

Trends in CBD Parking Characteristics, 1956 to 1968

R. W. STOUT, Bureau of Public Roads, Federal Highway Administration,
U. S. Department of Transportation

•WE LIVE in a complex urbanized society. In 1920 more than half of the nation lived in a rural environment. By 1975, approximately 75 percent of the country's population will be living in 262 urban areas (1, Table C1). The rapid growth of American cities presents a direct challenge to the transportation planner. He must plan, design, construct, and maintain transportation systems for these metropolitan areas. These systems not only must provide for the safe, efficient movement of people and goods, but they also must be responsive to the needs and travel desires of the people.

The growth in the popularity of the automobile as the major mode of travel has resulted in the need to investigate and analyze automobile travel continually in order to plan adequate transportation systems to meet the demand. In 1968, 79 percent of all families in the United States owned an automobile, and they traveled 483 million vehicle-miles in urban areas or approximately 50 percent of the total vehicle-miles of travel (2). Recently the number of registered motor vehicles passed the 100 million mark. This increase in the number and use of motor vehicles underlines the need for adequately planned transportation facilities. Every automobile trip begins and ends with storage of the vehicle. As the number of vehicles and trips increases, so does the need for parking facilities to handle these trips. These needs are critical in urban areas, particularly in the center city, where the competition for space among various land uses is highest.

Although every city is unique, they all possess certain common characteristics. There is a functional relationship among the highway system, land use activities, and terminal areas that transcends individual cities. The similarity of these patterns becomes more predominant as the cities increase in size and density, for "as cities grow there is a tendency for land uses of like character to become concentrated in functional areas of commercial, industrial and residential activity"(3). A more definitive pattern takes form in urban areas of comparable size. The assumptions and conclusions of O-D surveys—that people are habitual in their activities and tend to establish patterns when categorized on a regional level—are applicable to parking characteristics. The patterns tend to be repeated in cities of similar size and are used for a comparative measure of parking patterns and characteristics in the CBD.

The objective of this paper is to investigate and analyze trends in CBD parking by urban area size from 1956 to 1968. The data for 1956 were taken from the "Parking Guide for Cities" (3). The data for 1968 are from 99 parking studies conducted in urban areas since 1960. These studies were assembled and the data extracted, codified, and tabulated. The results were then analyzed and summarized by city size. For analysis purposes, the studies are categorized into five population groups that correspond to those used in 1956 and that simplify comparative procedures. Urbanized area populations were used for both studies. Only urban areas with 50,000 population or greater are included in the report. This is because (a) fewer data are available for the smaller cities; and (b) problems in these areas are smaller and have fewer possible alternatives, and the solutions require less information.

TABLE 1
NUMBER AND TYPE OF PARKING STUDIES—1960 TO 1968

Population Group	Number of Cities in Group	Number of Parking Studies			Percent of Cities in Sample	Mean Population of Sample	Mean Population of Group
		Type A	Type B	Total			
50,000-100,000	78	11	19	30	38	68,000	73,000
100,000-250,000	85	5	28	33	39	68,000	173,000
250,000-500,000	30	5	11	16	53	360,000	352,000
500,000-1,000,000	22	3	12	15	68	720,000	713,000
1,000,000 and over	16	2	3	5	16	3,700,000	3,236,000
Total	231	26	73	99	43		

The following data are provided as a general guide for cities considering a comprehensive parking study. They should not be used in lieu of an independent parking study. However, one meaningful analysis technique would be the comparative or analog method.

STUDIES AVAILABLE FOR ANALYSIS

In 1967 there were 231 urbanized areas (over 50,000) in the United States (4). The parking studies investigated were divided by population into five groups, as given in Table 1. The studies were classified into two types. Type A represents studies of a comprehensive nature and included extensive information on walking distance, trip purpose, trip duration, facility types, and the like. These represented approximately 26 percent of the total sample. Type B studies were of a lesser magnitude but still contained supply inventory and information on demand such as accumulation, purpose, and turnover.

The mean population for all cities in each group as well as the mean of the sample was calculated. These data were also compared to the means used in 1956 (Table 2). Significant shifts in population means can be seen in this period. The mean population for cities of 50 to 100 thousand decreased 15 percent. The cities of 100 to 250 thousand and 250 to 500 thousand experienced little change but did decrease 5 and 2 percent respectively. A radical change is noted in cities of more than half a million population. Cities between a half and one million grew 31 percent while the cities of more than a million increased almost 300 percent.

Although this report is not intended to be a demographic study of city growth, these changes in population size should be remembered when comparing the 1956 and 1968 data sets. Table 2 also compares the physical characteristics of the CBD's. The actual changes in area are consistent with the population shifts although not directly proportional. This table helps to dimension the physical size of the downtown and relate it to actual study areas.

TABLE 2
PHYSICAL CHARACTERISTICS OF CENTRAL BUSINESS DISTRICTS

Population Group	Year	Mean Population of Sample	CBD Area (sq mi)	CBD Blocks	Core Area (sq mi)	Core Blocks
50,000-100,000	1956	80,000	0.34	45	0.14	—
	1968	68,000	0.26	37	0.06	8
100,000-250,000	1956	167,000	0.38	60	0.09	—
	1968	160,000	0.38	70	0.08	17
250,000-500,000	1956	366,000	0.58	99	0.15	—
	1968	360,000	0.48	99	0.12	20
500,000-1,000,000	1956	549,000	0.50	139	0.11	—
	1968	720,000	0.89	115	0.29	36
1,000,000 and over	1956	1,306,000	0.99	162	0.22	—
	1968	3,700,000	1.74	224	0.45	62

TRAFFIC VOLUMES

One parameter related to downtown parking is traffic volumes into and out of the CBD. Over the study years, total volume into the CBD grew at a decreasing rate as population increased, and volume per 1,000 population steadily declined as city size increased. Table 3 compares the changes in volume per 1,000 population between 1956 and 1968. By studying these data, one can make the following general observations:

1. Cities of over 500 thousand population are experiencing a decreasing number of trips,
2. Cities between 100 and 500 thousand are experiencing an increasing number of trips, and
3. Cities of less than 100 thousand show little change.

The changes in trips per 1,000 population indicate that in the larger metropolitan areas, which usually have greater downtown congestion, fewer automobile trips are being made to the CBD. These trips either use other modes or are not made at all. However, in the medium-size areas, the degree of congestion is not as great, and the use of automobiles for downtown trips has increased.

SUPPLY

Parking supply data are essential for the analysis of downtown parking problems. A comprehensive parking facility inventory gives the actual number, type, and location of parking spaces. Periodic or continuous updating procedures will keep this information current.

The two data sets, 1956 and 1968, provide a chance to study changes in parking supply. Except for cities of 50 to 100 thousand, there is an overall increase in supply from 1956 to 1968. This reflects the growth of our cities. The fact that cities of 50 to 100 thousand had fewer spaces in 1968 than in 1956 is a result of the downward shift in the mean population of the group rather than an actual loss of spaces. A more equitable means of comparison is to contrast spaces per 1,000 population, which takes into account population changes (Table 4). All of the groups except cities of over one million show an increase of spaces per 1,000 population. Urban areas in the 100 to 250 thousand range had the greatest change (from 33.2 to 48.5 spaces per 1,000 or a nearly 50 percent increase). As previously mentioned, this group also experienced the greatest increase in traffic volumes, up nearly 30 percent. The number of spaces increased 33 percent in cities of one half to one million population. The other cities showed little increase in spaces per 1,000, while cities over one million actually decreased 10 percent.

Another important characteristic of parking supply is the distribution of spaces by facility type (Table 5). Between 1956 and 1968 there was a consistent decrease in the percent of curb or on-street parking spaces for all city sizes. The greatest change occurred in cities of 50 to 100 thousand, where the proportion of curb spaces dropped 55 percent. An interesting note is that, although the percent of curb spaces decreased, the percent of lot spaces increased for all city sizes at almost the same rate. For example, in the smallest urbanized areas, lot spaces increased from 33 to 60 percent

TABLE 3
TRAFFIC VOLUMES INTO CBD^a

Population Group	Volume	
	1956	1968
50,000-100,000	476	457
100,000-250,000	236	307
250,000-500,000	168	179
500,000-1,000,000	135	122
1,000,000 and over	66	49

^aTrips per 1,000 population (urbanized area) between 10 a.m. and 6 p.m.

TABLE 4
PARKING SPACES PER 1,000 POPULATION

Population Group	1956	1968
50,000-100,000	63.5	68.7
100,000-250,000	33.2	48.5
250,000-500,000	32.8	34.3
500,000-1,000,000	24.2	31.8
1,000,000 and over	18.1	15.9

TABLE 5
PERCENT DISTRIBUTION OF PARKING SPACES AVAILABLE IN CBD

Population Group	Year	Facility Type			
		On-Street	Off-Street	Lot	Garage
50,000-100,000	1956	59	41	33	8
	1968	35	65	60	5
100,000-250,000	1956	45	55	42	13
	1968	27	73	62	11
250,000-500,000	1956	28	72	57	15
	1968	20	80	64	16
500,000-1,000,000	1956	22	78	49	29
	1968	14	86	56	30
1,000,000 and over	1956	14	86	63	23
	1968	14	86	55	31

while the curb spaces decreased from 59 to 35 percent. Lots now represent between 50 and 60 percent of the supply regardless of city size, which was not true in 1956. There was little change and, in fact, some decrease in the distribution of garage spaces. Only in cities of over one million, where the change was from 23 to 31 percent, was there any real difference. However, there was a steady increase with city size in the percent of garage spaces. One final observation is that 1956 off-street spaces varied between 33 and 63 percent of the total supply, while in 1968 they ranged from 65 to 86 percent.

PARKING DEMAND

One of the major factors determining the parker's usage characteristics is his trip purpose. The primary reason for the automobile driver's trip is directly related to the parameters or parking characteristics of that trip. The trip purpose affects the duration of the trip, and duration affects the facility type used and the acceptable walking distance. Accumulation, or the measure of the number of parkers over a certain time period, shows the relative importance by purpose of each parking trip throughout the study period.

Table 6 gives the distribution of parkers by trip purpose. When the three main purposes of shop, business, and work were compared between 1956 and 1968 the following changes were found:

1. Shopping trips decreased an average of 3 percent for all population groups. This percentage is the average of the differences. For example, in cities of 50 to 100 thousand population, the percent of shopping trips decreased from 30 percent in 1956 to 24

TABLE 6
PERCENT DISTRIBUTION OF PARKING IN CBD BY TRIP PURPOSE

Population Group	Year	Purpose			
		Shop	Business	Work	Other
50,000-100,000	1956	30	30	17	23
	1968	24	31	20	25
100,000-250,000	1956	25	38	16	21
	1968	21	34	26	19
250,000-500,000	1956	17	42	23	18
	1968	19	33	30	18
500,000-1,000,000	1956	18	44	22	16
	1968	13	25	47	15
1,000,000 and over	1956	13	31	41	15
	1968	10	30	41	19

percent in 1968, or minus 6 percent. This is an actual change of 20 percent. The average actual change for all five groups was 12 percent.

2. Business trips experienced a similar decline; the average percent of difference was minus 6.5 percent, an average actual change for all five groups of minus 16 percent.

3. Work trips to the CBD had the most dramatic change. The average percent difference was 9 percent, an average actual increase for all groups of 45 percent. The most drastic change occurred in cities of one-half to one million population where the proportion of work trips increased from 22 percent in 1956 to 46 percent in 1968, an actual increase of 109 percent. The least change was in cities of one million and more, where the proportion of work trip parkers stayed constant at 41 percent.

Accumulations

The parking accumulation curves, number of parkers by time of day, are similar for 1956 and 1968. Both sets of curves show a general pattern of accumulation build-up during the 8 to 10 a.m. period, a relatively steady state between 10 a.m. and 4 p.m. (except for noon-hour trips in smaller cities), and a decline between 4 and 6 p.m. Regardless of city size, the total peak accumulation is less than total average supply. This occurs because many of the available spaces included in the supply are in the fringe areas of the CBD and are beyond acceptable walking distance.

A comparison of peak-hour accumulations, 1956 to 1968, shows that there was a relative percent decrease in peak accumulations and also a percent decrease in the range of facility utilization. In 1956 the average peak-hour usage by group was 78, 66, 66, 91, and 92 percent, while in 1968 the range was 65, 77, 75, 82, and 74 percent. From a strictly comparative point of view, the average ratio of peak-hour accumulation to available supply was 78 percent in 1956 and 74 percent in 1968. Although this change would indicate that there was less of a problem in 1968 than in 1956, one must consider other parameters such as the changing character of CBD trip purposes and the upswing in the number of all-day work parkers. There also was a significant change in number of spaces per 1,000 population since 1956.

Durations

As one would expect, average parking durations vary with the size of the urban area from approximately 1 hour in small urbanized areas to more than 3 hours in cities of over one million population. These and other results are given in Table 7. The average duration between 1956 and 1968 does show some variation. The greatest change occurs in the population range between $\frac{1}{4}$ and one million, where the average duration increased 0.8 hour. Cities in the 50 to 100 thousand and 100 to 250 thousand ranges increased 0.2 and 0.5 hour respectively, while cities of more than one million changed from 3 hours to 3.1 hours.

TABLE 7
AVERAGE PARKING DURATION (IN HOURS) FOR VARIOUS
TRIP PURPOSES IN CBD

Population Group	Year	Purpose			
		Shop	Business	Work	All
50,000-100,000	1956	0.7	0.7	3.8	1.4
	1968	0.6	0.8	3.3	1.1
100,000-250,000	1956	1.0	0.9	3.8	1.6
	1968	1.3	0.9	4.3	2.1
250,000-500,000	1956	1.3	1.1	4.8	1.9
	1968	1.3	1.0	5.0	2.7
500,000-1,000,000	1956	1.3	1.3	4.8	2.2
	1968	1.5	1.7	5.9	3.0
1,000,000 and over	1956	1.8	1.5	5.6	3.0
	1968	1.1	1.1	5.6	3.0

An interesting note is that, between the two dates, trips of less than $\frac{1}{2}$ hour increased in the smaller areas from 51 to 60 percent but decreased in the largest area from 28 to 16 percent. Naturally, the converse is true, with the larger cities showing an increase in the longer duration trips.

The average duration of the shopping trip did not change significantly from year to year or from group to group. The average duration was slightly more than $\frac{1}{2}$ hour in the small areas to about an hour in large urban areas. Business trips showed little difference, with the duration of the average business trip $\frac{3}{4}$ hour in small urban areas and $1\frac{1}{2}$ hours in large urban centers.

A more dramatic change occurred in the work trip durations, which were perhaps the most significant data analyzed. Except for the small cities, the parking duration of the work trip increased. The greatest increase was in cities between a half and one million population, where the average work trip parking duration jumped 1.1 hours from 4.8 to 5.9. When the results of the trip purpose and duration studies are compared, it is obvious that there was a large increase in work trips to the CBD and that their associated longer duration resulted in more parking spaces being used for long-duration work trips. These effectively reduced the actual available supply to other types of trips, a condition particularly prevalent in larger cities.

Turnover

Parking turnover measures the utilization of a parking space; it indicates how many times the space is used by different vehicles during a specified time period, usually 8 hours. In the two data sets the average turnover rates for all facilities combined decreased as population increased, and in 1968, regardless of facility type, turnover rates decreased with increased population. In both years, curb parking spaces averaged turnover rates three to four times higher than off-street spaces, and lot spaces averaged higher turnover rates than garages. The actual ratios are given in Table 8.

Between 1956 and 1968, there was a gradual reduction in the turnover rates for all city sizes, with little change in off-street turnover rates and with curb turnover rates increasing in some cases and decreasing in others (higher for low populations, lower for high populations). The lower turnover rates resulted from a change in the distribution of parking spaces. The proportion of curb spaces to total supply decreased for all cities (Table 5), and the increase in the proportion of off-street spaces, with their lower turnover ratios, led to a reduction in average turnover ratios.

Walking Distance

Perhaps the most difficult data to collect and analyze concern the distance that people walk from their parking place to their trip destination. As one would reason, acceptable walking distance is a function of trip purpose, duration, and the particular characteristics of the parker such as income level and occupation. The 1968 study data were

TABLE 8
PARKING TURNOVER RATIOS IN CBD

Population Group	Year	Parking Facility				Total
		On-Street	Off-Street	Lot	Garage	
50,000-100,000	1956	5.7	2.0	2.2	1.0	4.0
	1968	6.1	1.9	2.0	0.8	3.5
100,000-250,000	1956	5.8	1.5	1.6	1.0	3.3
	1968	5.7	1.5	1.6	1.0	2.7
250,000-500,000	1956	5.5	1.5	1.5	1.2	2.6
	1968	5.2	1.4	1.4	1.1	2.2
500,000-1,000,000	1956	6.9	1.5	1.6	1.2	2.9
	1968	4.5	1.2	1.2	1.4	2.0
1,000,000 and over	1956	4.4	1.6	1.7	1.3	2.0
	1968	3.8	1.1	1.2	1.0	1.3

TABLE 9
AVERAGE WALKING DISTANCE (IN FEET) BY TRIP PURPOSE IN CBD

Population Group	Year	Trip Purpose				Total
		Shop	Business	Work	Other	
50,000-100,000	1956	391	327	483	—	353
	1968	350	290	410	280	325
100,000-250,000	1956	539	416	539	—	397
	1968	470	390	500	340	422
250,000-500,000	1956	824	606	728	—	502
	1968	570	450	670	380	532
500,000-1,000,000	1956 ^a	656	528	698	—	523
	1968	560	590	650	500	631
1,000,000 and over	1968	388	398	673	310	500

^a1956 data calculated for cities of 500,000 and over.

TABLE 10
AVERAGE WALKING DISTANCE (IN FEET) BY TRIP DURATION IN CBD

Population Group	Year	Duration (hour)						
		0 to ¼	½ to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 and More
50,000-100,000	1956	238	347	425	471	523	532	—
	1968	176	310	350	355	377	366	430
100,000-250,000	1956	276	491	552	598	606	592	—
	1968	258	420	380	495	490	499	440
250,000-500,000	1956	392	580	688	768	801	747	—
	1968	275	440	510	546	565	613	740
500,000-1,000,000	1956 ^a	350	508	571	633	673	677	—
	1968	262	480	460	544	505	610	910
1,000,000 and over	1968	334	520	560	619	661	701	—

^a1956 data calculated for cities of 500,000 and over.

summarized by trip purpose and duration and compared to 1956 data in Tables 9 and 10. Aside from certain obvious facts, it is difficult to develop any significant trends in relation to walking distance because so many other parameters are involved. For 1968 the average walking distances were shorter in smaller cities. Shopping and business trips had shorter average walking distances than work trips. There was a slight trend toward longer average walking distances except in the small cities, where average total walking distance decreased from 353 to 325 ft. Further observations are left to personal interpretation.

One interesting note is that the minimum average walking distance is 325 ft and the maximum is 631 ft, a difference of 300 ft. Although this represents an increase of 100 percent, it is far from the percent increase in population and on a relative scale does not have the magnitude of variation one might expect. This points to what is considered to be one of the more important criteria in parking facility location: to minimize walking distance or walking time.

SUMMARY

The major changes in CBD parking characteristics between 1956 and 1968 were examined. The physical changes such as populations, traffic volumes, and parking supply were discussed. The most noted variation was the 50 percent increase in spaces per 1,000 population in cities of 100 to 250 thousand and their 30 percent increase in inbound traffic volumes.

The demand side of parking was analyzed. The decline of shopping and business parking trips was observed. The 45 percent average increase in work trips to the CBD

represented the most radical change. The greatest increase in work trips occurred in cities of one-half to one million population.

The rest of the data varied somewhat from 1956. Accumulation, duration, and turnover all reflected the increase in the number of longer duration work trips. Data on walking distance were the most difficult to classify except for the slight trend toward longer average walking distance.

REFERENCES

1. Holmes, E. H. Circular Memorandum to FHWA Regions and Divisions. March 17, 1966.
2. 1969 Automobile Facts and Figures. Automobile Manufacturers Association, Detroit, 1969.
3. Parking Guide for Cities. U.S. Bureau of Public Roads, 1956.
4. Standard Metropolitan Statistical Areas. U.S. Bureau of the Budget, 1967.