

# Parking Studies By Abbreviated Methods

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This report relates the experience of the Oregon State Highway Department and the City of Corvallis with "short-cut" parking study methods. The results of short-cut methods were compared to the findings of a peak moment interview study conducted by the city.

Estimates obtained by short-cut methods show reasonable agreement with the interview findings; and the estimated distribution of parkings based on commercial development, in groups of blocks of high demand, agree remarkably well with the distribution found by interviews.

The short-cut methods employed include the GAF and rank size order methods which were developed by the Highway Transport Research Branch of the Bureau of Public Roads, and were published by the Highway Research Board (1) and the Bureau of Public Roads (2).

Distribution of total demand is based on a combination of commercial development and estimates of demand for unique or non-commercial developments.

● THE OREGON State Highway Department has for some time felt a pressing need for a parking study methodology less costly in time, money, and manpower than a comprehensive study. Such methodology is necessary for small cities, which are in a position to benefit from a sound parking program, but cannot afford to conduct a comprehensive parking study.

Many of the smaller cities in Oregon, particularly those from 5,000 to 20,000 population, have real parking problems, which will become more acute with time, and these cities would like to formulate plans to provide adequate parking. How much information is necessary, and how much money can logically be spent to obtain that information?

The policy of the department has been to discourage comprehensive studies in small cities because the cost of a comprehensive interview study seems out of proportion to the benefits, and qualified personnel are not available at either the state or local levels for assignment to such a study. Furthermore, there is the rapid change in conditions in cities of this size. The large amounts of data accumulated in comprehensive studies lose much of their value after a short time in small, rapidly growing, cities.

When Corvallis asked the assistance of the highway department in the conduct of a parking study, short-cut methods were recommended to obtain the necessary information. It was agreed that the city would inventory existing parking spaces, conduct a peak moment interview study, and prepare an inventory of commercial building space by business type. The School of Engineering of Oregon State College would assist the city in this work. The state would make available such technical assistance as was requested in the planning and analysis of these studies, estimate total parkings by the GAF and rank size methods<sup>1</sup>, and compare the results of these estimates with the results obtained by the city from the peak moment interviews.

The 1950 population of the city was 16,207; the State Census Board's 1956 estimate is 17,900. These totals include approximately 6,000 students at Oregon State College.

Corvallis is the principal retail trading center for an area with approximately 60,000 people. According to the 1954 Census of Business, retail sales of Corvallis were nearly \$24,000,000.

The existing parking problem in Cor-

<sup>1</sup> For a brief explanation of these methods see Appendix A.

vallis is made more complex by the demands arising from the various activities associated with, and sponsored by, Oregon State College. These include the normal academic, social, and athletic functions of the college, all of which at-

tract large numbers of people from outside the city, and numerous academic, technical, and administrative conferences and meetings which attract visitors the year round.

Figure 1 is a map of the city showing

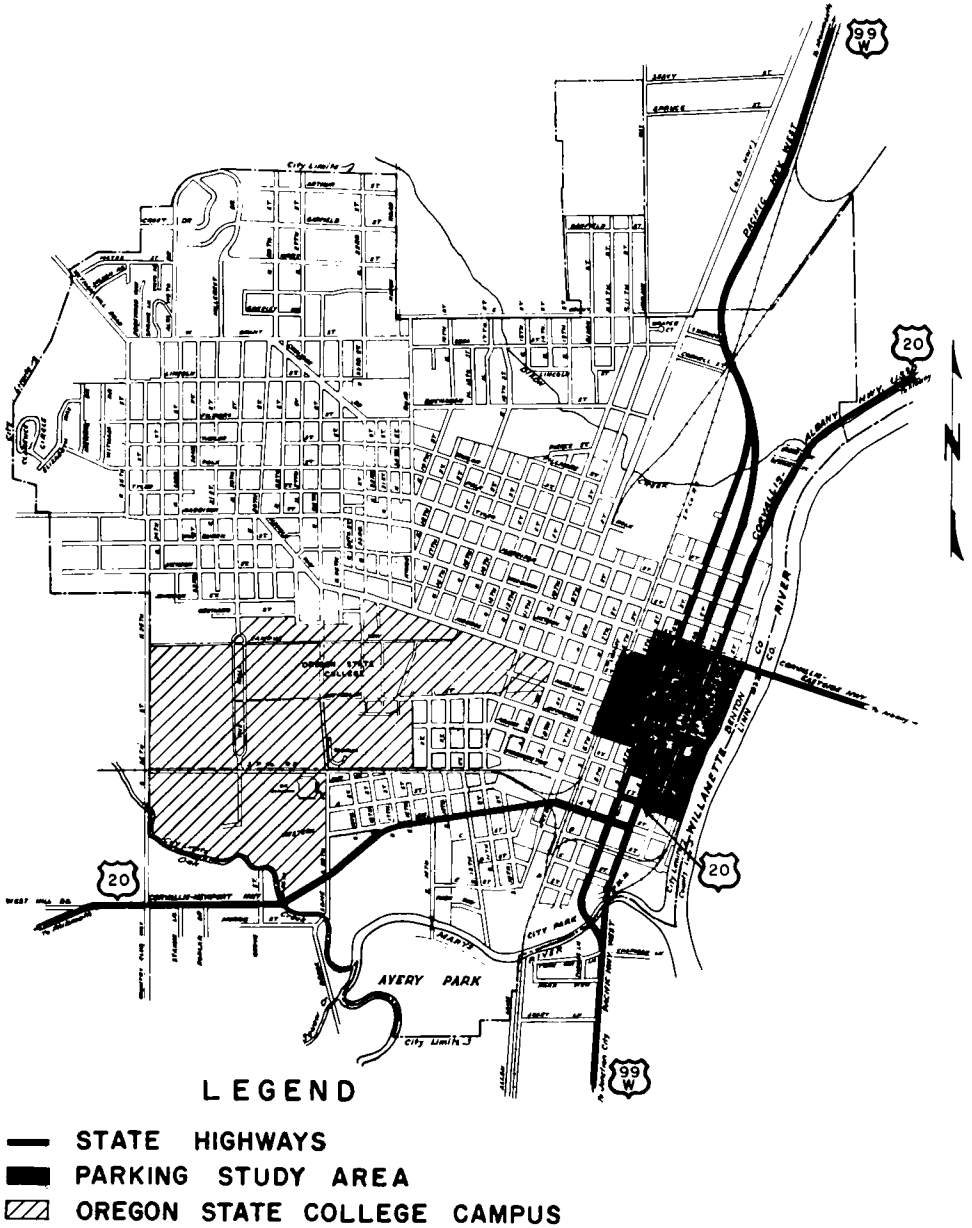


Figure 1. Corvallis, Benton County.

the parking study area and highway routings.

#### COMPARISON OF RESULTS

The peak moment interview study was taken as a base for evaluation of the GAF and rank size estimates. The block-by-block demand for space is shown in Appendix B (Table 1). There were 1,209 vehicles parked in the study area at that time. The average of the GAF and Rank Size estimates was 1,260. The peak moment interview study gives the demand for each block, while the other estimates give only total figures. Actually, in a city of this size it is not necessary to have block-by-block distributions, but it would seem desirable to have an estimate of the number of parkings for the core and the ring.

Using commercial building space as an indicator of parking generation, the total accumulation of 1,260 was distributed through the study area. The first step in this distribution was to prepare estimates of blocks which were unique in that they contained developments which did not fit the general pattern of the study area. An example of such blocks were those which contained industries, hotels, lumber yards, public buildings, etc. The parking in these blocks was estimated according to the employment, the number of rooms in each hotel, and the number of offices in public buildings. Methodology for such estimates and the commercial development in each block are shown in Appendix B (Tables 2 and 3). These estimates were deducted from the peak moment accumulation and the remainder of the accumulation was distributed on a pro rata basis according to the proportion of the total commercial development in each block. A comparison of demand by blocks is given in Table 4.

Originally, an effort was made to estimate the parking requirements for each block using requirements from various city building codes which specify the number of off-street parking spaces to be provided for each type of building. None of these efforts met with success, principally because building space is not a true

indicator of parking generation ability. Too many other variables enter the picture, for example, differences in management, products sold and utilization of space. These factors vary from one business to another through such a wide range of values that estimates of parking demand which do not take them into account will contain large errors.

However, when the blocks were grouped, these errors tended to cancel out. As stated earlier, a block-by-block distribution is not essential in such a city, but a core and ring distribution would be desirable.

The estimate for the 6-block core, blocks 16 through 21, was 623 vs 555, and for the ring of blocks surrounding the core, 413 vs 433, by the rank size and GAF estimates and the peak moment interview, respectively. The difference for the core is on the order of 12 percent, and for the ring, five percent (Figure 2).

As a result of this study, a series of steps has been drawn up to serve as a guide for the conduct of short-cut parking studies in the small cities. Each step should be carefully checked to assure accuracy, but it is believed that sufficient checks are included in these steps to reduce the possibility of large errors.

Step 1. Select the study area using the central business district plus a sufficient area to encompass those blocks where all day parking occurs.

Step 2. Prepare an inventory of all existing parking spaces available for public, private, or customer parking.

Step 3. Prepare a map of the study area showing the location of legal available parking spaces from data gathered in Step 2.

Step 4. Prepare an inventory of all buildings in the study area and prepare a map showing these buildings with their gross occupied area.

Step 5. Collect Census data for GAF and rank size methods.

Step 6. Conduct cordon counts by standard methods.

Step 7. Prepare estimates of total parkings by GAF, rank size, and cordon count methods.

Step 8. Obtain an actual count of vehi-

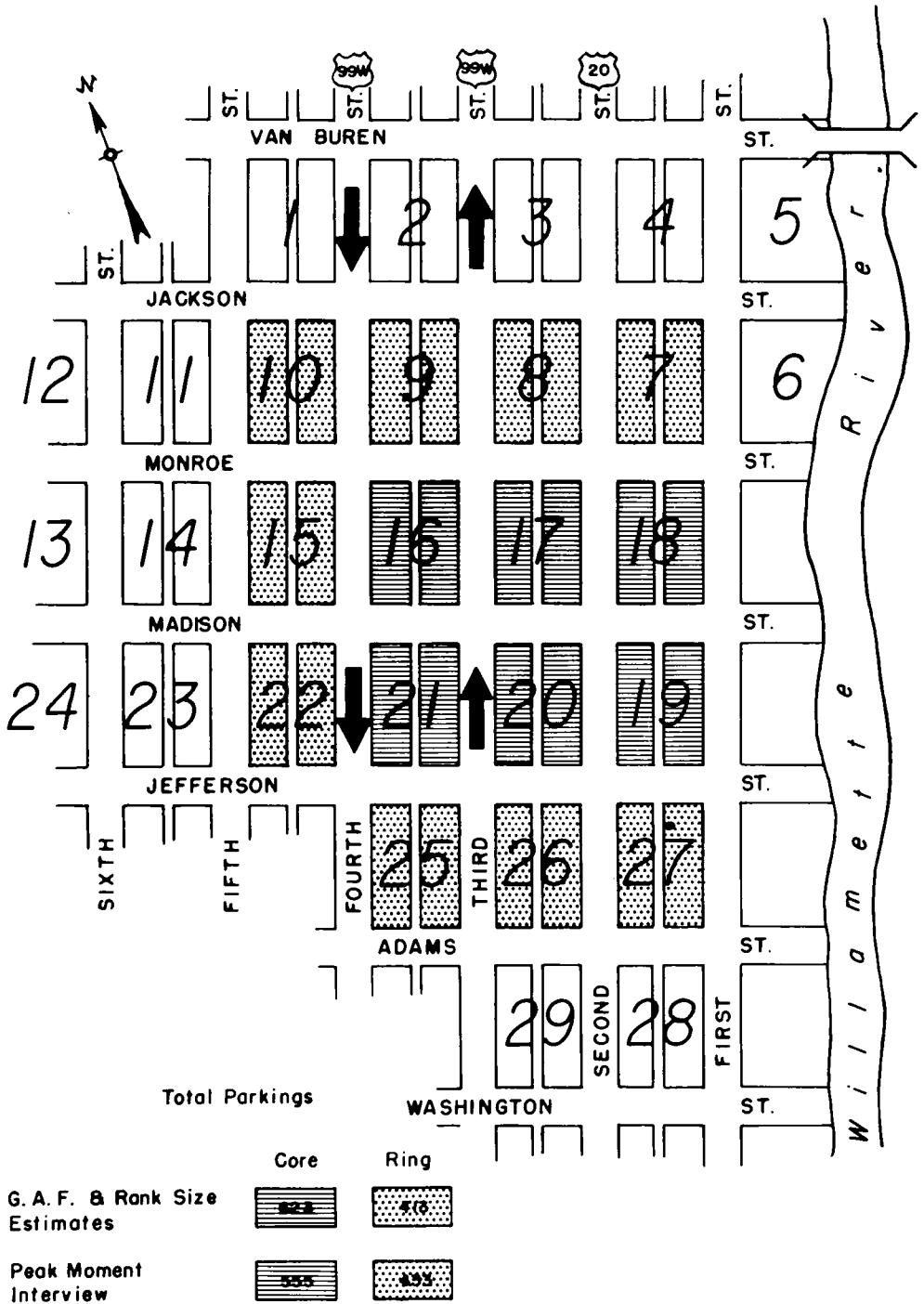


Figure 2. Peak moment parking in the core and ring.

cles (passenger vehicles and trucks) parked in the study area at the curb, in off-street spaces, and alleys both legal and illegal. This count should be made at one-hour intervals during the afternoon of a typical weekday so that an approximation of the peak accumulation can be obtained.

Step 9. Determine those blocks in the study area which have industry, hotels, lumber yards, or other developments which do not fit the general pattern of intensive commercial development. Estimate the parking demand for these blocks or portions thereof according to employment, number of hotel rooms, etc., and deduct these estimates from the total peak hour parkings.

Step 10. Assign remainder of peak hour parkings to groups of blocks on the basis of the percentage of the total commercial development. It is permissible to tabulate such estimates by block to select the core and ring, but such estimates should then be combined in groups because of the large errors certain blocks may contain.

Step 11. Select a number of possible parking lot locations throughout the city, including particularly those lots which are not improved, and those with low

cost or obsolete improvements. In this list, include more than enough to meet the deficiencies.

Step 12. Obtain appraisals for each tract listed in Step 11, and add to the market value the cost of clearing and improving for parking use.

Step 13. Evaluate each lot from three standpoints: (a) its probable usage; (b) its cost; (c) how well it would fit existing plans for development of the central business district.

## CONCLUSIONS

It is concluded from this study that short-cut methods can be used to estimate parking demand in small cities. There are sufficient checks to assure against large errors, and the sacrifice in accuracy is more than offset by the savings in cost, time, and manpower. If large areas are used, such as the core and ring, the distribution of demand for parking can be estimated based on total commercial development (office and retail building space), although separate estimates must be made for certain individual blocks containing unique or non-commercial development.

## APPENDIX A

### METHODOLOGY

#### *Peak Moment Interviews*

The results of the peak moment interview study conducted by Corvallis were used to evaluate the estimates made by the state. The parking study area included the wholesale and retail district; it totaled 29 blocks and extended beyond the commercial district far enough to include the area where all day parking was observed (Figure 3).

The peak moment of parking accumulation was found to be 4:30 p.m. from studies of curb space usage which had been previously made. Interviewers were stationed at curb faces and public off-street lots at 4:30 p.m. on various weekdays, with instructions to interview only those persons parked at that time. From the interviews they learned the first destination of the parker after leaving his vehicle, the purpose of his trip, and the last stop prior to parking. Vehicle type, parking type, and location were also recorded. From these data, it was possible to determine the desire for

parking in any block during the peak moment.

Those who used private and customer parking lots were not interviewed, nor were those parked in alleys. Vehicles parked in alleys were counted and assigned directly to the demand for the block in which they were parked. Customer and employee lots were assigned to the block in which the commercial establishment providing the lot was located. Vehicles parked in private lots were assigned to various blocks on the basis of estimates by the parking lot operator. These lots were generally rented by the month to workers in the central business district. The private lots were small, and the operators were acquainted with their patrons and their usual destination in the city.

#### *GAF and Rank Size Methods*

The methodology for preparing estimates of total parkings between 10:00 a.m. and 6 p.m. in the central business district of a city is available from two source (1 and 2). These methods were developed from a study

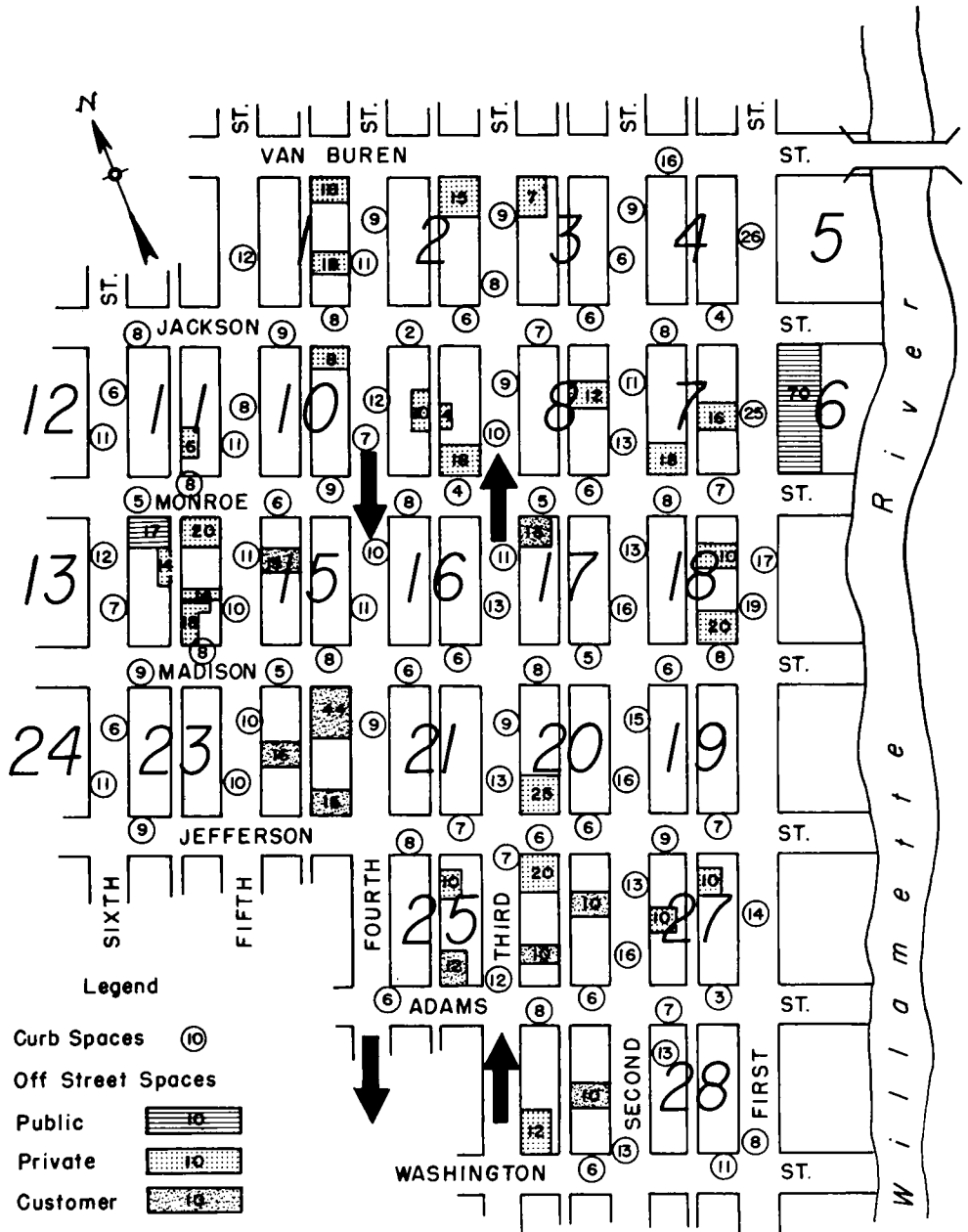


Figure 3. Parking study area with inventory of parking spaces.

of the vehicle parkings in a sample of 58 American cities of varying sizes and the economic characteristics which prevailed in these cities. The economic characteristics included population, employment, and retail sales data.

Based on these relationships, several methods of estimating parking volumes for additional cities were developed. The first is the rank size order method. This method is based on the theory that cities of like economic characteristics (as expressed in terms

of employment and population) have similar parking characteristics. For this method the 58 cities were ranked and grouped into five categories in accordance with their levels of economic activity as indicated by population, employment in manufacturing, service trade, etc., and parking. To estimate parking for an additional city, the appropriate economic category is established in accordance with its relative level of manufacturing employment, etc. Parking in the additional cities is assumed to be the same as the similarly ranked cities for which parking is known.

The statistical data used to establish the economic position of Corvallis are given in Tables 5-8.

The first step in estimating Corvallis parking was to fit the city into one of the five economic groups based on the prevailing economic pattern. Since the economic pattern did not reveal any obvious similarity to one specific economic group, the grouping process will require some explanation.

Corvallis was ranked as a Group II city, which indicates that it is predominately a retail trade center. The city group criteria are given in Table 9. The "indicated group" for Corvallis varies considerably for the different economic factors. Although the economic factors utilizing population and manufacturing and retail trade employment indicate Corvallis to be a Group I city, employment in the service and wholesale trades indicates the city to be in the Group III and IV categories, respectively.

The reliability of these rankings should be qualified as follows:

Group No.	Type of City	Examples
I	Resort-Tourist Center	Miami, Fla.; Reno, Nev.
II	Retail Trade	Lincoln, Neb.; Walla Walla, Wash.
III	Balance-Retail & Mfg.	Portland, Ore.; Richmond, Va.
IV	Manufacturing	St. Louis, Mo.; Lynchburg, Va.
V	Manufacturing (Predom.)	Cleveland, O.; Gary, Ind.

In accordance with the procedures for the rank size order method, the parking rank for a Group II city (Table 10) is approximately eight positions above the population rank for that city, bringing Corvallis parking up to the 45th rank in comparison with the 58 cities included in the original studies. This rank indicates that Corvallis would have approximately 9,300 parkings in the central business district between the hours of 10:00 a.m. and 6:00 p.m.

The second method, GAF sales and parking, utilized the theory that there is a definite relationship between parking requirements and retail sales. In developing this method, the number of parkers per million dollars of general merchandise, apparel, and furniture, appliance and furnishing sales were compared with the population of the 58 cities. To estimate parking, a city is first

1. The 1947 Census of Manufacturing did not include a figure for manufacturing employment for Corvallis and an estimate was necessitated. As a result, the accuracy of total employment and the derived percent distribution of employment by type is dependent on the accuracy of the manufacturing employment estimate.

2. The 58 cities in the original study included very few west coast cities, all of which have experienced large population increases. Therefore, the Group I rank for city population percent increase could not be given much weight.

3. The percent of employment in wholesale trades in Corvallis and most other Oregon cities is small because of the centralization of this trade in the Portland area. Examination of the cities included in the original study indicated that relatively few cities in regions with a metropolitan area in a similar dominating position were included. Therefore, the effect of this ranking in the final analysis was minimized.

In determining the economic group for cities, special emphasis was placed on the relative rank of GAF sales and employment in manufacturing, with respect to population rank. The indicated group appears to be III for retail sales, and II for manufacturing employment.

Finally, the generalized city groupings indicate that the economic position of Corvallis is more similar to the Group II cities than the others. The generalized city groupings are as follows:

ranked as a retail, manufacturing, or average city. The number of parkers per million dollars of sales for the city is then derived from a chart which shows the population and the number of parkers per million dollars of sales for the 58 cities. This amount is multiplied by the cities' dollar sales to obtain the parking volume.

Corvallis, a retail center with a population of 16,207 in 1950, would have approximately 1,750 parkings per million dollars of GAF sales. GAF sales in 1948 were \$5,000,000, but only \$4,260,000 in 1954: thus, 1948 parkings would be 8,750 and 1954 parkings 7,460.

These two estimates were averaged to obtain an indication of Corvallis parking requirements. A third method is available, but was not appropriate since it utilized the inbound cordon count of vehicles which is not available. The average of the two es-

timates is 8,380. This would include all vehicles parked in the study area between 10:00 a.m. and 6:00 p.m. To put the estimates in terms equivalent to the peak moment interview, it was necessary to convert the total parkings to peak accumulation.

A review of parking studies made in cities of similar size showed that the peak accumulation averaged about 15 percent of the total parkings; thus, the peak accumulation for Corvallis would be 15 percent of 8,380, or 1,260.

Careful study was given to the projection of the estimates to 1956. The decline in GAF sales between 1948 and 1954 indicated that parking demand might not have increased during the 6-year period by an appreciable amount. Shortly after the study began, a building in the business district, which had contained a leading restaurant and several thousand square feet of office

space, was destroyed by fire. The city hall which was located in one of the blocks included in the core had previously been vacated and was standing idle awaiting demolition.

It was felt that these losses in parking generation in the business district would certainly reduce total parking and probably offset any gains made in the past several years.

## REFERENCES

1. "Influence of Population, Sales, and Employment on Parking," S. T. Hitchcock, *Proceedings*, Highway Research Board (1953).
2. "Influence of Population, Sales, and Employment on Parking," *Public Roads*, December, 1953.

## APPENDIX B

## TABLES

TABLE 1  
PEAK HOUR DEMAND FOR SPACE BY BLOCKS  
FROM PEAK MOMENT INTERVIEW STUDY

Block No.	Number of Vehicles Desiring Parking Space
1	33
2	9
3	39
4	29
5	0
6	0
7	41
8	45
9	44
10	26
11	9
12	1
13	0
14	65
15	111
16	114
17	108
18	89
19	95
20	94
21	55
22	69
23	3
24	0
25	36
26	28
27	35
28	10
29	23
Total	1,209

TABLE 2  
NUMBER OF PARKINGS FOR  
UNIQUE CONDITIONS

Conditions	Estimated Parkings
Employees in industry, offices, etc.	One per 3 employees
Hotels	One per 14 rooms
Public buildings	One per 3 employees plus one for each office
Private buildings	One per each 3 employees plus one for each company vehicle
Retail lumberyards and implement houses	Use 1,000 sq ft for total



TABLE 3  
COMMERCIAL BUILDING SPACE, EMPLOYEES IN INDUSTRY, OFFICE BUILDING SPACE, AND  
HOTEL ROOMS IN EACH BLOCK OF THE CENTRAL BUSINESS DISTRICT

Block Number	Commercial Building Space, 1,000 sq ft		Hotel Rooms	Industry Employees
	Retail	Office		
1	0	0		26
2	5	0		
3	34	0		
4	30	0		14
5	0	0		
6	0	0		
7	25	15		
8	35	0		
9	15	10		
10	0	0		41
11	4	2		
12	0	0		
13	0	0		
14	0	23		
15	22	4	104	
16	68	1		
17	52	25		
18	28	20	88	
19	52	0	60	50
20	67	0		
21	36	12		
22	18	15		
23	0	0		
24	0	0		
25	14	6		
26	32	6		
27	8	12		26
28	6	0		
29	9	3		
Total	560	144	252	157

TABLE 4  
COMPARISON OF TOTAL PARKINGS BY BLOCKS

Block No.	Estimated Parking For Non-Commercial Uses	Commercial Building Space, 1,000 sq ft	Portion of Total Coml. Space	Total Parkings Minus Col. 2	Parkings by Block, Col. 4 x Col. 5	Total Parkings, Col. 2 + Col. 6	Total Parkings From Interview Study
1		0	0	1,135	0	32	33
2	32	5	0.0071	1,135	8	8	9
3		34	0.0483	1,135	55	55	39
4	5	30	0.0426	1,135	48	53	29
5		0	0	1,135	0	0	0
6		0	0	1,135	0	0	0
7		30	0.0426	1,135	48	48	41
8		35	0.0497	1,135	56	56	45
9		25	0.0355	1,135	40	40	44
10	25	0	0	1,135	0	25	26
11		6	0.0085	1,135	10	10	9
12		0	0	1,135	0	0	1
13		0	0	1,135	0	0	0
14		23	0.0327	1,135	37	37	65
15	15	26	0.0369	1,135	42	57	111
16		69	0.0980	1,135	112	112	114
17		77	0.1094	1,135	125	125	168
18	13	48	0.0682	1,135	77	90	89
19	26	52	0.0739	1,135	84	110	95
20		67	0.0952	1,135	109	109	94
21		48	0.0682	1,135	77	77	55
22		33	0.0469	1,135	53	53	69
23		0	0	1,135	0	0	3
24		0	0	1,135	0	0	0
25		20	0.0284	1,135	32	32	36
26		38	0.0540	1,135	61	61	26
27	9	20	0.0284	1,135	32	41	35
28		6	0.0085	1,135	10	10	10
29		12	0.0170	1,135	19	19	23
Total	125	704	1.0000	1,135	1,135	1,260	1,209

TABLE 5  
STATISTICAL DATA FOR CORVALLIS

Population		
1950 City population		16,207
1940-1950 population increase, percent		93.1
1956 Estimate (State Board of Health)		17,900
Employment		
Year	Type	Number
1947	Manufacturing	470*
1948	Retail trade	1,027
1948	Wholesale trade	126
1948	Service trade	187
Total		1,810
Percent of Total Employment		
Manufacturing		26.0
Retail trade		56.6
Wholesale trade		7.0
Service trade		10.4
Total		100.0
Ratios		
Retail Trade employment to manufacturing employment		1:0.46
Employment per 100 population		11.2:100
GAF Retail Sales		
1948		\$4,953,000
1954		\$4,260,000
Ranking with 58 Selected American Cities		
GAF sales		53
Population		52
Manufacturing employment		56.5
Parking		45*

\* Estimated.

TABLE 6  
BENTON COUNTY TOTAL VEHICLE REGISTRATIONS

Year	Registrations*
1948	11,079
1949	12,549
1950	13,800
1951	12,566
1952	12,391
1953	12,740
1954	13,722
1955	14,299

\* State of Oregon, Department of Motor Vehicles.

TABLE 7  
BENTON COUNTY POPULATION

Year	Population*
1950	31,570
7/1/1951	33,638
7/1/1952	34,845
7/1/1953	34,966
7/1/1954	34,370

\* 1950 Bureau of The Census; 1951-54 Board of Health, State of Oregon.

TABLE 8  
OREGON STATE COLLEGE STUDENT REGISTRATIONS\*

Year	Registrations†
1948-49	7,992
1949-50	7,366
1950-51	6,335
1951-52	5,335
1952-53	6,293
1953-54	5,258

\* Excluding summer enrollment.

† Oregon State College Bulletins.

TABLE 9  
CITY GROUP CRITERIA\*

Criterion	Corvallis		City Groups				
	Amount	Indicated Group	I	II	III	IV	V
City population, % increase 1940-50	93.1	I	81.1	31.1	20.2	7.7	13.2
Employment, per 100 population	11.2	I	15.2	19.0	23.6	35.5	36.4
Percent employed manufacturing	26.0	II	12.6	28.8	43.8	59.4	72.9
Percent employed retail trade	56.6	I	51.4	40.5	33.3	24.6	18.0
Percent employed wholesale trade	7.0	IV	15.6	16.6	13.3	8.7	4.9
Percent employed service trade	10.4	III	20.4	14.1	9.6	7.3	4.2
Retail trade-mfg. employment ratio	1:0.46	I or II	1:0.2	1:0.7	1:1.3	1:2.5	1:4.2

\* Bureau of Public Roads definitions.

TABLE 10  
RELATIVE RANK WITH RESPECT TO POPULATION RANK\*

Criterion	Corvallis		City Groups				
	Amount	Indicated Group	I	II	III	IV	V
GAF retail sales	+0.7	III	-0.1	-0.1	-0.4	+1.1	+2.1
Employment in manufacturing	+5.5	II	+16.7	+7.6	+0.6	-6.1	-9.5
Number of parkers	—	—	-8.3	-7.6	+0.5	+1.0	+7.7

\* Sales, employment, rank above or below population.