TRAFFIC CHARACTERISTICS OF SHOPPING CENTERS IN SOUTH AFRICA

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The existence of large regional shopping centers in South Africa is a relatively recent occurrence. As the scale, diversity, and number of all sizes of centers expanded, it became increasingly apparent that the applicability of overseas, particularly U.S., traffic design data often used should be tested. A different life-style and different hours of operation dictated that design standards for South African conditions needed to be reconsidered. This report summarizes such research.

•SHOPPING CENTERS in the Pretoria-Johannesburg metropolitan region were surveyed (Table 1). The classification of centers follows that commonly used (6); however, the scale is not of the same magnitude. Neighborhood centers are dominated by a supermarket and have less than 45,000 ft^2 (4180 m^2) of gross leasable floor area. Community centers are dominated by a department store and have from 45,000 to 200,000 ft^2 (4180 to 18 580 m^2) of gross leasable area (GLA). Regional centers have two or more department stores with over 300,000 ft^2 (27 870 m^2) of GLA. Hours of operation were generally 8:30 to 5:30 on weekdays and 8:30 to 1:00 on Saturdays. Surveys were normally conducted from a half hour before opening to a half hour after closing. Transit users and walk-in trade were negligible at all centers. The distinction between shopping and convenience goods followed the usual designation (2). Convenience goods include items purchased frequently and regularly such as food, drugs, and hardware. Shopping goods are items purchased selectively such as furniture, appliances, clothing, and jewelery. All indexes were related to GLA.

The traffic planner is mainly interested in two sets of shopping center activity values. One set measures the center activity during the street peak period and the other measures activity during the peak period of the center itself. The afternoon street peak period for the most part coincides with the weekday shopping peak period. Trip generation figures for this hour on an average weekday are needed to evaluate the effect of shopping center traffic on street traffic. (Some planners might prefer a peak weekday.)

The general sales patterns for South Africa indicate typical peak shopping activity at the end of each month and shortly before Christmas. The highest and lowest end-of-month peaks occur the week prior to Christmas and the last week in January, respectively. It was therefore assumed that center peak values of interest to the designer would fall within the range of values found for these 2 weeks. Such surveys would determine the high and low extremes of these peak design values.

STUDY FINDINGS

Design Day

Tables 2 and 3 give comparisons of various characteristics for the 2-week-long surveys and show that Thursday is the nearest to an average weekday for survey purposes.

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Table 1. Shopping center statistics.

Shopping Center	Classification	Gross Leasable Area (ft^2)	Percentage of GLA for Shopping Goods	Present Parking Index (spaces/ 1,000 ft^2 of GLA)
A. Glenfair	Neighborhood	27,450	20	6.6
B. Superand	Neighborhood	37,030	40	—[a]
C. Waterkloof	Neighborhood	43,530	40	2.3
D. Esperanto	Community	47,360	60	11.9[b]
E. Bryanston	Community	52,630	70	5.6
F. Killarney	Community	72,560	50	5.4
G. Rand Park	Community	105,000	40	6.9
H. Southdale	Community	122,920	80	6.5
I. Hyde Park	Community	123,890	80	4.6
J. Kempton City	Regional	316,670	60	3.8
K. Sandton City	Regional	344,440	80	6.7

Note: 1 ft^2 = 0.09 m^2.

[a]No parking layout designated. [b]Allows for future expansion.

Table 2. Weekly variation in daily trip generation and percentage of traffic.

Characteristic	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.
Daily trip generation (trips/1,000 ft^2 of GLA)						
Community center, Dec. 18-23, 1972[a]	65.4	75.5	70.5	73.6	95.2	63.9
Community center, Jan. 29-Feb. 3, 1973[b]	57.4	59.8	64.0	62.6	75.6	67.8
Regional center J, Dec. 18-23, 1972	30.9	33.0	34.0	34.4	45.6	24.4
Regional center J, Jan. 29-Feb. 3, 1973	24.8	23.7	24.6	23.8	26.2	23.8
Percentage of total weekly traffic						
Community center, Dec. 18-23, 1972[a]	14.9	17.0	15.9	16.5	21.3	14.4
Community center, Jan. 29-Feb. 3, 1973[b]	14.8	15.5	16.5	16.2	19.5	17.5
Regional center J, Dec. 18-23, 1972	15.3	16.3	16.8	17.0	22.6	12.0
Regional center J, Jan. 29-Feb. 3, 1973	16.9	16.1	16.7	16.2	17.8	16.2

Note: 1 ft^2 = 0.09 m^2.

[a]Unweighted average of centers G, H, and I. [b]Unweighted average of centers G and H.

Table 3. Weekly variation in peak-hour trip generation and parking accumulation.

Characteristic	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.
Peak-hour trip generation (trips/1,000 ft^2 of GLA)						
Community center, Dec. 18-23, 1972[a]	9.3	9.6	8.8	9.8	13.1	17.0
Community center, Jan. 29-Feb. 3, 1973[b]	8.0	8.4	8.4	8.6	10.4	17.3
Regional center J, Dec. 18-23, 1972	4.2	4.4	4.6	4.8	5.8	5.9
Regional center J, Jan. 29-Feb. 3, 1973	4.0	2.9	3.1	3.1	3.9	5.9
Maximum parking accumulation index (vehicles/1,000 ft^2 of GLA)						
Community center, Dec. 18-23, 1972[a]	4.8	4.0	4.1	4.8	5.1	5.7
Community center, Jan. 29-Feb. 3, 1973[b]	2.2	2.4	2.6	2.5	2.9	5.4
Regional center J, Dec. 18-23, 1972	1.3	2.0	2.1	1.9	3.4	2.5
Regional center J, Jan. 29-Feb. 3, 1973	1.1	1.0	1.1	1.0	1.1	2.9

Note: 1 ft^2 = 0.09 m^2.

[a]Unweighted average of centers G, H, and I. [b]Unweighted average of centers G and H.

Table 4. Traffic characteristics for an average weekday.

Center	Daily Trip Generation[a] (trips/ 1,000 ft^2 of GLA)	Shopping Center Peak Hour	Trip Generation During Center Peak Hour (trips/1,000 ft^2 of GLA)	Street Peak Hour	Shopping Center Trip Generation During Street Peak Hour (trips/1,000 ft^2 of GLA)
Neighborhood					
A	118.6	4:30 to 5:30	21.6	4:45 to 5:45	21.3
Community					
D	60.0	4:45 to 5:45	9.6	4:30 to 5:30	9.3
E	57.7	1:30 to 2:30	6.9	4:30 to 5:30	6.6
G	67.6	2:45 to 3:45	8.9	4:45 to 5:45	7.8
H	63.3	4:15 to 5:15	9.0	4:30 to 5:30	8.8
I	46.4	4:00 to 5:00	6.1	4:45 to 5:45	4.7
Average	59.0		8.1		7.4
Regional					
J	22.4	4:15 to 5:15	3.4	4:30 to 5:30	3.4

Note: 1 ft^2 = 0.09 m^2.

[a]Refers to the 10-hour period from 8:00 a.m. to 6:00 p.m.

The last Saturday in January followed an end-of-month payday. On this day about the same number of cars used the centers as on any weekday in that week but in fewer hours. Also the Saturday at the end of January gave the same hourly trip generation intensity and parking accumulation as any day prior to Christmas. Activity on the Saturday following an end-of-month payday was further tested by conducting vehicle counts at four centers on all Saturday mornings during a 2-month period. These counts showed that the end-of-month Saturday was indeed the busiest and that there was little variation between end-of-month Saturdays.

These findings led to the decision to use any normal Thursday as a representative design day of average weekday conditions at shopping centers and the Saturday at the end of any month as a design day for access and parking requirements.

Average Weekday

Data from surveys conducted on Thursdays are given in Tables 4 and 5. (Shopping center J was the only regional center surveyed on a weekday. Because its market area was not yet fully developed, there are some doubts about the survey values.) Figure 1 shows the average variation in shopping center traffic flow during a weekday at community centers D, E, G, H, and I. Figure 2 shows the daily variation in parking accumulation for a weekday at the same community centers, and Figure 3 shows the shopping center trip generation during the street peak hour versus GLA.

Daily trip generation rates for a weekday at community centers varied from a high of 95.2 trips per 1,000 ft^2 (93 m^2) of GLA in the week before Christmas to an average of 59.0. In comparison with U.S. values, Keefer (1) found an average of 16.08 trips per 1,000 ft^2 of GLA, LARTS (2) found a value of 46 trips per 1,000 ft^2 of GLA for community centers, and Miller (3) found a range of 45 to 101 trips per 1,000 ft^2 for three community centers. Daily trip generation rates for South Africa appear to be generally higher than those for U.S. centers.

For most centers studied, the shopping center and weekday afternoon street peak hours tend to coincide. From Figure 2 a range of values for street peak-hour trip generation for different center sizes can be determined. This trip generation tends to decrease as center size increases. The average value found for community centers was 7.4 peak-hour trips per 1,000 ft^2 (93 m^2) of GLA for a street peak period between 4:30 and 5:45 p.m. with an approximately 50-50 directional split in shopping center traffic.

For an average weekday the trip generation rate at community centers was 8.1 trips per 1,000 ft^2 (93 m^2) of GLA for a center peak occurring between 1:30 and 5:45 with an approximately 50-50 directional split.

Vehicle occupancy was lowest in the morning and increased in the afternoon after schools were out. Vehicle occupancy for a weekday averaged 1.6 for neighborhood and community centers and 1.8 for regional centers.

For an average weekday the daily trip generation rate for service vehicles was 6.0, 4.3, and 2.4 trips per 1,000 ft^2 of GLA for neighborhood, community, and regional centers respectively. The trip generation rate for the peak hour of service vehicle activity on an average weekday was 1.2, 0.7, and 0.3 trips per 1,000 ft^2 of GLA for neighborhood, community, and regional centers respectively. The peak period for service vehicle activity occurred between 11 a.m. and 1 p.m. with a directional split of approximately 50-50. The service vehicle activity during the street peak period is minimal.

On an average weekday the average maximum parking accumulation index was 0.3, 0.2, and 0.1 vehicle per 1,000 ft^2 of GLA for neighborhood, community, and regional centers respectively. The peak accumulation could be expected to occur between noon and 2 p.m. Parking duration increased only slightly from neighborhood to regional centers and averaged about 30 min.

Sixty percent of the peak accumulation of service vehicles required a loading dock with a preferred height of 3 ft 6 in. (1.1 m). Less than 6 percent of service vehicles at all centers were tractor-trailers. Seventy-four percent of the service vehicles were between 13 and 26 ft (3.9 and 7.9 m) long; 18 percent were less than and 8 percent were

Table 5. Parking characteristics for an average weekday.

Center	Maximum Parking Accumulation Index (vehicles/ 1,000 ft² of GLA)	Time of Peak Parking Accumulation	Parking Duration (min)	Parking Turnover (vehicles/ stall/day)
Neighborhood				
A	3.2	10:30	22	9.0
Community				
D	3.4	3:15	41	1.8
E	2.8	12:30	34	3.4
G	5.2	3:00	50	5.1
H	2.7	1:15	44	4.9
I	3.4	Noon	42	5.0
Average	3.5		42	4.0
Regional				
J	1.1	4:45	94	3.0

Note: 1 ft² = 0.09 m².

Figure 1. Variation in shopping center traffic flow for a weekday at a community center.

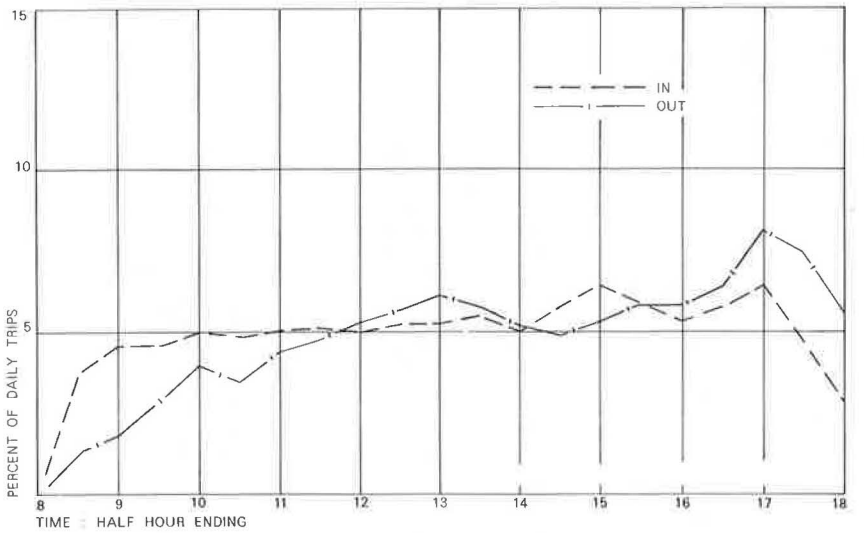


Figure 2. Variation in parking accumulation for a weekday at a community center.

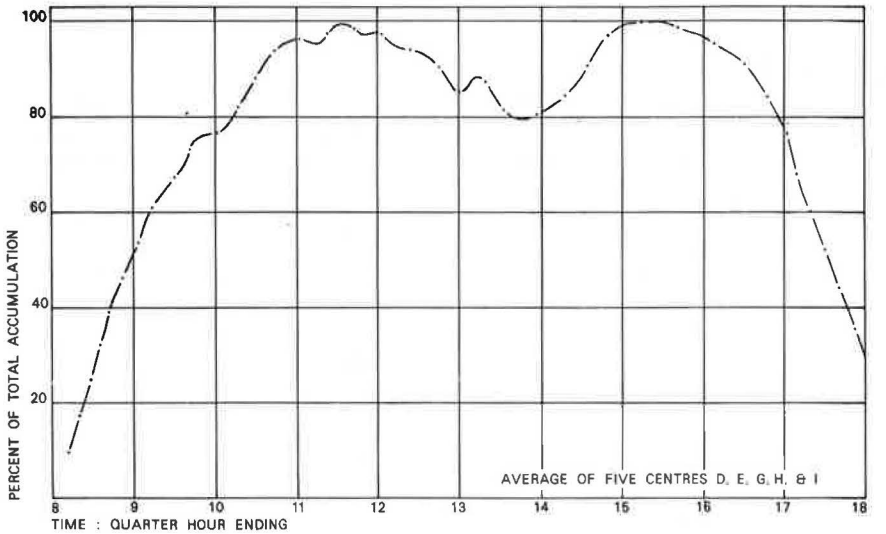


Figure 3. Variation in weekday shopping center trip generation versus size of center.

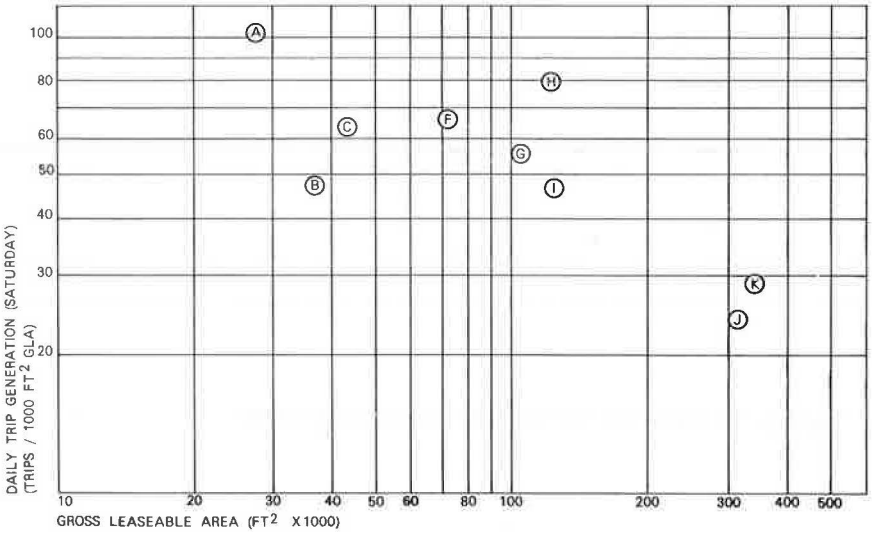


Table 6. Traffic characteristics for a design Saturday.

Center	Daily Trip Generation (trips/ 1,000 ft² of GLA)	Trip Generation During Center Peak Hour (trips/1,000 ft² of GLA)	Peak Hour for Shopping Center Traffic
Neighborhood			
A	102.7	27.4	11:45 to 12:45
B	47.5	13.7	11:30 to 12:30
C	63.9	17.4	10:15 to 11:15
Average	71.4	19.5	
Community			
F	66.5	17.4	10:15 to 11:15
G	55.6	13.7	10:30 to 11:30
H	80.1	20.9	11:30 to 12:30
I	46.8	19.6	10:30 to 11:30
Average	62.2	17.9	
Regional			
J	23.8	5.9	10:30 to 11:30
K	28.7	7.9	10:30 to 11:30
Average	26.2	6.9	

Note: 1 ft² = 0.09 m².

Table 7. Parking characteristics for a design Saturday.

Center	Maximum Parking Accumulation Index (vehicles/ 1,000 ft² of GLA)	Time of Peak Parking Accumulation	Parking Duration (min)	Parking Turnover (vehicles/ stall/day)
Neighborhood				
A	5.6	10:45	–	15.5
B	3.8	Noon	19	–
C	5.5	11:15	38	12.6
Average	5.0		28	14.0
Community				
F	5.8	10:45	62	6.4
G	3.6	12:15	–	4.0
H	7.3	11:30	–	6.2
I	5.7	11:15	47	5.0
Average	5.6		54	5.4
Regional				
J	2.9	11:15	–	3.1
K	5.7	11:15	91	2.3
Average	4.3		91	2.7

Note: 1 ft² = 0.09 m².

Figure 4. Variation in shopping center traffic flow for a design Saturday at a community center.

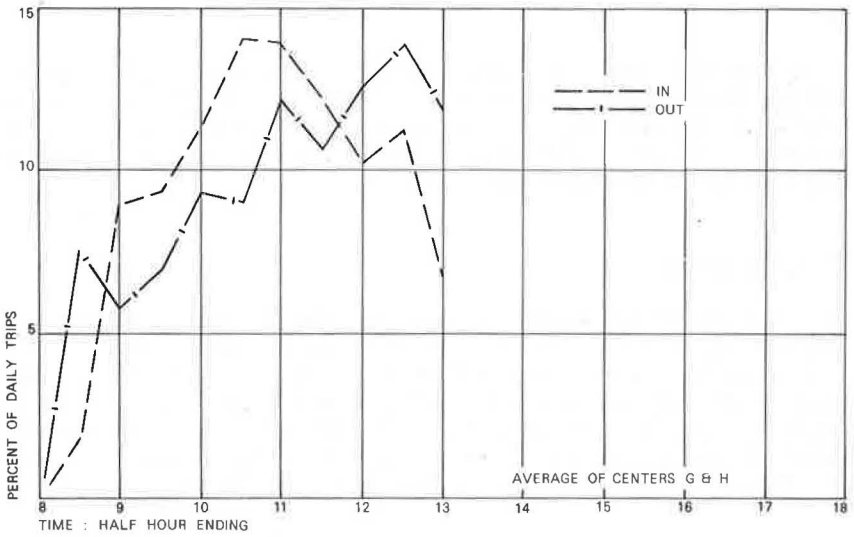


Figure 5. Variation in shopping center trip generation for a Saturday versus size of center.

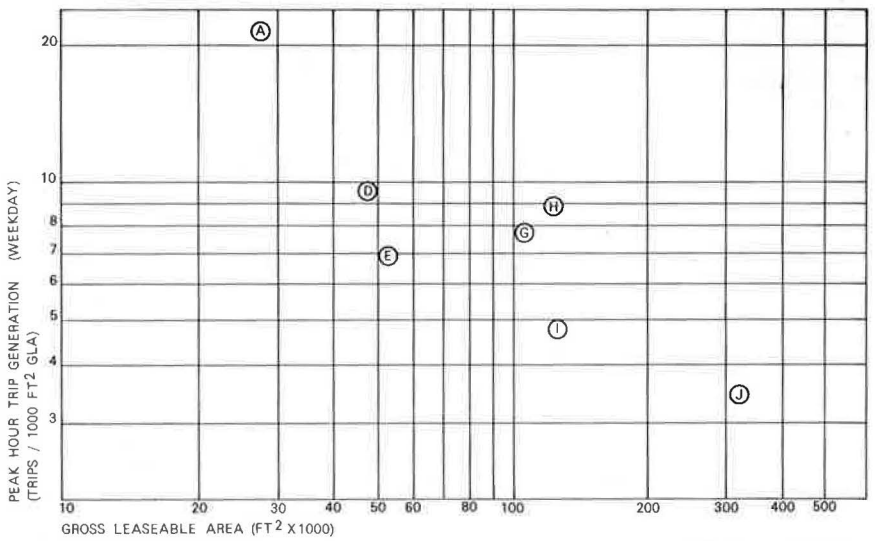
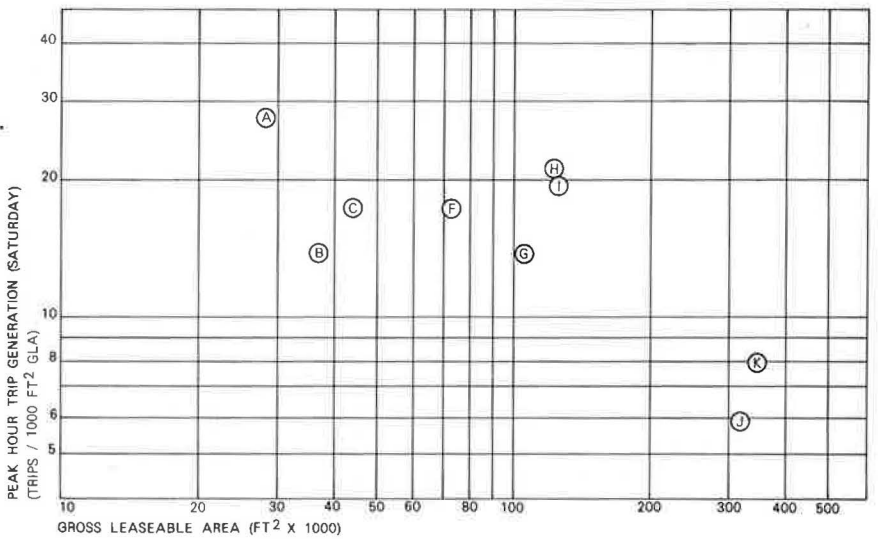


Figure 6. Variation in peak-hour trip generation for a design Saturday versus size of center.



more than this range. In loaded height, 29 percent were less than 6.5 ft (1.9 m), 50 percent were between 6.5 and 10 ft (1.9 and 3 m), and 22 percent were more than 13 ft (3.9 m). In terms of gross vehicle weight, 50 percent of the service vehicles were between 11,000 and 33,000 lb (4990 and 14 970 kg), 43 percent were less than 11,000 lb, and 7 percent were more than 33,000 lb.

Design Saturday

Data from surveys conducted on end-of-month Saturdays are given in Tables 6 and 7. Figure 4 shows the variation in shopping center traffic flow on such a design Saturday at community centers. Figure 5 shows the daily trip generation rate versus GLA and again illustrates the decreasing daily generation rate with increasing center size. Figure 6 shows how the design Saturday peak trip generation rate decreases with increasing center size, and Figure 7 shows the daily variation in parking accumulation at community centers. Figure 8 shows the variation in parking index with center size.

Figure 7. Variation in parking accumulation for a design Saturday at a community center.

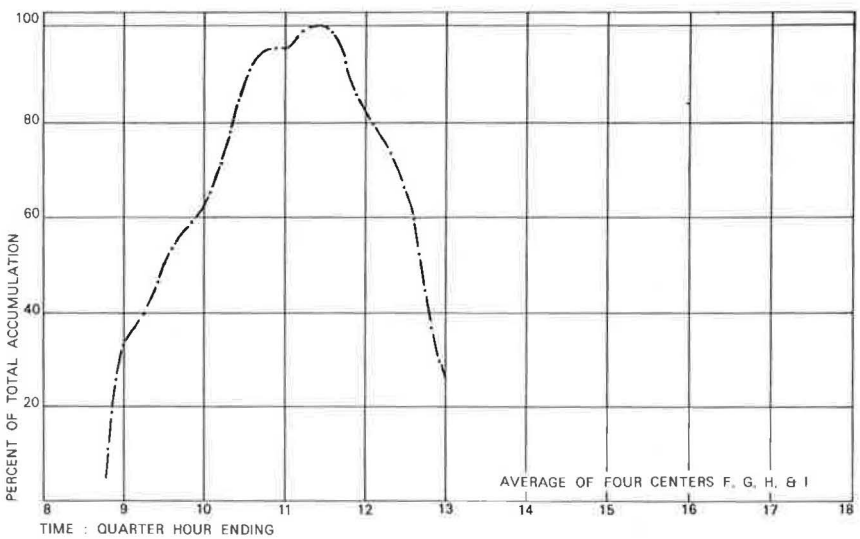
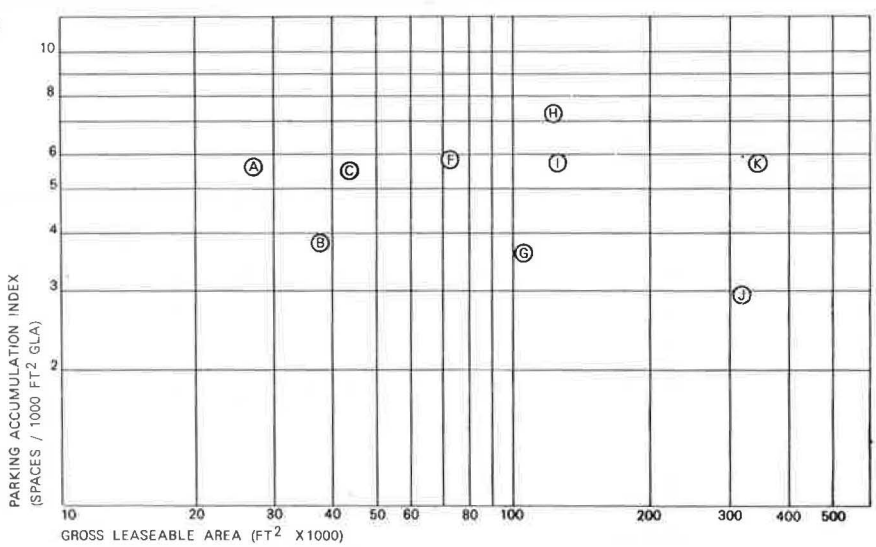


Figure 8. Variation in parking accumulation index for a design Saturday versus size of center.



Average values for daily trip generation of 71.4, 62.2, and 26.2 trips per 1,000 ft^2 (93 m^2) of GLA were found for neighborhood, community, and regional centers respectively. For a design Saturday, the peak trip generation rates are 19.5, 17.9, and 6.9 trips per 1,000 ft^2 of GLA for neighborhood, community, and regional centers respectively. The shopping center peak period occurs from 10:00 a.m. to 12:30 p.m. with an approximately 50-50 directional split.

For a design Saturday the average maximum parking accumulation index was 5.0, 5.6, and 4.3 spaces per 1,000 ft^2 (93 m^2) of GLA for neighborhood, community, and regional centers respectively. For the middle range of centers, the data support the Urban Land Institute value of 5.5 spaces per 1,000 ft^2 of GLA found for U.S. centers. Because data are lacking for centers at the ends of the size scale, Figure 8 and Table 5 include the authors' recommendation of higher parking index values for smaller centers and lower values for larger centers (4, 5). The peak demand can be expected to occur between 10:45 a.m. and 12:15 p.m.

Parking duration on a Saturday averaged 28 min for neighborhood centers, 54 min for community centers, and 91 min for regional centers. The short duration and high generation rates for neighborhood centers lead to a daily turnover rate for Saturday of 14.0 vehicles per stall. Community centers show a turnover of 5.4 vehicles per stall and regional centers 2.7 vehicles per stall. Higher daily generation rates for South African centers cause the daily turnover rates to be proportionately higher than U.S. values.

Vehicle occupancy increased through the morning. Vehicle occupancy was 1.8 for neighborhood and community centers and 2.0 for regional centers, slightly higher than for weekdays.

SUMMARY

Certain South African shopping center traffic characteristics correlate very well with U.S. data, but others do reflect local life-style differences.

Any normal Thursday seems to provide acceptable average values of typical weekday shopping center traffic characteristics. The pre-Christmas shopping peak is well represented by any end-of-month Saturday and any such Saturday can be used as a design day for access and parking requirements at shopping centers.

For an average weekday the shopping center peak generally coincides with the afternoon street peak hour. The vehicle trip generation rate during this p.m. street peak hour is important in determining the effect of shopping center traffic on street traffic. For a community center the value of 7.4 trips per 1,000 ft^2 of GLA was found. Vehicle occupancy was 1.6 persons per vehicle, parking duration 42 min, and parking turnover 4.0 vehicles per stall per day.

For an end-of-month Saturday the shopping center peak-hour trip generation is important for the design of access points. The maximum parking accumulation index is necessary for determining the required number of parking spaces. For a community center the peak-hour trip generation rate is 17.9 trips per 1,000 ft^2 of GLA and the maximum parking accumulation index is 5.6 vehicles per 1,000 ft^2 of GLA. Vehicle occupancy was 1.8 persons per vehicle, parking duration was 54 min, and parking turnover was 5.4 vehicles per stall per day.

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