

Trip Generation at Fast-Food Restaurants in Johor Bahru, Malaysia

Ishtiaque Ahmed^{a*}, Ahmed Abdulameer^b, Othman Che Puan^c, Anil Minhans^d

^aAssociate Professor, Faculty of Civil Engineering, Transportation Research Alliance (TRA), Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

^bM.Eng., Department of Geotechnical and Transportation, Faculty of Civil Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

^cHead, Transportation Research Group, Transportation Research Alliance (TRA), Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

^dSenior Lecturer, Transportation Research Alliance (TRA), Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

*Corresponding author: ishtiaque@utm.my

Article history

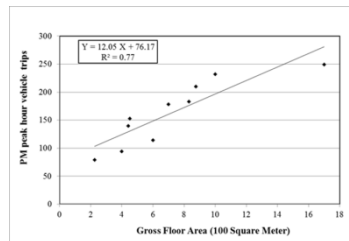
Received :26 May 2014

Received in revised form :

25 July 2014

Accepted :6 August 2014

Graphical abstract



Abstract

Trip Generation rates are important for transportation engineers and planners in the Travel Demand Forecasting process as well as for Traffic Impact Studies. Trip generation by a given land use type depends on one or more factors based on the socio-economic characteristics. The Institute of Transport Engineers (ITE) publishes and updates trip generation rates for different land use types at an interval of 2-3 years. In Malaysia, the Ministry of Public Works publishes trip generation information and the latest edition was published in 2010. Both of these documents recommend that the published trip rates be verified with local data, if possible. Different researches have been conducted in the developed countries but very rare in Malaysia. This study developed trip generation rates at fast-food restaurants in Johor Bahru, Malaysia. Ten fast-food locations were studied in detail. Trip rates were related to the number of parking spaces and gross floor area. However, the trip rates did not depend on the Number of Seats in the restaurants. The trip rates found in this study were lower than the ITE Trip Generation and higher than the Malaysia Trip Generation Manuals.

Keywords: Fast-food trip generation; fast-food trip parameters; Malaysia fast-food trips; fast-food restaurant trips; fast-food trip factors

© 2014 Penerbit UTM Press. All rights reserved.

1.0 INTRODUCTION

These days, most of the Asian cities face rapid urbanization and motorization, leading to sharp increase in urban travel demand and trip generations. Trip generation at fast food restaurants is important topic for the transportation planners while considering the impact of new developments or due to changes in land use.

The Institute of Transportation Engineers (ITE) is an international body of transport professionals based in Washington, DC, USA, that publishes and updates the information regarding the trip generation for various types of land uses in USA. The Trip Generation Manual (9th Edition), 2012 [1] is the latest version that includes 172 different land use types. Though many studies have been conducted in different countries on trip generation rates, the ITE's Trip Generation Manual is considered to be the most comprehensive document on trip generation. The Highway Planning Unit of the Ministry of Works Malaysia published the Trip Generation Manual Malaysia 2010 [2] that provides trip generation information on 61 different land use types in Malaysia. The above two documents are widely used as reference guide books for estimating trip generation rates in Malaysia including the "fast-food restaurant with drive-through window". For this land use type, the ITE Trip Generation Manual provides trip

generation data for three different parameters a) 1000 Sq. Feet Gross Floor Area b) Number of Seats and c) Peak Hour Traffic on Adjacent Street. However, the Malaysian manual2 provides trip generation relationship with one parameter only i.e. 1000 square feet (TSF) gross floor area.

A study in Saudi Arabia developed trip rates at fast-food restaurants in Jeddah based on a) gross floor area and b) number of employees [3]. A study in Virginia, USA studied eight fast-food restaurants in terms of a) gross floor area b) number of seats and c) number of employees and concluded that the trip rates per seat varied the least when the range of rates was considered [4]. Both the seating capacity and gross floor area were considered important. A study in the north-eastern U.S.A found that the trip rates did not vary with the floor area or the number of seats of the fast-food restaurants [5]. A study on trip characteristics of a national chain of fast-food restaurants in the Minneapolis-St. Paul area found that the noon peak hour trip generation rates were substantially higher than the afternoon peak hour rates [6]. The above study results in general indicated that results varied among studies substantially.

The sites in this study were located in Johor Bahru, the capital city of the state of Johor, and the second-largest city of Malaysia. During the last decade, a large number of fast-food

restaurants mushroomed in the area without adequate planning. The study considered three (03) parameters to establish relationships of the trip generation rates of the selected land use type i.e. a) gross floor area of the restaurant b) number of provided parking spaces c) number of seats in the restaurant. Ten (10) fast-food restaurants on different areas were selected to study the trip generation rates. The selected fast-food restaurants belonged to three international chain restaurants i.e. McDonald's, KFC and Burger King, all with drive through windows.

■2.0 DATA COLLECTION

Field surveys were conducted during May-June and September-October of 2013. Holidays were taken into account for data collection. A preliminary study conducted at 3 locations on 4 days (Thursday through Sunday) of two consecutive weeks indicated that in general Saturday (lunch time) 12:00 noon-3:00 pm and Friday (dinner time) 6:00 pm-9:00 pm generated highest number of trips. Based on this finding, Saturday- representing the week-end and Friday-representing the week-day were chosen for the data collection. The arriving and departing vehicles were counted using Automatic Traffic Counters (ATCs) and were verified through video data and short-term manual counts. The number of vehicles included the drive-through counter customer trips as well.

Data on number of provided parking spaces and the total number of seats were collected through visual observations and through stake holder consultations. The following three parameters were considered:

- **Gross Floor Area:** The studied restaurants were geometrically more or less of rectangle shape. The length and width of each restaurant were measured using measuring tape.
- **Number of parking spaces available:** Number of parking spaces available was considered to be the supply side of the parking and any space used for parking (whether designated or not) was considered.
- **Number of seats in the restaurant:** The total number of provided seats used by the customers for sitting was counted. Some restaurants had most of the seats inside the building whereas some restaurants had a large number of seats in different locations outside the main building glass doors. The indoor versus outside glass door seat proportions varied considerably. Both indoor and outdoor seats were considered in this research.

■3.0 DATA ANALYSIS AND FINDINGS

The data collected at the study sites were used to determine the trip generation rates based on the gross floor area, number of parking spaces and number of seats of fast food restaurants. After estimation of peak hour trips for all studied fast-food restaurants, the trip generation data were compared with the studied three parameters (which were easily measurable) as shown in Table 1 and Table 2 for Friday evening Peak Hour and Saturday afternoon Peak Hour periods representing the Peak Hours of the Generator for the weekdays and week-end respectively. The results showed that, on an average during Friday evening and Saturday evening in the PM peak hour of the generator, there were (21.04) and (24.56) vehicle trip ends per 100 square meters of gross floor area, (53.78) and (64.23) vehicle trip ends per (10) parking spaces, and (0.69) and (1.11) vehicle trip ends respectively.

The comparison of data between the above two tables showed that the Saturday evening (PM) peak hour trip rates were greater than the Friday afternoon (PM) rates. In this study, the Saturday evening peak hour vehicle trip ends at the study sites were further studied and plotted against respective gross floor area, number of parking spaces and number of seats as shown in Figure 1 through Figure 3. Statistically significant correlations were observed between the Saturday PM peak hour trips and the gross floor area (GFA) of the restaurants with an (R-Square) value of 0.77 and the coefficient of the independent variable was significant (p value of 0.00074). Similar relationships were also observed between the Saturday PM peak hour trips and the Number of Parking Spaces with an (R-Square) value of 0.88 and the coefficient of the independent variable was significant (p value of 4.3E-05). No clear relationship between trips and number of seats could be established. The relationship between the numbers of peak-hour trip ends with the number of seats was found to be statistically insignificant implying that number of seats could not reliably predict vehicle trip ends. It is worth noting that an in-depth analysis and critical review of the trip rates reported in Trip Generation also suggested that seats cannot reliably predict vehicle trip ends. One reason could be that other factors, besides number of seats, can explain most of the variations in vehicle trips.

Table 1 P.M peak hour trip rate calculation for 10 fast-food restaurants on (weekdays)

Name of locations	In	Out	Total	%In	%Out	GFA ^a (sq.m.)	NPS ^b	NS ^c	Rate ^d GFA	Rate ^e PS	Rate ^f Seats
Mc.D Jln Indah	112	116	228	49	51	875	40	142	26.06	57.00	1.61
KFC T. University	46	44	90	51	49	450	28	103	20.00	32.14	0.87
B.K Jln. Tun Razak	40	36	76	53	47	600	11	170	12.67	69.09	0.45
Mc.D Jln Tebrau	132	100	232	57	43	1700	44	303	13.65	52.73	0.76
Mc.D Taman Setia	96	87	183	52	48	700	31	120	26.14	59.03	1.53
Mc.D- Jln S-P	101	98	199	52	48	830	29	154	23.98	68.62	1.29
Mc.D-Jln S-JB	119	114	233	51	49	1000	42	224	23.30	55.48	1.04
B.K- Toll Skudai	38	39	77	49	51	225	15	95	34.22	38.50	0.81
KFC- Jln S-JB	46	41	87	53	47	440	15	116	19.77	58.00	0.75
B.K- Jln S-P	32	23	55	58	42	520	16	94	10.58	34.38	0.59
Average				52	48				21.04	53.78	0.96

Table 2 P.M peak hour trip rate calculation for 10 fast-food restaurants on (weekends)

Name of locations	In	Out	Total	%In	%Out	GFA ^a (sq.m.)	NPS ^b	NS ^c	Rate ^d GFA	Rate ^e PS	Rate ^f Seats
McD Jln Indah	103	107	210	49	51	875	40	142	24.00	52.50	1.48
KFC T. University	73	80	153	48	52	450	28	103	34.00	54.64	1.49
B.K Jln. Tun Razak	59	55	114	52	48	600	11	170	19.00	103.64	0.67
McD Jln Tebrau	133	116	249	53	47	1700	44	303	14.65	56.59	0.82
McD Taman Setia	90	88	178	51	49	700	31	120	25.43	57.42	1.48
McD- Jln S-P	96	87	183	52	48	830	29	154	22.05	63.10	1.19
McD-Jln S-JB	120	112	232	52	48	1000	42	224	23.20	55.24	1.04
B.K- Toll Skudai	40	39	79	51	49	225	15	95	35.11	52.67	0.83
KFC- Jln S-JB	70	70	140	50	50	440	15	116	31.82	93.33	1.21
B.K- Jln S-P	43	42	85	51	49	520	16	94	16.35	53.13	0.90
Average				51	49				24.56	64.23	1.11

a-Gross Floor Area (GFA) in Square Meter, b- Number of available Parking Spaces c- Number of Seats d- Trips per 100 Square Meter of GFA, e- Trips per 10 Parking Spaces, f- Trips per Seat

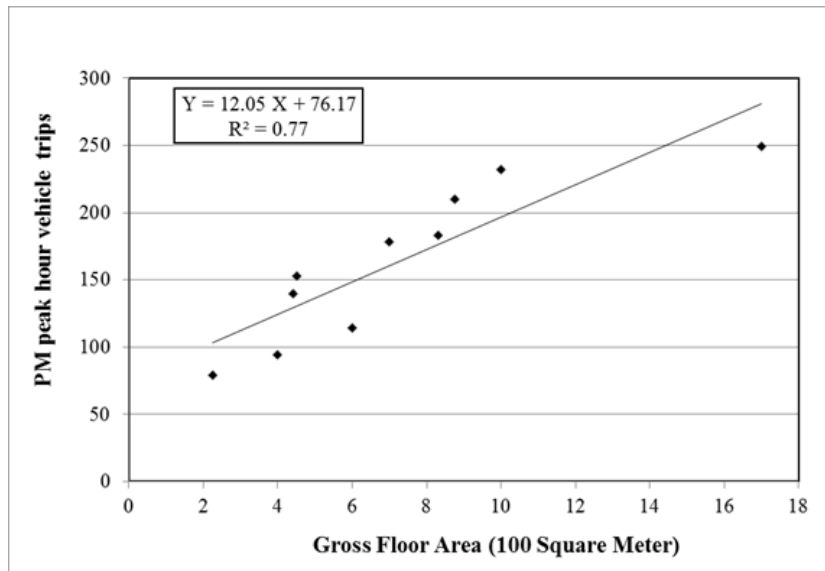


Figure 1 Data plots of Saturday peak-hour vehicle trip ends versus gross floor area

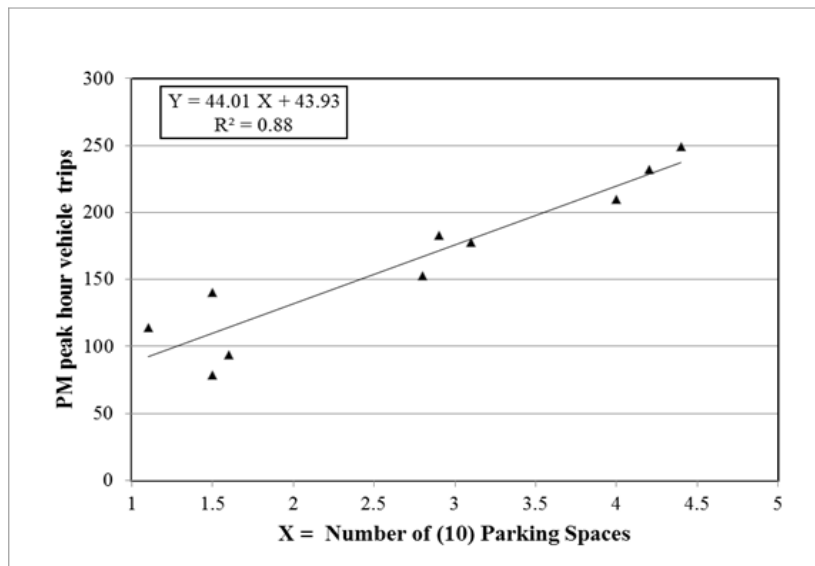


Figure 2 Data plots of Saturday peak-hour vehicle trip ends versus Number of parking spaces

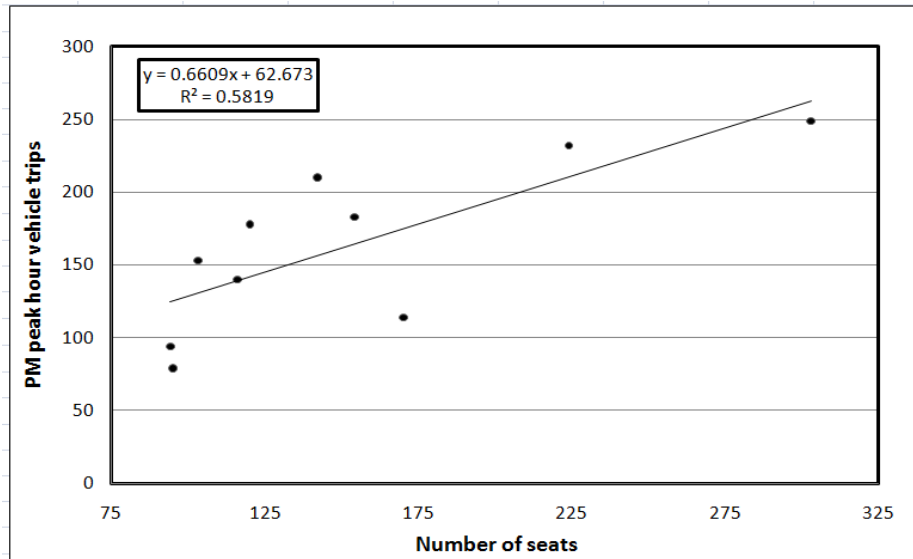


Figure 3 Data plots of Saturday peak-hour vehicle trip ends versus number of seats

In order to develop the predictive models for trip generation including the drive through window trips at fast-food restaurants on Saturday PM peak hour period (peak hour of the Generator) for the local condition, simple-linear regression and multiple-linear regression model development both were attempted.

The developed linear regression models were of the following two forms:

- i. $Y = 44.01 X + 43.93$ (1)
X= Number of (10) Parking Spaces
($R^2 = 0.88$, Standard Error- 20.37, t-test- 7.99)
- ii. $Y = 12.05 X + 76.17$ (2)
X= Gross Floor Area (100 Square Meter)
($R^2 = 0.77$, Standard Error- 29.06, t-test- 5.22)

A multiple linear regression model was developed as follows:

- iii. $T = 44.87 + 4.71 (GFA) + 31.11 (PS)$ (3)
GFA= Gross Floor Area (100 Square Meter)
PS= Number of (10) Parking Spaces
($R^2 = 0.93$, Standard Errors- 17.20, t-test- GFA 2.05 (P-Value 0.07) & t-test- P.S- 3.26 (p-value 0.005)
(Intercept p-value 0.01)

Based on the statistical indicators, the developed multiple regression equation (Equation 3) was noted to have the highest predictability compared with the single regression equations. The multiple-linear model equation contained two (2) parameters, gross floor area (GFA) and the number of parking spaces (PS) which were found to have good correlation with the number of vehicle trips generated at a 95-percent confidence level.

4.0 DISCUSSIONS

The study showed that the gross floor area and the available number of parking spaces were significant parameters in determining the number of trip generations. This is in line with the ITE Trip Generation and the Malaysian manuals. This is

practical in the sense that a larger GFA indicates a bigger restaurant in general. A bigger restaurant will naturally need more number of parking spaces in an automobile oriented society. However, this study finding was contradictory to the Virginia study⁴ finding, that the Number of Seats in Malaysia was not related to the number of trips. The analyzed data in this study showed that the number of seats in a restaurant in the studied restaurants was not related to the GFA. One observation on this was that in Malaysia, due to climatic condition, many customers prefer to sit outside of the glass doors of the restaurant and proportion of the seats in and outside the main enclosure varied among restaurants.

The trip generation rates obtained in this study were compared with the ITE Trip Generation Manual¹ (Land Use: 934) and Malaysia Trip Generation Manual² (Code 07 06 10/11) as shown in Table 3. The comparison showed that the trip generation rate of the study based on the GFA was higher than those mentioned in Malaysia Trip Generation Manual and lower than those available in the ITE Trip Generation Manual. This can be explained as the socio-economic characteristics and lifestyle of an average Johor Bahru, Malaysia citizen is much different than that of an average person living in the United States. However, why the rate mentioned in the Malaysia Trip Generation was much lower than those found in this study may be due to the rapid urbanization and the increased population growth and vehicle ownership in Johor Bahru, resulting in increased demand

Table 3 Comparison of average PM peak hour trip generation on Saturday

	Average Trip Rate			Regression Equation		
	GFA*	NO. PS***	Seats	GFA	NO. PS	Seats
Trip generation (study)	24.56 (22.82)**	64.23	1.11	T = 44.87 + 4.71(GFA*) + 31.11 (PS***)		N/A
Malaysia Trip Generation Manual ² (Code 07 06 10/11)	13.60	N/A	N/A	N/A	N/A	N/A
ITE Trip Generation Manual ¹ (Land Use: 934)	59.00	N/A	2.39	N/A	N/A	N/A

*This study considered 100 Square Meter (equivalent to 1076 Square Feet) of Gross Floor Area (GFA) but the Malaysian manual and the ITE manual considered 1000 Square Feet (equivalent to 92.9 Square Meter) of GFA.

** converted to 1000 Square Feet.

*** For each 10 number of Parking Spaces.

5.0 CONCLUSIONS

In this study, trip generation rates at fast food restaurants during PM peak hour of the Generator on a Saturday in Johor Bahru, Malaysia were developed. The trip generation was found to be related to two parameters a) gross floor area and b) the number of available parking spaces. The parameter “number of seats” was found not to have a significant relationship with the number of trips generated at fast-food restaurants. The developed trip generation models are capable of predicting trip generations and will help transportation planners to better predict trip generations for fast-food restaurants in the local context

References

- [1] Institute of Transportation Engineers (ITE). 2012. *Trip Generation Manual*. 9th Edition. Washington DC, USA.
- [2] Highway Planning Unit Ministry of Works Malaysia. 2010. *Trip Generation Manual* 2010. Malaysia.
- [3] Al-Zahrani, A. H. M. and T. Hasan. 2008. Trip Generation at Fast Food Restaurants in Saudi Arabia. *ITE Journal*. 78(2): 24–29.
- [4] Arnold Jr, E. D. 1984. Trip Generation at Special Sites. *Final Report, No. VHTRC 84-R23*: Virginia Highway and Transportation Research Council, Virginia.
- [5] Bonsignore, R. and W. J. Roache. 1992. Trip Generation: Fast Food For Thought. *ITE Journal*. 62(2): 33–36.
- [6] Wonson, M. 1989. Trip Characteristics of Fast-Food Restaurants. *ITE Journal*. 59(2): 43–45.
- [7] Shariff, N. M. 2012. Private Vehicle Ownership and Transportation Planning in Malaysia. *In International Conference on Traffic and Transportation Engineering*.