Discount Superstore Trip Generation

A NATIONAL DISCOUNT SUPERSTORE TRIP GENERATION STUDY DETERMINED CURRENT WAL-MART SUPERCENTER TRIP GENERATION CHARACTERISTICS. A KEY CONCLUSION WAS THAT TYPICAL SEASON VEHICLE TRIP GENERATION RATES WERE SOMEWHAT HIGHER (EXCEPT SUNDAY) THAN THOSE REPORTED IN *TRIP GENERATION, 7TH EDITION*. WEEKDAY PASS-BY TRIPS WERE SLIGHTLY LOWER THAN STATED IN *TRIP GENERATION HANDBOOK, 2ND EDITION*.

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THE TEXAS TRANSPORTATION Institute (TTI) conducted a national discount superstore trip generation study to develop rates to accurately represent current Wal-Mart supercenter trip generation characteristics on a nationwide basis. This study established a representative national sample from which trip generation rates and equations could be developed for use in traffic access and impact studies. The national study consisted of the following basic steps:

- Develop a scope of work for the data collection phase, including survey site selection, site reconnaissance, data collection and data summary.
- Obtain data on all domestic supercenter stores from Wal-Mart.
- Randomly select an unbiased sample of 32 study sites.
- Hire and train supervisors of data collection firms, located close to the selected sites, to collect the data.
- Collect site and trip generation data at 32 stores for the typical season during September to mid-November; conduct pass-by surveys at 10 of these stores (randomly selected from the 32 stores); and collect data for the peak season at five of the same superstores (randomly selected from among the 32 stores) between the weekend after Thanksgiving (November 27, 2007) and December 16, 2007.
- Analyze data to determine trip generation rates or equations for both typical and peak seasons and determine pass-by trip percentages.
- Compare survey results with data under Land Use Code 813 in the 7th edition of *Trip Generation* and the 2nd edition of the *Trip Generation Handbook*.[1,2]

The objective was to have the national study include a representative sample of stores. TTI designed a method to select a sample of stores that could be counted efficiently and would produce results that were statistically valid. As with any study of this type, it was necessary and prudent to balance the cost of the study with the expected results in terms of precision and accuracy. The sample size of 32 provided a large enough sample so the results would benefit from the central limit theorem, which states that the sampling distribution of the means will approach that of a normal distribution even if the population being sampled is not normally distributed.

The following criteria were established for stores to qualify for this study:

- standard superstores (i.e., stores may or may not contain lube and tire centers and/or garden centers but no new concept or special market stores);
- located in a standard metropolitan statistical area (MSA);
- at least two years old;
- annual transactions per square foot within plus or minus two standard deviations of the mean (to omit extreme outliers on both high and low ends);
- free-standing stores that could be isolated to perform an accurate count of inbound and outbound vehicles (i.e., stores could be isolated from outparcels and adjacent development without inclusion of cut-through or out-parcel traffic in the counts; and
- no construction, special promotions, or events at the store that might disrupt normal activity at the superstore.

Figure 1a shows the geographic distribution of U.S. Wal-Mart supercenters throughout the 48 contiguous states. Figure 1b shows the distribution of the 32 selected stores. The stores selected for inclusion in this study generally track the distribution of all stores.

Weekly transactions of seven stores (randomly selected from the 32 sample stores) were evaluated to ascertain whether the period of time being considered as typical would be representative for the year. The range of values during this time fell within the 95-percent confidence interval

for annual average weekly transactions, so it was felt the data collected during that time period would be representative of typical conditions.

Due to the presence of out-parcel development on nearly all discount superstore sites and the design of driveways in most locations, nearly all stores required manual or video counting for the trip generation study. These were necessary to sufficiently isolate the supercenter store traffic and because driveway tangent lengths were insufficient to assure vehicles would cross counter tubes at right angles.

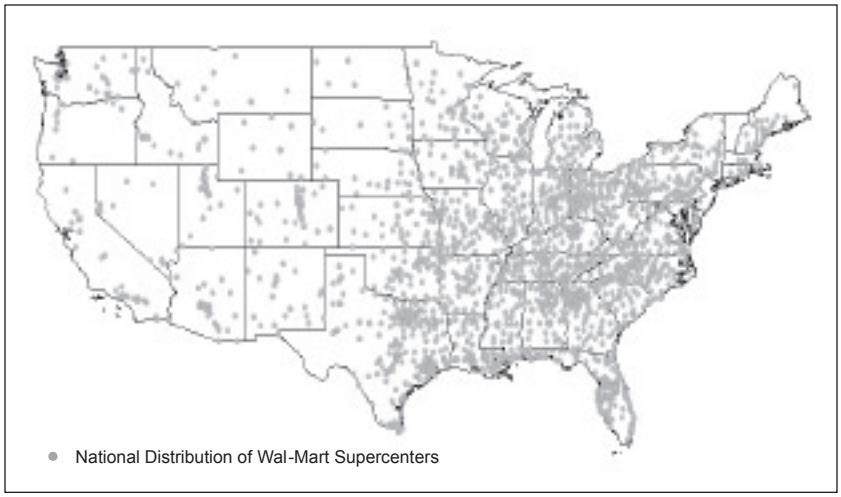

Figure 1a. Distribution of Wal-Mart supercenters in the 48 contiguous states.

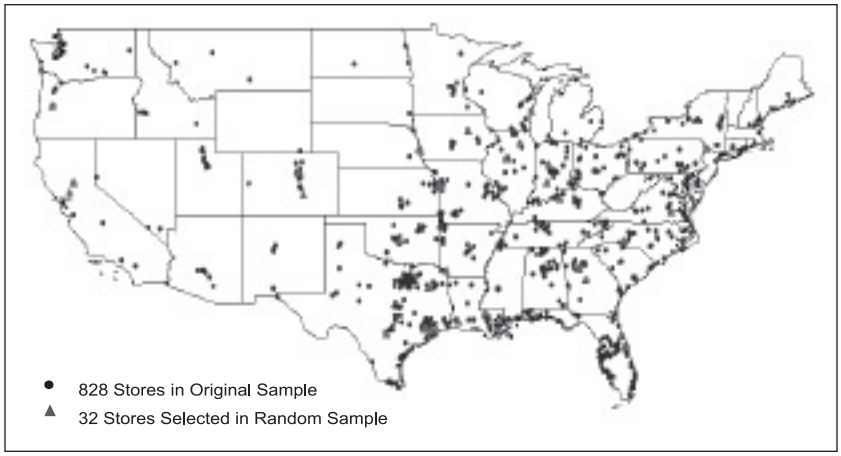

Figure 1b. Distribution of randomly selected 32 stores included in the study.

FINDINGS

Trip Generation—Typical Season

Typical season trip generation rates varied between individual superstores. Rates were developed based on the ITE definition of gross floor area (GFA) (excludes fenced covered areas). GFA data were available and confirmed by an independent architecture firm. Table 1 shows the rates and directional splits derived from the national study counts and the rates from the 7th edition of *Trip Generation*. Rates for the a.m. and p.m. street peak hours are based on the hour (four consecutive 15-minute periods) with the highest volume of traffic on adjacent streets between 7:00 and 9:00 a.m. and between 4:00 and 6:00 p.m., respectively. These definitions and the corresponding results are slightly different from those used in the 7th edition of *Trip Generation.*

Figure 2 shows the trip generation scatter diagram for weekday daily trips versus GFA. The straight lines represent the ITE average rate and the average rate found in the national study. Scatter diagrams for other time periods had similar scatter. Linear regressions on the data yielded correlation coefficients that ranged from 0.02 to 0.25. While some of this scatter was found to correspond to transactions per square foot, there was no statistical significance to that relationship.

Little information has been published previously about when peak hours of generators typically occur. For the 32 stores included in this study, peak hours of generators occurred at different times on each of the three survey days:

- Weekdays: 75 percent from 11:00 a.m. to noon; most of remainder began one-half-hour earlier;
- Saturdays: most occurred from noon to 2:00 p.m. or from 4:45 p.m. to 6:15 p.m.; and
- Sundays: spread broadly with most from noon to 4:45 p.m.

This study confirmed that the most appropriate time for weekday analyses of traffic access needs and impacts is the p.m. peak hour. The weekday p.m. peak hour of generation was always higher than the corresponding a.m. period. In fact, the a.m. peak was almost always smaller than any afternoon hour. Weekend generator peaks were less consistent and occurred throughout the late morning or afternoon.

Trip Generation—Peak Season

Surveys were also conducted at five of the 32 stores during the peak season between the week after Thanksgiving (November 27, 2007) and the week prior to Christmas (December 16, 2007). This excluded the peak weekends following Thanksgiving and preceding Christmas because they are the very highest business days of the year and not typical of peak season trip generation. The five stores were randomly selected from among the 32 store sample. Table 2 summarizes the peak season trip generation ratios. It also compares the same store inbound-outbound splits.

As shown in Table 2, there was almost no difference between weekday typical and peak season trip generation rates. There was a difference in the weekend trip generation rates. Saturday peak season rates were 14 percent higher for the day, 13 percent higher for the street peak hour and 20 percent higher for the peak hour of generator. Sunday peak season trip generation was also higher than the typical season, with a 6

percent difference for the day and 9 percent difference for the peak hour of generator.

Pass-By Trips

Pass-by interviews were conducted at 10 of the 32 superstores. These 10 superstores were randomly selected from among the 32 superstores contained in the sample.

Interviews were conducted on weekdays between 3:00 and 7:00 p.m. and on Saturdays between noon and 4:00 p.m., which is generally when peak site traffic generation occurs. Weekday and Saturday pass-by interviews were conducted at the same 10 superstores. All pass-by interviews were conducted on typical weeks; none were done during the peak season.

Weekday p.m. peak period. Table 3 shows the pass-by trip percentages found at the 10 surveyed superstores. Weekday percentages ranged between 13 and 36 percent. The straight average for the 10 superstore percentages was 26 percent. This compares with 28 percent reported in ITE's *Trip Generation Handbook, 2nd Edition*, and is a statistically insignificant difference.

Saturday afternoon peak period. Table 3 also shows similar data for the Saturday afternoon peak periods during typical seasons. The average pass-by trip percentage is 21 percent, somewhat lower than for weekday street peak periods.

The relationship between pass-by trips and adjacent street traffic volumes was tested for both weekdays and Saturdays. No statistically significant relationship was found for the stores included in this study.

Table 1. Recommended typical season superstore trip generation rates and equations.

Period	Vehicle trip generation rate (/1,000 ft.^{2} GFA)		National study directional split (%)	
	ITE	National study	In	Out
WEEKDAY				
Daily	49.21	53.04	50	50
a.m. street peak hour	1.84	1.46	56	44
a.m. peak hour of generator[1]	3.17	3.40	52	48
p.m. street peak hour	3.87	4.50	50	50
p.m. peak hour of generator[2]	4.03	4.77	50	50
SATURDAY				
Daily	57.50	65.73	50	50
Street peak hour	None	5.18	51	49
Peak hour of generator[3]	5.01	5.63	49	51
SUNDAY				
Daily	46.98	58.34	50	50
Peak hour of generator[3]	4.27	5.33	51	49

[1] a.m. peak hour of generator: a.m. hour between midnight and noon of highest volume of traffic entering and exiting the site.
[2] p.m. peak hour of generator: p.m. hour between noon and midnight of highest volume of traffic entering and exiting the site.
[3] Peak hour of generator: hour of highest volume of traffic entering and exiting the site.

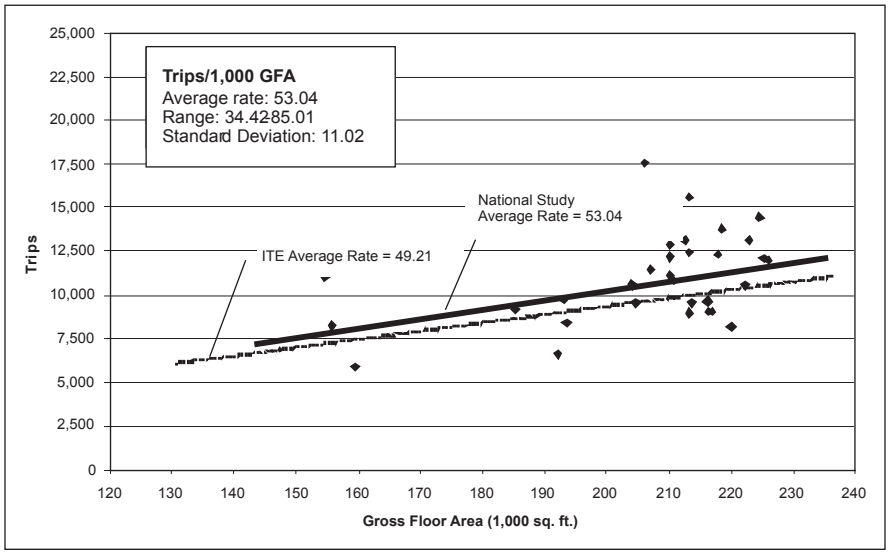

Figure 2. Trip generation scatter diagram—weekday daily trips.

COMPARISON OF STUDY AND ITE TRIP GENERATION REPORT DATA

Table 4 compares trip generation rates for the 7th edition of ITE's *Trip Generation* and the findings from this study. While the Wal-Mart superstore trip generation rates are higher (with one exception) than the ITE rates, the differences are not statistically significant except for the Sunday daily rate. This finding is best illustrated by Figure 3, which shows that the distributions of both ITE and Wal-Mart weekday p.m. street peak hour rates have similar patterns. The overlapping distributions about the means signify that the differences are not statistically significant.

The statistical computational and illustrative findings were similar for all periods shown in *Trip Generation, 7th Edition* under ITE Classification 813. The distributions compared similarly for almost all time periods surveyed (weekday, Saturday and Sunday daily and peak hours).

With one exception (a.m. street peak hour), trip generation rates found in this study were higher than those shown in *Trip Generation, 7th Edition* for discount superstores. These differences ranged between 7 and 25 percent. With these differences almost all being positive, it was important to determine if differences between the ITE rates and the rates found in this study were statistically significant and not attributed to chance.[3] This statistical test is sensitive to the size and variance of both samples.

The high degree of variability and small numbers of observations in the ITE

data are the reasons almost all of the differences in the rates shown in Table 4 were found to not be statistically significant at the 0.05 level. Only one rate (Sunday daily trips/1,000 ft.^{2}) is significantly different statistically.

Truck Trip Generation

This survey included counts of truck trips to and from the discount superstore sites. During a typical weekday, truck trip generation averaged 0.87 trips per 1,000 GSF. During typical days, these stores are scheduled to receive 2–3 trucks from the company's own distribution centers (total of 16–21 trucks per week). Additional trucks (defined in the data reported here as any "truck" with six or more tires) include those of direct suppliers, service companies, express deliveries and customer owned vehicles.

CONCLUSIONS

This study provided a larger sample with which to examine trip generation characteristics of discount superstores. The findings and conclusions are attributable to Wal-Mart supercenters that are a subset of all such stores that could be included in this ITE land use classification. The research team developed the following conclusions based on this study:

- Typical season vehicle trip generation rates were somewhat but not statistically significantly higher (except Sunday) than those in the existing *Trip Generation, 7th Edition* report.
- The trip generation data collected in this study can be combined with the other data ITE already has under this land use classification to enlarge ITE's database.
- The weekday pass-by trip percentage was slightly lower than that contained in the ITE *Trip Generation Handbook, 2nd Edition*, for discount superstores (26 percent rather than the 28 percent in the handbook); that difference is not statistically significant.
- The Saturday pass-by data collected in this study will provide a new category in the *Trip Generation Handbook* because it currently has no such data for that day. The Saturday pass-by percentage is lower than during the week, at 21 percent.

Table 2. Summary of peak/typical season trip generation ratios.

Period	Trips/1,000 sq. ft. GFA	Percent trips inbound	
	Ratio peak/typical	Peak	Typical
WEEKDAY			
Daily	1.011	50	50
a.m. street peak hour	0.949	55	53
p.m. street peak hour	0.993	50	51
a.m. peak hour of generator	1.008	53	52
p.m. peak hour of generator	1.010	50	50
SATURDAY			
Daily	1.139	50	50
Street peak hour	1.131	51	50
Peak hour of generator	1.200	50	50
SUNDAY			
Daily	1.061	50	50
Peak hour of generator	1.094	50	50

Table 3. Pass-by trip percentages.

City	State	Weekday 3:00–7:00 p.m. peak period			Saturday Noon–4:00 p.m. peak period		
		Interviews	% Pass-by	Adjacent street traffic	Interviews	% Pass-by	Adjacent street traffic
Louisville	KY	196	32%	7,048	360	28%	6,144
Pasadena	TX	404	26%	10,832	240	16%	11,898
Cedar Falls	IA	197	36%	8,411	156	13%	7,484
Pueblo	CO	180	14%	3,524	300	11%	4,764
Plano	IL	182	13%	3,957	162	18%	3,871
Sheboygan	WI	490	25%	8,835	441	22%	8,256
San Antonio	TX	621	29%	12,523	748	28%	12,332
Colonial Heights	VA	286	24%	13,026	270	26%	12,995
Milford	PA	119	34%	5,809	123	26%	7,024
Marysville	CA	686	34%	6,910	810	25%	5,429
10 superstore average			26%			21%	

Table 4. Trip generation rate comparisons.

Period	Trip generation rate[1]		Percent difference
	ITE	National study	
Weekday daily	49.21	53.04	7.8%
Weekday a.m. adjacent street peak hour	1.84	1.46	-20.7%
Weekday a.m. peak hour of generator	3.17	3.40	7.3%
Weekday p.m. adjacent street peak hour	3.87	4.50	16.3%
Weekday p.m. peak hour of generator	4.03	4.77	18.4%
Saturday daily	57.50	65.73	14.3%
Saturday adjacent street peak hour	N/A	5.18	N/A
Saturday peak hour of generator	5.01	5.63	12.4%
Sunday daily	46.98	58.34	24.2%
Sunday peak hour of generator	4.27	5.33	24.8%

[1] Trip rates are trips per 1,000 square feet GFA.

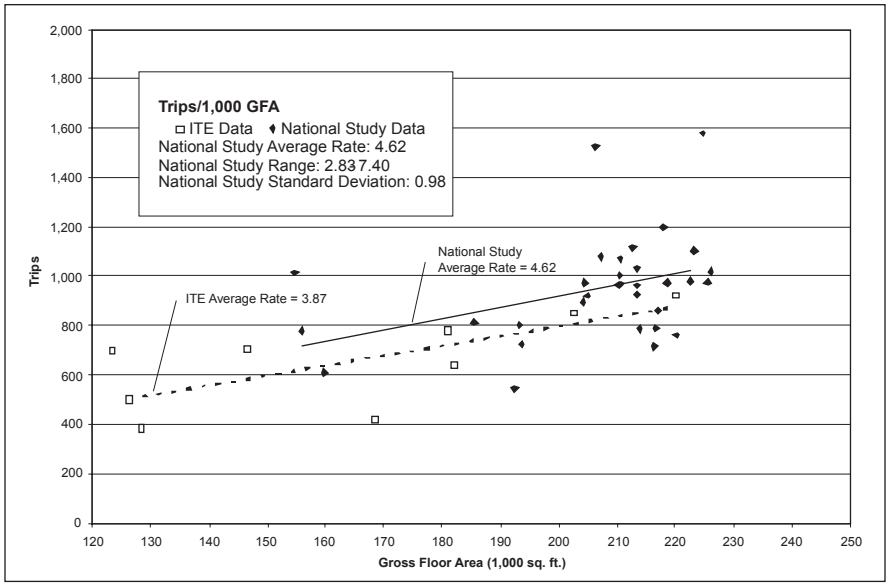

Figure 3. Comparison of weekday p.m. street peak-hour trip generation—ITE sample and 32 surveyed stores.

- Same-store typical and peak season trip generation rates are available for the first time for comparison. Weekday trip generation rates are essentially similar in both seasons; no peak season period rate is more than 5 percent higher than its typical season counterpart. However, during weekends, trip generation is higher, with Saturday peak season rates 13- to 20-percent higher than typical season and Sundays 6- to 10-percent higher.
- Based on the average trip rates and variances observed in this study, the sample size necessary to conduct a similar survey was computed. The sample size for all trip rates except the a.m. adjacent street peak hour was less than 30. The sample size for the a.m. adjacent street peak hour was 46. It was concluded that the sample size selected for this study was sufficient to meet the objectives of the study.
- With out-parcel development being included on discount superstore sites and design of driveways precluding use of tube counters in most locations, nearly all such stores require manual or video counting for trip generation studies. These are necessary to sufficiently isolate the superstore store traffic and because driveway tangent lengths are insufficient to assure vehicles cross counter tubes at right angles. ■

References

1. *Trip Generation, 7th Edition.* Washington, DC, USA: Institute of Transportation Engineers, 2003.

2. *Trip Generation Handbook, 2nd Edition*. Washington, DC: Institute of Transportation Engineers, June 2004.

3. The statistical test used is based on the theorem that if the distributions of two independent random variables have the means μ_1 and μ_2 and the variances σ_1^2 and σ_2^2, then the distribution of their sum (or difference) has the mean $\mu_1 + \mu_2$ (or $\mu_1 - \mu_{2)}$ and the variance $\sigma_1^2 + \sigma_2^2$. (Miller, I. and J.E. Freund, *Probability and Statistics for Engineers*. Englewood Cliffs, NJ, USA: Prentice-Hall Inc., 1965, pp. 165–167).

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