1942, page 23.

[4] C. A. Hogentogler, E. A. Willis and J. A. Kelley, *Intangible Economics of Highway Transportation,* Proceedings of the Thirteenth Annual Meeting, Highway Research Board (National Research Council), 1934. page 197.

[5] *Report of the Committee on Parking and Terminal Facilities,* (American Automobile Association), 1940, page 12.

Taxes from business district properties in most cities pay a large portion of the expenses of operating the city government. In the larger cities throughout the country, according to the information received by the American Automobile Association, from 10 per cent to 40 per cent of the total assessed land and property values in the city is represented in the central business district. In the city of New Haven, Connecticut, the central business district pays 20 per cent of the total city property tax on only 1½ per cent of the taxpaying area of the city.

It would seem then, that any condition which seriously affected the taxpaying ability of the central business district of any city must be regarded with grave concern by those officials responsible for the welfare of the city. And the problem of providing adequate parking facilities qualifies as a condition, which, if not considered immediately, will seriously threaten the economic future of all cities.

3. *Approach to the Problem.*

A study made in Detroit in 1937 to determine parking practices[6] showed 32,000 off-street parking spaces available within 0.4 miles of the center of destination; but further study showed that at 2:30 P. M., the peak hour of demand for parking space, these off-street spaces were filled only to 37 per cent of their capacity. This is due to two factors: location of the facility and the price charged for parking service. To quote Mr. Koch: "A deficiency in the supply of parking facilities is not indicated. It would seem futile to increase the number of berths unless added spaces could be supplied at low rates and in more convenient locations."

This thesis will not concern itself with the subject of prices or rates to be charged for the service of parking but will be concerned exclusively with a discussion of the *location* of off-street parking facilities.

The best general locations for off-street parking facilities may be determined by the study of data obtained from an Origin and Destination Survey. Since the resulting locations almost invariably fall within the most highly concentrated portions of the central business districts, land value is a factor which can never be ignored.

This thesis will present a study of land values in central business districts and, based on one case study, will prove the following points concerning the selection of land to be used for off-street parking facilities:

1. Within the concentrated portions of business districts where demand for space is great, there exists a great differential in value between various parcels of land located in any block.

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[6]Harry C. Koch, *Parking Facilities for the Detroit Central Business District,* Proceedings, Tenth Annual Meeting, Institute of Traffic Engineers, 1939, page 73.

2. Proper selection of the parcels of land to be used for parking purposes can allow the provision of these facilities at a much lower cost.
3. Proper selection of land parcels will allow a minimum of interference with vital commercial activities.
4. Proper selection of land parcels will deprive the city of a minimum of tax returns from private industry.
5. Proper selection of locations for off-street parking facilities will allow the location of several small facilities, convenient to generators of traffic, at a much cheaper cost than the cost of constructing a large, central parking area.

New Haven, Connecticut, was selected as a city to study for the following reasons:

1. It is believed that New Haven represents the average middle-sized American city in that its central business district is suffering from decentralization and is losing value rapidly.[7]
2. New Haven is suffering from traffic congestion at the present time and has an acute shortage of adequate terminal facilities.
3. The personnel of the City Planning Commission of New Haven is anxious to cooperate in any project which might help to alleviate the existing traffic problems in its city.

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[7] *Tomorrow is Here*, (City Plan Commission, New Haven, Connecticut), 1944, page 14.

CHAPTER II

STUDY OF SEPARATE INTERIOR-BLOCK LAND PARCELS

". . . In the final analysis it is location, made accessible by means of communication which constitutes the chief external factor of value of city land.[1] . . . Unless urban land is so situated as to make it accessible, it will be relatively unimportant for community uses."[2]

The above quotation, although taken from a book concerned exclusively with the science of evaluation of land, seems to have a definite bearing on the traffic problem as it exists today in urban areas. For it is the highway which makes urban land areas accessible, and it is this accessibility which enhances the value of this urban land.

1. Comparison of Interior-Block and Street-Front Property.

Based on this line of reasoning, it seemed logical to the author that there should be a direct relationship between the accessibility of the individual land parcels to the street system and the comparative values of the various land parcels. If the quotation above is a correct one, it would be expected that property in an urban area which fronted on major streets would have a much higher unit value than property located in the rear of business establishments and accessible only by alleyways.

Therefore, it was decided to conduct a comparative study of the values of street-front properties and interior-block properties within numerous city blocks located in and adjacent to the central business district of New Haven. Since the purpose of the study is to determine from an economic standpoint the desirability of acquiring various parcels of land for parking facilities, it is necessary to consider the total improved value of the land parcel and all structures now existing thereon. This total of land value and building value will hereinafter be referred to as "improved" value of the land.

Access was obtained to the tax assessor's vault in New Haven and total values of both land and buildings were obtained for all land parcels of fifteen separate city blocks. These blocks varied in location from 350 feet from the center of the city to a distance of 2,000 feet from the center of the city. Of these fifteen areas studied, twelve are within 1,000 feet of the center of the city, which has been defined as an area extending approximately one-half block or 200 feet in each direction from the intersection

[1]Walter W. Pollock and Karl W. H. Scholz, *The Science and Practice of Urban Land Valuation*, Philadelphia: The Manufacturers' Appraisal Compnay, 1926. page 4.

[2]Ibid, page 3.

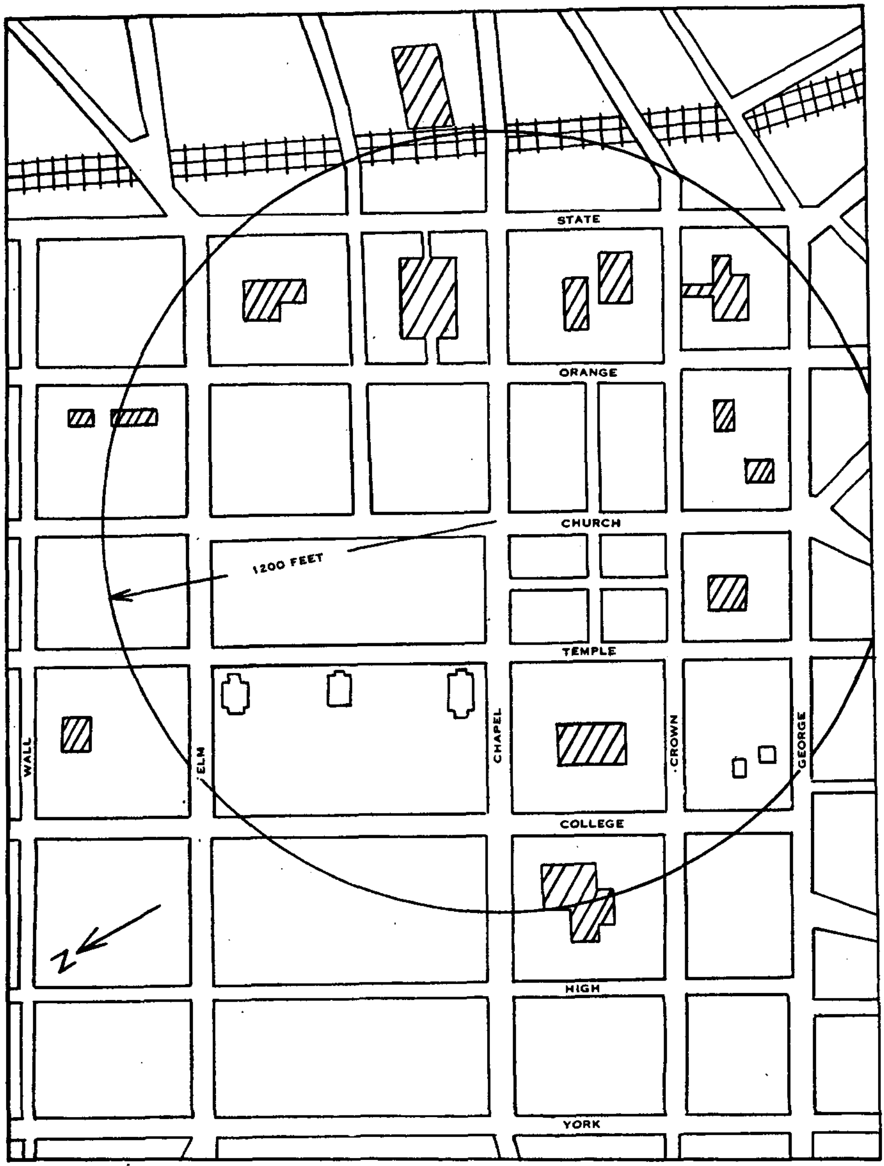

FIGURE 1

Interior-block areas studied within walking distance of the center of the city

of Church and Chapel Streets. This intersection is the "heart" of the central business district of New Haven, and is the main transfer point of buses and street cars radiating from the central business district to outlying areas. The 1,000 foot distance has been suggested by various authors as the maximum distance which a parker will willingly walk from his parking place to his destination. A study made in Savannah, Georgia[3] shows that 88.2 per cent of all parkers interviewed parked less than this 1,000 foot distance from their respective destinations. The detailed locations of these twelve areas in New Haven, hereafter referred to as "primary" areas of study, are shown in Figure 1, page 6.

These areas were selected for study because each of the blocks contained separate "interior-block" land parcels. This terminology, while probably not standard among real estate men, has been used to denote land parcels which are entirely surrounded by others; that is, land parcels which do not have direct frontage on any of the four streets surrounding the block.

Upon study of the assessed values of the various land parcels, it was determined that assessed valuations had been given to various street-front land parcels on the basis of the number of front feet which the land parcel occupied along the street. However, in the case of interior-block land parcels, no such measure had been used, but a record was kept of the total area in square feet of the land parcel and the total assessed valuation. It was readily seen that no direct comparison could be made between these two different measures of value. Therefore, it was necessary to adjust the values of the two types of land parcels to a common denominator.

This was accomplished by obtaining the total area and improved value of all parcels of land. By dividing the total improved value of an individual land parcel by its total area in square feet, the total improved value per square foot for each land parcel was obtained. This information is summarized in Table 1, page 8.

Averages of value per square foot for both front property and interior-block property were obtained for each city block studied.

These values were plotted in graph form and are shown in Figure 2, page 9. In this figure, the land values of both front and interior-block property are plotted against the distance of the block from the center of the city.

It can be seen in Figure 2 that the highest land values for both front and interior-block property were found in the blocks nearer to the center

[3]S. T. Hitchcock and T. E. Willier, *Determining Parking Requirements by Study of Parking Habits.* Proceedings of the Twenty-Fourth Annual Meeting, Highway Research Board (National Research Council), 1944, page 260.

TABLE I

Summary of Data

Showing Comparative Improved Land Values of Street-Front and Interior-Block Land Within 15 New Haven City Blocks Examined

BLOCK	DISTANCE FROM CENTER OF CITY	STREET-FRONT PROPERTY: TOTAL AREA (SQUARE FEET)	STREET-FRONT PROPERTY: TOTAL IMPROVED VALUE (DOLLARS)	STREET-FRONT PROPERTY: IMPROVED VALUE PER SQUARE FOOT	INTERIOR-BLOCK PROPERTY: TOTAL AREA (SQUARE FEET)	INTERIOR-BLOCK PROPERTY: TOTAL IMPROVED VALUE (DOLLARS)	INTERIOR-BLOCK PROPERTY: IMPROVED VALUE PER SQUARE FOOT
A	350 ft.	124,397	3,069,065	$24.67	21,030	130,720	$6.21
B	400	179,976	4,257,480	23.66	13,849	35,415	2.56
C	450	168,349	3,191,610	18.96	21,032	38,080	1.71
D	500	118,989	2,147,565	18.05	3,150	8,375	2.66
E	550	134,301	2,153,745	16.04	12,846	39,500	3.07
F	800	179,352	2,311,105	12.87	16,208	64,040	3.95
G	850	160,112	1,809,750	11.30	3,545	5,975	1.68
H	900	152,258	1,351,725	8.88	11,400	12,860	1.13
I	1000	200,604	2,333,785	11.63	4,620	12,775	2.76
J	1100	107,523	741,125	6.90	13,278	16,820	1.27
K	1200	121,329	370,400	3.05	25,700	7,500	0.29
L	1500	183,809	612,850	3.33	13,500	22,300	1.65
M	1600	145,435	336,515	2.31	1,300	130	0.10
N	1800	72,536	179,045	2.47	3,045	525	0.17
O	2000	136,440	322,210	2.36	5,500	700	0.13

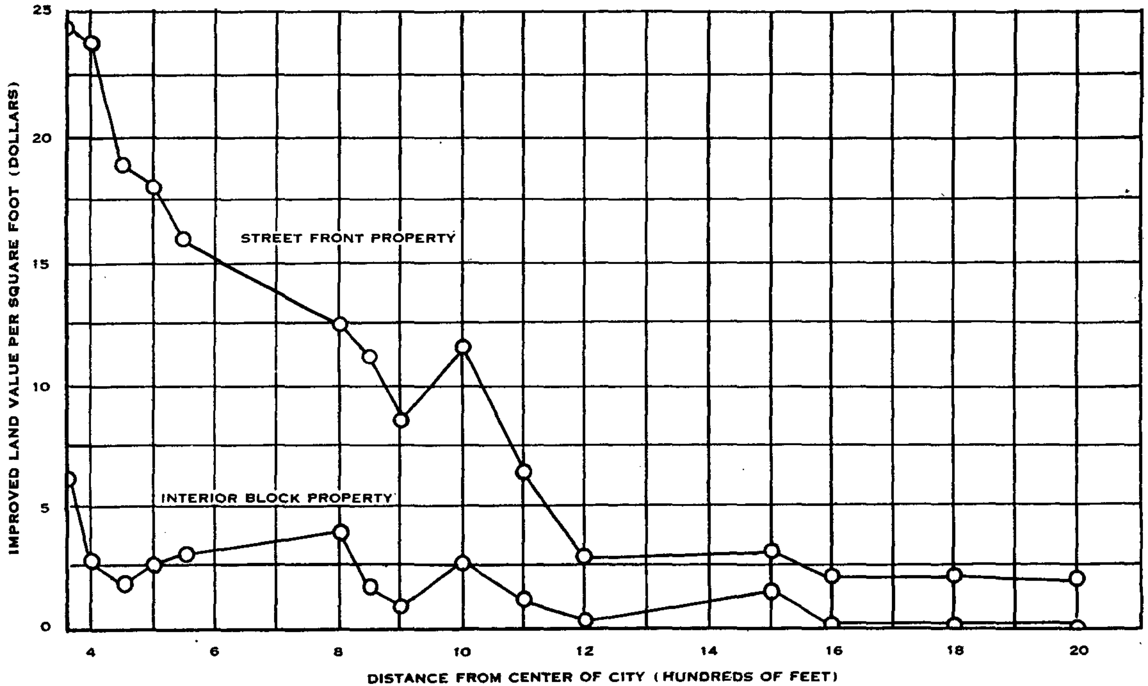

FIGURE 2

Comparison of land values for street-front property and interior-block property at various distances from the center of the city

of the city. As the distance from the center of the city increases, the curve representing land value of front property decreases very rapidly. The curve representing interior-block land values decreases also as the distance from the center increases, but this decrease is not as rapid, nor is it as constant as the curve representing front property values.

Irregularities exist in the curves. For example, an abnormally high value of both front and interior-block property was found at a distance of one thousand feet from the center of the city. This is explained by the fact that this particular block contains many parcels of tax-free land. Since the assessed value given these land parcels is purely a matter of record, the land parcels have been given values by the tax assessor far above their actual value. This condition will probably exist in any city, depending entirely upon local conditions, but it is believed that the general character of this curve will repeat itself within any given urban area.

2. *Economic Savings by Use of Interior-Block Land for Off-Street Parking Facilities*

While Figure 2 shows graphically the comparative values of front and interior-block property at various distances from the center of the city, it is desirable to determine the actual difference between the average values of the two types of land parcels. For instance, in the block located 400 feet from the center of the city, the front property has a value of \$23.66 per square foot, whereas the interior-block property has an average value of \$2.56, giving a difference in value of \$21.10. This difference has been computed for each of the blocks studied and has been classified as the "Savings" which would result from the use of interior-block property for parking in lieu of front property at various distances from the center of the city. The above information is shown graphically in Figure 3, page 11. The curve represents the savings per square foot resulting from the use of interior-block land, and includes only the initial cost of acquisition of land and existing appurtenances. Since most front properties are heavily developed and interior-block properties contain generally run-down or temporary buildings, there would undoubtedly be other costs involved in the acquisition of front properties for parking facilities. These additional costs would create an even greater saving in favor of the use of interior-block land for parking locations.

Let it be assumed that parking facilities are to be provided for one hundred cars within at least one of the primary areas of study with which this thesis is concerned. Using the figure of 180 square feet per car space to be provided, which is the value recommended by the American Automobile Association,[4] it is possible to show an actual cash saving of \$425,880

[4]American Automobile Association, op. cit., page 9.

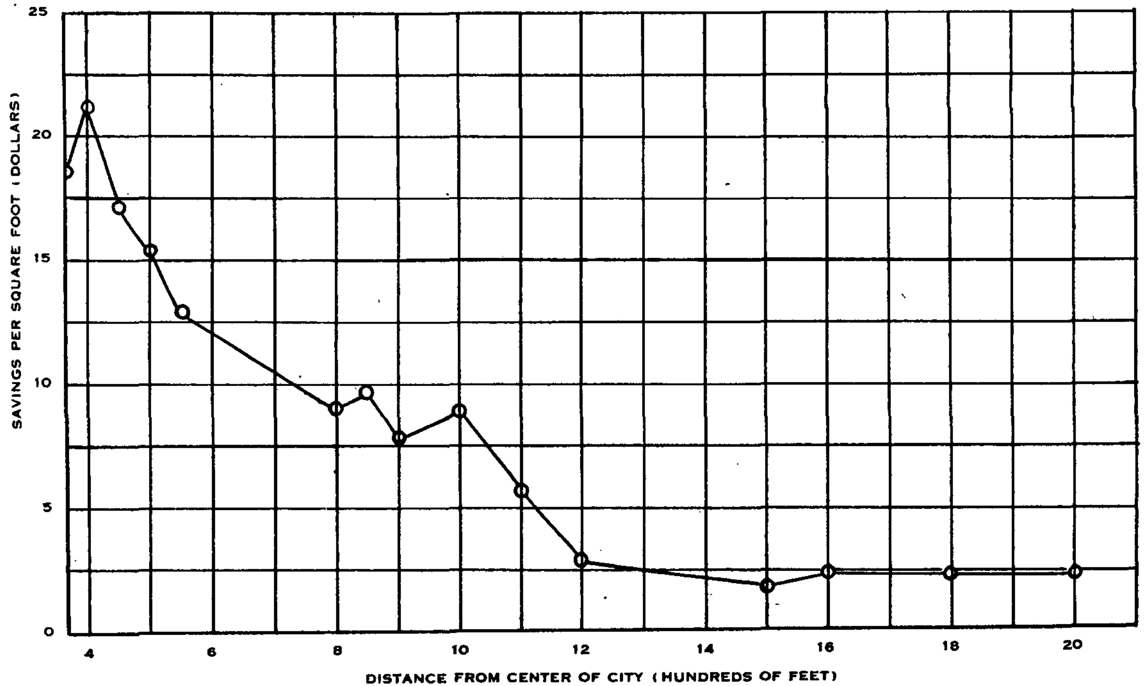

FIGURE 3

Savings per square foot by use of interior-block property instead of street-front property for parking facilities at various distances from center of city resulting from the use of interior-block property instead of front property in the block located 400 feet from the center of the city. This saving of nearly half a million dollars represents the amount saved in the initial acquisition of land for the dead storage of vehicles, and may be shown to be even greater by computing the additional expenses necessary for demolition, changing of utilities, and other necessities which accompany the condemnation of heavily built front property.

These computations do not take into account the acquisition of front property to provide necessary entrances and exits to interior-block locations, but these matters will be discussed in detail in a succeeding chapter.

3. Factors Determining Total Initial Cost per Car Space.

The total cost per car space of providing off-street parking facilities is dependent upon two factors: land acquisition cost and the construction cost of whatever type of facility is provided. All of these costs vary widely. In order to obtain a relationship between the total investment costs per car space and varying land costs, the Committee on Parking and Terminal Facilities of the American Automobile Association[5] conducted a survey in 1940 to determine the average cost of construction per car space for various types of parking facilities on land of varying values. These results are shown in Figure 4, page 13, which has been taken from the committee's report.

The American Automobile Association report points out that in making calculations for this graph, construction costs were held constant to obtain comparable figures for varying land costs. Construction costs of open air garages were set at $200; of enclosed garages, at $500 per car space. This figure did not include the cost of acquiring land. These figures reflect pre-war prices of materials and labor and would undoubtedly be much higher at the present time. Each parking space was allotted 180 square feet in lots, open air and enclosed garages. Three story structures were assumed in the case of garages.

As shown in Figure 4, where the line indicating total investment cost per car space on the open parking lot crosses the line indicating total investment cost per car space in the open air garage, it costs less to provide parking space, insofar as total investment is concerned, in the open air garage when land costs are above $1.65 per square foot than on the parking lot.

Applying the information obtained in Figure 4 to the areas studied for this presentation, it is found that 47 per cent of the interior-block locations studied have an average land cost of $1.65 per square foot or less, where-

[5]American Automobile Association, op. cit., page 9.

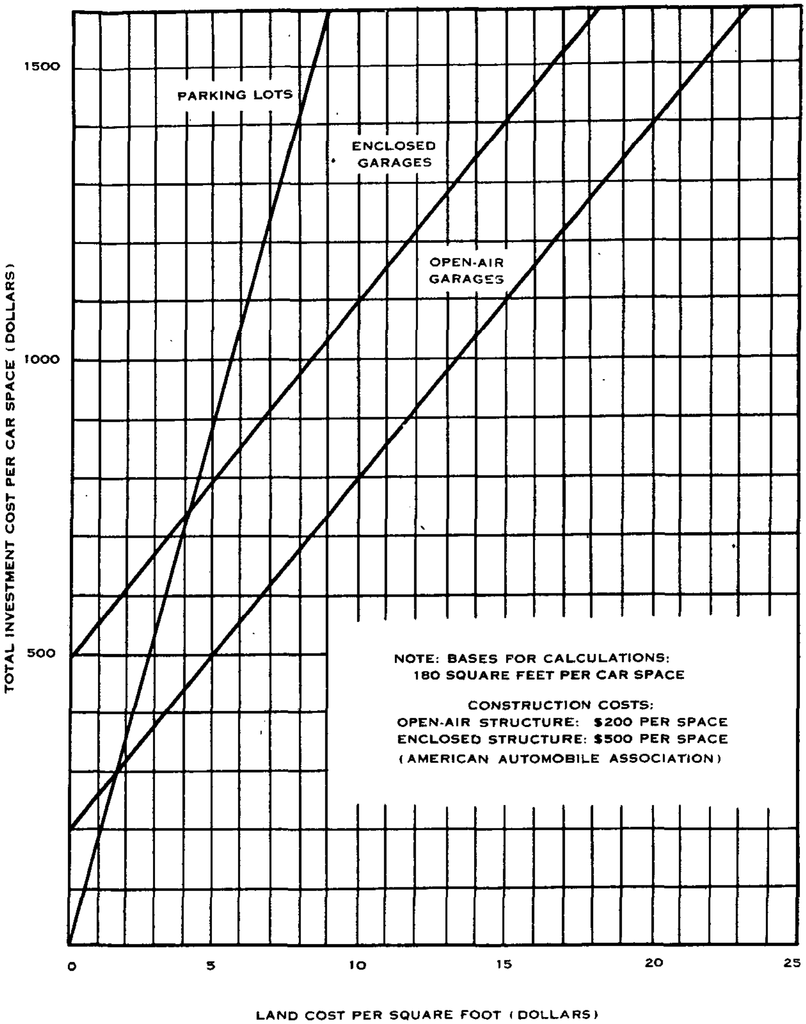

FIGURE 4

Total investment costs per car space of off-street facilities for differing land costs as none of the front properties in the same locations have an average land value of $1.65 per square foot or less. It is readily seen then, that the location of parking lots on any of the front properties in the primary areas studied would be an economically unsound project, whereas these same parking lots can be economically justified in 47 per cent of the locations by using the interior-block properties of the same blocks. These areas which can be justified on this basis are found as close as 900 feet from the center of the city.

4. Comparative Value to the City of Interior-Block and Street-Front Property.

Another factor which should be considered in the selection of land to use for off-street parking facilities, is the comparative value to the city, in its present form, of each type of land being considered for use. Table 2, page 15, shows this information for the fifteen city blocks considered in this presentation. Land areas in square feet and assessed values in dollars were totalled for all parcels of front property and all parcels of interior property within each of the fifteen blocks. Areas and values for each land classification were then divided by the areas and values for *all* land within each block in order to determine the per-centage of block area which each type of land occupied and also to determine the per-centage of value which each type contributed to the total block.

Comparisons of value between different blocks bear no significance, for the blocks are of different dimensions, and the ratio of front property to interior-block property is different for each block. However, it is significant to compare the figures individually for each block.

The per-centage of total block area devoted to interior-block property varies from a low of 1 per cent to a high value of 17 per cent.

As can be seen by examining Block L in Table II, this block has 7 per cent of its total block area devoted to interior-block property, but the block derives only 3.5 per cent of its total value from this interior property. This is a ratio of value to area of 1 to 2. However, block M, while showing only 1 per cent of its area devoted to interior-block property, shows this same property contributing the small amount of 0.04 per cent of the total block assessed value. These figures give a ratio of value to area for Block M interior-block property of 1 to 25.

By obtaining averages for all blocks studied, an average ratio of unit value to unit area for interior-block property studied is 1 to 6. This means that the interior-block properties studied have a unit value to the city only one-sixth that of the unit value of the street front properties in the same areas.

TABLE II

Comparison of Area and Assessment Values of Front and Interior-Block Property

BLOCK	TOTAL BLOCK: AREA (SQUARE FEET)	TOTAL BLOCK: TOTAL IMPROVED VALUE (DOLLARS)	STREET-FRONT PROPERTY: PER CENT OF BLOCK AREA	STREET-FRONT PROPERTY: PER CENT OF BLOCK VALUE	INTERIOR-BLOCK PROPERTY: PER CENT OF BLOCK AREA	INTERIOR-BLOCK PROPERTY: PER CENT OF BLOCK VALUE
A	145,527	3,199,785	85	96.0	15	4.0
B	193,825	4,292,895	92	99.1	8	0.9
C	189,381	3,229,690	83	98.8	17	1.2
D	122,139	2,155,940	97	99.6	3	0.4
E	147,147	2,193,245	91	98.2	9	1.8
F	195,760	2,375,145	91	97.3	9	2.7
G	163,657	1,815,725	97	99.6	3	0.4
H	163,658	1,364,585	93	99.5	7	0.5
I	205,224	2,346,560	97	99.4	3	0.6
J	120,801	757,945	89	97.7	11	2.3
K	147,029	377,900	82	98.0	18	2.0
L	197,309	635,150	93	96.5	7	3.5
M	146,735	336,645	99	99.96	1	0.04
N	75,581	179,570	95	99.7	5	0.3
O	141,940	322,910	96	99.7	4	0.3

This indicates that the use of interior-block properties, particularly if they are to be obtained by condemnation, will not deprive the city of a great amount of taxes from land. For if it is assumed that taxes are paid in direct ratio to assessed values, it can be said that a piece of land located on street-front property will return to the city six times the amount in taxes from private industry that a piece of land of similar dimensions within the block interior is capable of returning.

CHAPTER III

STUDY OF RELATIVE VALUE OF VARIOUS PORTIONS OF STREET-FRONT LAND PARCELS

It can be seen by examination of Figure 1, that the interior-block land parcels available for use as parking facilities are of a variety of sizes and shapes. This condition will probably be found wherever separate land parcels exist.

Since there is a definite decrease in value for separate parcels of land located within the interior of city blocks, it seems probable that there should be a comparative value between various portions of any land parcel fronting upon the street. If the same relationship exists between various sections of front property as exists between front property as a unit and interior property, then it would appear that the value of each foot of a front land parcel would decrease in value from the value of the preceding foot as the depth of the land parcel increases.

1. The Somers Depth Curve.

Such a relationship was established some time ago in the construction of the Somers Depth Curve, shown in Figure 5, page 17.[1]

Such a depth curve establishes a mathematical relationship between any two parts of sites affected by a single street influence, and makes possible the systematic treatment of varying depths for purposes of valuation.

The investigation into the relative depth values of regular lots of varying depths was begun many years ago by Mr. Somers in the city of St. Paul, Minnesota, where the business section of the city was laid out in a series of blocks, 300 feet square, divided into twelve regular lots, each with 50-foot frontage and 100 feet of depth. After a careful study of many hundreds of lots in actual use, and of many hundreds of transfers of lots of different dimensions in the section under consideration, a tentative scale of values was adopted. Approximately 70 per cent of the value of a 100-foot depth was found to have been absorbed by the 50 feet nearest the street front, giving 30 per cent of the total value to the rear 50 feet. A 15 per cent increase in value over the 100-foot depth was assigned to the third 50 feet in a lot of 150 foot depth. These per-centages were represented graphically and a regular curved line drawn from the zero point, representing the street line, through a 50 foot point, representing a lot 50 feet deep, at an elevation to indicate 70 per cent, thence through a 100-foot point at an elevation indicating 100 per cent, and finally to a 150 foot point at elevation of 115 per cent.

[1]Pollock and Scholz, op. cit., page 88.

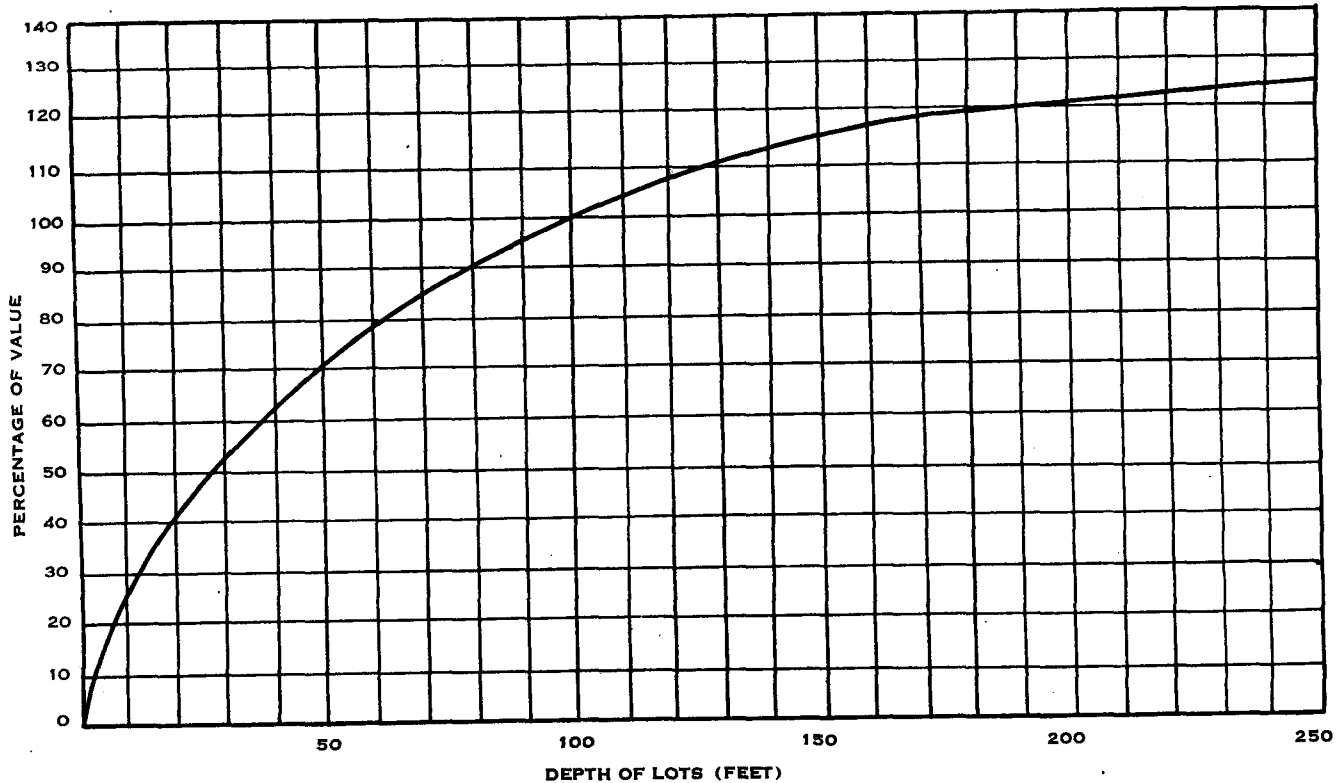

FIGURE 5
Somers Curve of Land Value

In constructing his curve, Mr. Somers did not hesitate to employ empirical methods along with his mathematical analysis to make them conform more closely to actual observations. The curve of value for the first 100 feet is approximately accurate, following a logarithmic scale. From 100 feet on, the per-centages are slightly scaled, while between 200 and 600 feet the mathematical ratios have been changed and at least 25 per cent added to make the depth influence extend farther than would be obtained by continuing the logarithmic scale adopted for the first 100 feet. The resultant Somers Curve is, strictly speaking, not mathematically accurate beyond depths of approximately 150 feet, but has been modified to conform to actual observations made by its inventor. The result is a depth curve which, although not constructed on the same logarithmic scale throughout, nevertheless expresses a definite mathematical relationship between areas located at different depths from the street front.

Figure 5 shows the portion of the original Somers Depth Curve extending to a depth of 250 feet, and from this curve have been obtained the values which are shown for two-foot intervals from the street front to a depth of 150 feet in Table III, page 19. These values apply to lots having a single street influence, and cannot be used for evaluating portions of land parcels located on the corners of intersecting streets. To obtain the value of any two feet merely subtract from the valuation allocated to that particular number of feet the relative value of the immediately preceding number of feet in the table. The difference will indicate the relative value to be allocated to any specific two-foot section. Such a computation will show that each square foot following the one fronting on the street has a lower valuation than the preceding square foot.

2. *Application of the Somers Depth Curve.*

It seems proper, then, to use this Somers Curve in determining the value of rear portions of front property in order to obtain additional area for the location of interior-block parking facilities. In the majority of areas studied for this presentation, the rear portions of front-street land parcels were used very inefficiently. If these sections of the street-front property can be obtained at a reasonable price—and such is the case by use of the Somers System—the interior-block land parcels can be expanded to sufficient size to house a large number of vehicles.

An attempt was made to determine whether this system of land valuation had ever been used to obtain land for parking facilities, in order to obtain the experience of practical application of this principle. Such an application was found in the village of Garden City, New York.

TABLE III

SOMERS CURVE OF VALUE

SHOWING PER-CENTAGE OF UNIT-FOOT VALUE FOR LOTS FROM 2 FEET DEEP TO 150 FEET DEEP

DEPTH	PER-CENTAGE	DEPTH	PER-CENTAGE	DEPTH	PER-CENTAGE
2	6.10	52	74.00	102	100.85
4	11.75	54	75.50	104	101.70
6	16.75	56	76.90	106	102.48
8	21.20	58	78.20	108	103.25
10	25.00	60	79.50	110	104.00
12	28.36	62	80.77	112	104.72
14	31.61	64	82.00	114	105.43
16	34.92	66	83.21	116	106.13
18	37.97	68	84.42	118	106.81
20	41.00	70	85.60	120	107.50
22	43.96	72	86.70	122	108.11
24	46.61	74	87.78	124	108.75
26	49.17	76	88.82	126	109.35
28	51.61	78	89.87	128	109.93
30	54.00	80	90.90	130	110.50
32	56.10	82	91.89	132	111.02
34	58.20	84	92.86	134	111.55
36	60.30	86	93.80	136	112.05
38	62.20	88	94.73	138	112.52
40	64.00	90	95.60	140	113.00
42	65.90	92	96.50	142	113.43
44	67.60	94	97.40	144	113.85
46	69.30	96	98.30	146	114.25
48	70.90	98	99.17	148	114.64
50	72.50	100	100.00	150	115.00

In 1936, a definite parking plan to serve the business section of the village was established.[2] Land for the parking facilities was obtained by condemnation, the Somers System being employed to determine the relative valuation of rear portions of street-front property. Fifteen typical examples of the use of the Somers System in determining valuation are shown in Table IV, page 20. The data from which this table was compiled were obtained from Mr. Allan H. Rogers, Superintendent of Public

[2]Allan H. Rogers, *A New Solution to the Parking Problem,* (Public Works Magazine), July 1938, page 20.

TABLE IV

ASSESSMENT OF REAR LAND FOR OFF-STREET PARKING FACILITIES BY USE OF SOMERS SYSTEM

	AREA IN SQUARE FEET		ASSESSED VALUATION					
				REAR AREA				
PARCEL NUMBER	ENTIRE PARCEL	REAR AREA TO BE USED FOR PARKING	ENTIRE PARCEL	PRORATED BY AREA	PRORATED BY SOMERS SYSTEM	TOTAL SAVINGS BY USE OF SOMERS SYSTEM	NO. OF CAR SPACES ACQUIRED (180 SQUARE FEET PER CAR SPACE)	SAVINGS PER CAR SPACE BY USE OF SOMERS SYSTEM
1	43,250	3,000	$82,700	5,739	800	$4,939	17	$290.50
2	4,500	1,200	5,520	1,472	528	944	6	157.33
3	20,000	5,000	22,300	5,575	1,280	4,295	28	153.40
4	7,500	2,000	9,200	2,453	880	1,573	11	143.90
5	23,200	12,200	20,000	10,517	3,306	7,211	67	107.61
6	13,920	4,500	12,000	3,879	1,582	2,297	25	91.88
7	20,000	8,000	22,300	8,920	5,483	3,447	44	78.11
8	17,635	4,532	15,000	3,855	2,129	1,726	25	65.04
9	20,000	5,000	4,375	1,093	251	842	28	30.07
10	20,000	5,000	4,375	1,093	251	842	28	30.07
11	25,000	10,000	4,550	1,820	399	1,421	55	25.83
12	25,000	10,000	4,550	1,820	399	1,421	55	25.83
13	25,000	10,000	4,550	1,820	399	1,421	55	25.83
14	25,000	10,000	4,550	1,820	399	1,421	55	25.83
15	25,000	10,000	3,950	1,580	346	1,234	55	22.43

Works, Garden City, who supervised the entire project from its inception in 1936 to the present day.

By comparing the cost of rear land obtained prorated according to area, and as it was actually prorated by the Somers System, a tremendous saving is seen in the initial cost of land acquisition. Based on 180 square feet per car space, savings are seen to range from $22.43 per car space to a maximum saving of $290.50 per car space.

The right of the village to condemn land by use of the Somers System was challenged legally, and the case went to the higher courts of New York State. However, the village was supported in its use of this system of land valuation.

This example of the use of rear portions of street front land parcels can be of great value to a traffic engineer who is considering the same type of project. Proof of its soundness is found in a letter from Mr. Rogers of Garden City to the author, in which Mr. Rogers states that the parking facilities have been unanimously accepted by the citizens of Garden City and the village is making plans at the present time to establish more parking facilities by the same method of land valuation.

CHAPTER IV

LOCATIONS OF ENTRANCES AND EXITS FOR INTERIOR-BLOCK PARKING FACILITIES

If interior-block property is to be used for parking purposes with a minimum of disturbance to business establishments located on the street-front property of the block, careful consideration must be given to the location of the entrances and exits to the parking areas. Due to the high square-foot value of front property, the acquisition of access through this front property may be a large item in any budget for interior-block parking facilities.

In a majority of instances, alleyways may exist which are public property, and these may be converted to use in connection with parking facilities. In other cases, as in New Haven, the master plan of the City Plan Commission may have as its very basis the closing of certain streets to create larger blocks. If this condition should materialize, the use of the closed streets for access to parking facilities can probably be easily obtained.

1. Land Values Related to Vehicular Volume.

However, extreme cases may develop in which there are no alleyways or other entrances available for use. In order to obtain a comparison between the value of front property and traffic on the street it borders, traffic volumes were obtained for October, 1945, from the Connecticut State Highway Department for the streets surrounding the blocks studied, and this information was plotted against the square foot value of the front property for each street. In cases where land values were known for both sides of the street on which volume was given, average values were obtained. When two or more streets carried the same volume, averages of the land values of the two streets were used. The results are shown in Figure 6, page 23.

It can be seen that as traffic volumes increase, land values show a general tendency to decrease. The trend is gradual, but readily seen and it is believed that a study involving more complete data would reveal the same characteristics.

It appears sound then, both from an economical standpoint and a traffic standpoint, to locate the entrance of an interior-block parking facility on the street carrying the heaviest traffic flow. As a general rule, such a treatment will make the parking facility more accessible to the greatest number of potential users.

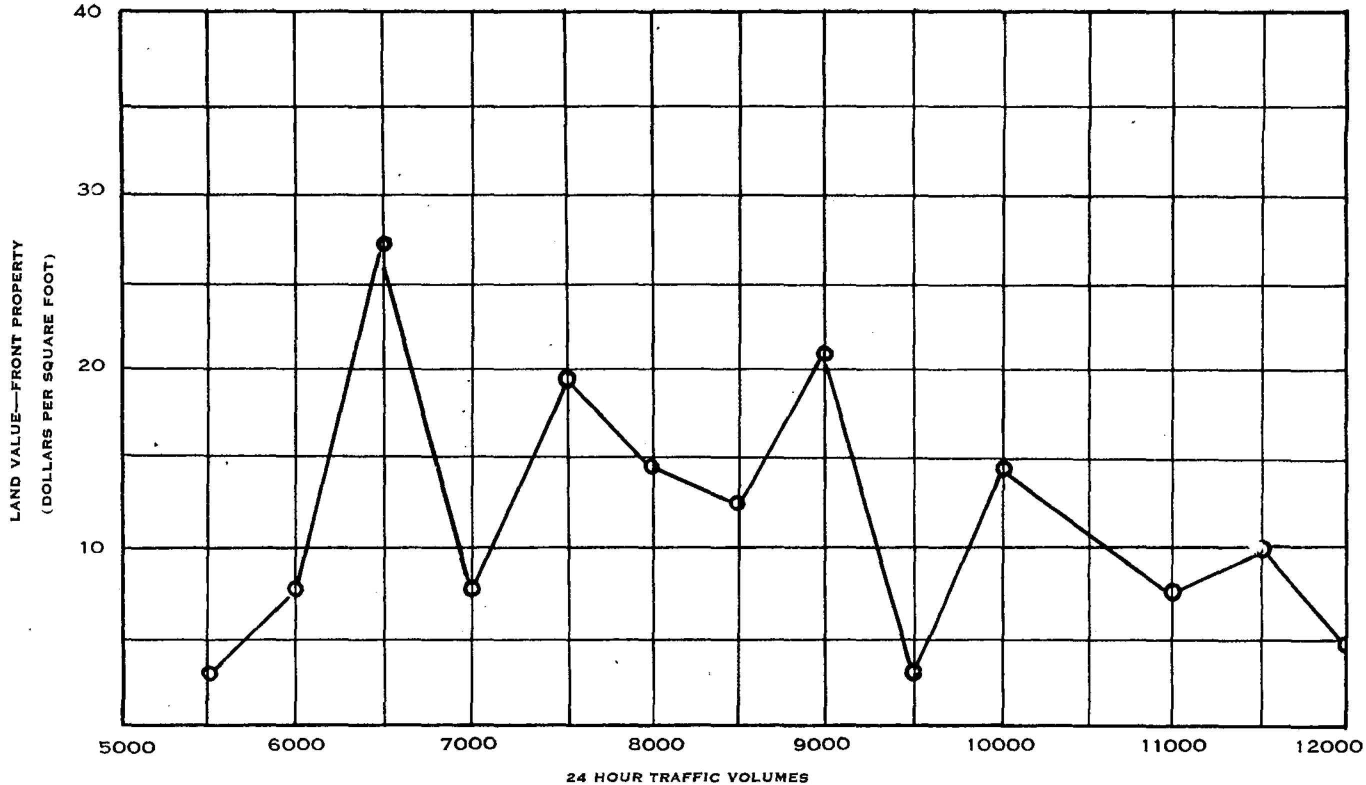

FIGURE 6

Land values of street-front property facing on streets having various 24 hour traffic volumes

2. Land Value Related to Pedestrian Volume.

However, consideration should be given to the interference which will be caused to pedestrians by the location of entrances to parking areas. In order to determine the relationship between land value of street front property and pedestrian volume on the street adjacent to the property, short counts were made to determine the pedestrian volume on the streets surrounding the fifteen city blocks studied for this presentation. Fifteen-minute counts were made on each of the four streets surrounding each block, and the four counts were totalled to obtain an hourly volume which has been called the "block average." In order to correlate the counts between blocks as closely as possible, all counts were made on week days, Monday through Friday, during fair weather, and between the hours of 2:00 P. M. and 4:00 P. M. These block averages were then plotted against the average street-front property value, and the results are shown in Figure 7, page 25.

It can be seen that the pedestrian volumes are lowest for those blocks having the lowest street-front land values and that the pedestrian volume increases directly with an increase in land value.

Pedestrian volumes were compared with land values for each of the streets individually, and a direct correlation was found in 39 of the 60 streets involved. It can be said then, that in 65 per cent of the streets studied, the streets with the highest land value, also carried the heaviest pedestrian volume.

Based on these observations, it appears sound to locate entrances to interior-block parking facilities on the street with the lowest street-front land values, for this will allow acquisition of land at a minimum of cost, and at the same time will afford access to the maximum traffic and give a minimum of interference with pedestrian travel.

In some cases, where demand for space is great, or where multi-storied buildings are standing on the areas where entrances are desired, it may be wise to secure access rights through street-front property on the ground floor of a building, and leave the upper floors undisturbed. The author has been assured by architects that this is possible without disturbing the stability of the structure in almost every type of structure now in use in American cities. Examples of this type of entrance were obtained in New Haven, and are shown on page 26.

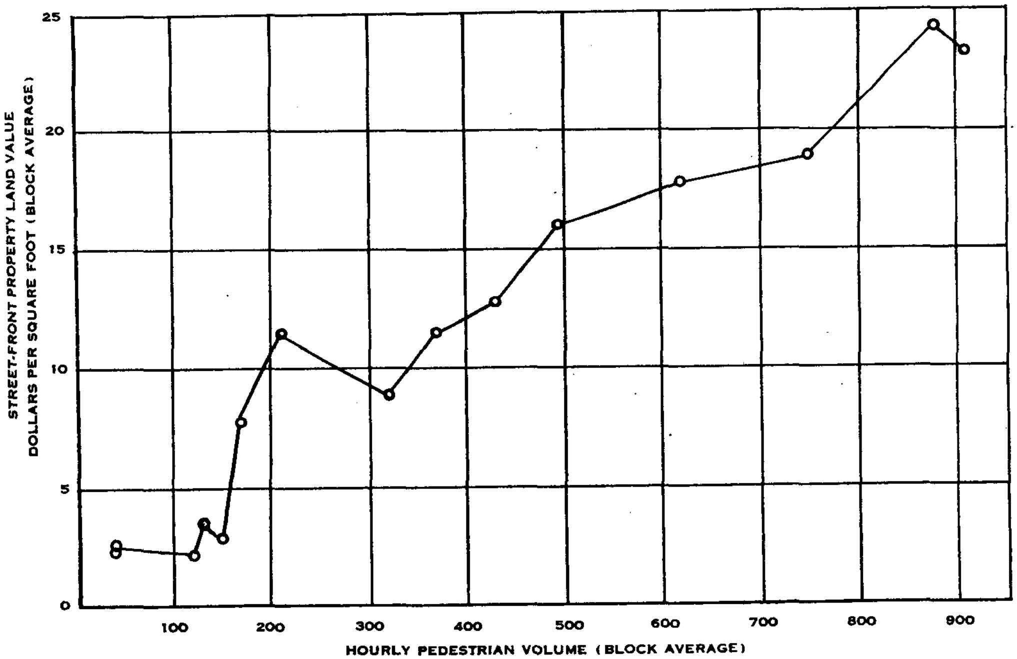

FIGURE 7

Land values of street-front property facing on streets having various hourly pedestrian volumes

Front

Rear

FIGURE 8
Pictures showing use of ground floor entrances in multi-storied buildings

CHAPTER V

CONCLUSIONS

From the foregoing tables, figures, and discussion, the following conclusions may be drawn:

1. In city blocks where separate interior-block land parcels exist, there is a great differential in value between the assessed valuation of the street-front property and the interior-block property.

2. The value of both street-front and interior-block property decreases as the location of the property increases in distance from the center of the city.

3. Savings in initial cost of land acquisition as high as $20 per square foot may be realized as a result of using interior-block property in lieu of street-front property for the location of off-street parking facilities. Based on 180 square feet per car space, this represents a saving of $3,600 per car space provided.

4. The location of parking *lots* on land with a higher valuation than $1.65 per square foot is an economically unsound project, according to a study made in 1940 by the American Automobile Association. None of the street-front property studied can be used for parking *lots* under this condition, whereas 47 per cent of the interior-block areas in the same city blocks were found to be of sufficiently low value to justify parking *lots*.

5. A parcel of street-front property will, on the average, return to the city six times the amount in taxes from private industry that an interior-block land parcel of the same dimensions and in the same block is capable of returning.

6. The Somers Depth Curve established a mathematical relationship between any two parts of a street-front land parcel affected by a single street influence.

7. Each square foot of a street-front land parcel has a lower valuation than the preceding square foot as the depth of the land parcel increases.

8. By use of the Somers System of land valuation, rear portions of street-front land parcels may be obtained at a reasonable price, thus encouraging the full development of block interiors for parking.

9. In the central business district studied, land values on streets with higher traffic volumes tend to be lower than those on streets with lower traffic volumes.

10. In the same area, land values tend to be higher on streets with higher pedestrian volumes than those on streets with lower pedestrian volumes.

11. Based on items 9 and 10 above, the location of entrances to interior-block parking facilities on streets with lowest land values will generally provide accessibility to the maximum traffic and create minimum interference with pedestrians.

12. It is possible to locate entrances and exits to interior-block parking facilities on the ground level of buildings without interfering with the use of upper floors for commerce or industry.

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