

Trip Generation Characteristics of Kindergartens in Johor Bahru, Malaysia

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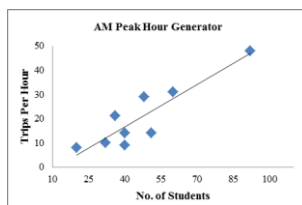
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Article history

Received :5 June 2014
Received in revised form :
25 September 2014
Accepted : 16 October 2014

Graphical abstract



Abstract

Transportation planners need prior data on "Trip Generation" for new developments and for predicting changes in the trip generation due to modifications in the existing land use types. Trip Generation depends on various factors, especially the socioeconomic characteristics. Currently, transportation planners in Malaysia have to depend on the trip generation data of foreign countries because the data in the Trip Generation Manual of Malaysia provides inadequate information on many land use types including the Educational Institute type- "Kindergarten". The major objective of the study was to study the "Trip Generation" characteristics for the "Kindergartens" in Johor Bahru, Malaysia. The study included identification of the statistically significant parameters that are related to the trip generation rates. Data were collected from selected nine (09) kindergarten locations in Johor Bahru area. The data collection also included survey of stakeholders including information on the number of students, the number of staff, availability of the day-care facilities, school timings and number of shifts at the facility. The collected data provided information on the "Trip Generation" in local context and environment. Statistical analyses were carried out to establish relationships between the dependent variable and the independent variables. Linear regression models were developed which were found to be capable of predicting trip generations by the "Kindergarten" land use type. The models could be used by the professionals for the Johor Bahru, Malaysia local environment.

Keywords: Trip generation rates, kindergarten trip generation, trip attraction kindergartens, trip demand kindergartens, travel demand kindergartens

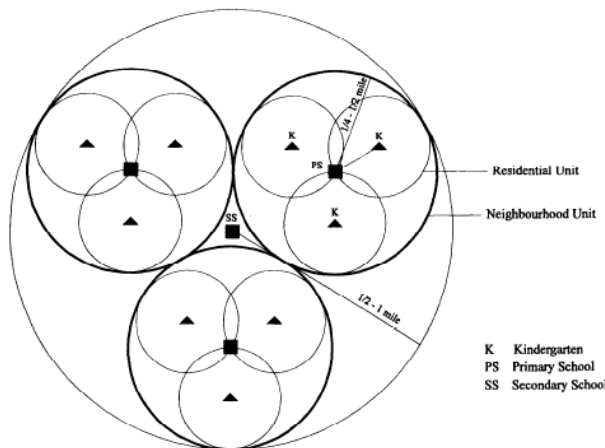
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1.0 INTRODUCTION

Trip generation rate plays a role in many phases of transportation planning related activities. It is the first phase in the travel demand forecasting process. It involves the estimation of the total number of trips entering or leaving a particular area of any specific type of 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 on the trip generation for various types of land uses in USA. The latest one is the Trip Generation Manual (9th Edition), 2012 that includes one hundred and sixty two (162) land use types [1]. The Highway Planning Unit of the Ministry of Works Malaysia published the "Trip Generation Manual Malaysia 2010" that provides trip generation information on sixty-one (61) different land use types in Malaysia [2]. Currently, transport planners in Malaysia have to depend on the trip generation data and models developed based on data collected in foreign countries because the data in the Trip Generation Manual of Malaysia provides inadequate information on many land use types including the Educational Institute type- "Kindergarten" or what is known as "Tadika" in the local language.

Literature review shows that a number of studies have been conducted on Trip Generations mainly in the developed world. A study by McCourt [3] showed that the present ITE trip generation number for afternoon peak hours at elementary schools may not be adequate when sport fields are present adjacent to the school. The Technical Activities Committee of the Tennessee Section of the Institute of Transportation Engineers (ITE) conducted a study [4] to evaluate parking demand characteristics for day-care facilities and found that results were fairly comparable to the ITE published values. A study by Gatlis [5] indicated that more elementary school children are being transported to and from school by cars in the automobile oriented societies. The study suggested that school officials can reduce school traffic congestion and enhance traffic safety by providing adequate parking. Studies have also been conducted on trip generations for other land use types. For example, a study in Virginia, USA [6] 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. Seating capacity and the gross floor area (GFA) were considered to be more important.

Kindergarten/Tadika is the preschool education level in Malaysia. It is generally provided by private for-profit preschools, though some are run by the government or religious groups. Some primary schools have attached preschool sections. Attendance in a preschool program is not universal; while people living in urban areas are generally able to send their children to private kindergartens, few do in rural areas. Registered preschools are subjected to zoning regulations and must comply with other regulations such as health screening and fire hazard assessment. Many preschools are located in high density residential areas, where normal residential units compliant to regulations are converted into the schools. Based on community school planning, Department of Town and Regional Planning, Ministry of Housing and Local Government collaboration with Ministry of Education Malaysia, has established planning guidelines for schools in a community area. Figure 1 shows the trip distance and journey time from home to school and community school planning in neighborhood area. These particular planning aspects will provide the safety environment for the communities in the manners of trip generation from home to schools. Moreover this planning guideline can help to assign community trips to the schools safely within the boundary of housing area.



TYPICAL NEIGHBOURHOOD ORGANIZATION

Figure 1 Location of schools in relation to distance from cathment area⁶

However, there is still insufficient data points used in the Malaysian Manual for the Kindergartens. Therefore, the trip generation are predicted based on the foreign handbooks and those may be often inaccurate. The information provided can be

misleading as well for the local context. Moreover, in the Malaysian Manual, no regression model exists for predicting daily or peak hour trip generation rates for the kindergarten land use type. The aim of this study is to determine the trip generation rates at the selected Kindergartens/Tadikas. The objectives of the study are the following:

- To determine trip generation rates at the selected sites of kindergartens in the Johor Bahru Area.
- To identify statistically significant parameters that affect the trip generation rates for the selected land use.
- To develop mathematical relationships between the significant parameter(s) and the trip generation rate of the selected land-use type.

The remaining part of the paper is structured as follows:

2.0 METHODOLOGY

This study involved the detailed review and information gathering about the fundamentals of trip generation and regression models. A pilot study was set up to identify potential sites for this study. This was done through internet based location mapping of the potential sites. The initially identified locations were visited and further screening was done. Nine (09) kindergartens were selected for further studies.

The data collection in this study was carried out in accordance with the ITE's Manual of Transportation Engineering Studies⁹. The data was collected using a designed data collection table, on which the arrival and departure times for the vehicles coming to the kindergartens were recorded along with the respective registration numbers of the vehicles. The surveys were carried out during the operating hours of the kindergartens. As a measure of checking, videos were captured and were processed manually with a computer for the expected peak hours to verify the accuracy of the manually recorded data.

Data collected in this study were grouped into two categories. These are stakeholder data and field data. The stakeholder data, which were collected from Headmaster/Headmistress, included the number of students, the number of staff, availability of the day-care facilities, school timings and number of shifts at the facility. The field data included the number of car/other mode trips entering and exiting the facilities and survey of number of school(s) within three (03) kilometer (KM) radius area. Table 1 summarizes the background information on the kindergartens. The corresponding range for the nine facilities was twenty (20) to ninety two (92), with an average of forty-seven (47) children. The average number of staff at the facilities was five (5).

Table 1 Background Information on Kindergartens

Locations	Kindergarten's Name	No. of Students	No. of Staff	No. of Sessions	No. Of Kindergartens Within 3KM radius	Day Care Facilities
1	Aqsa	40	6	1	5	No
2	Sinar Kreatif	48	6	2	16	Yes
3	Q-dees	40	5	2	21	Yes
4	Smart Reader	60	5	2	30	No
5	Minda Bijak	36	5	1	24	Yes
6	Permata	20	4	1	10	Yes
7	Amal	32	4	1	5	No
8	Cahaya	51	6	1	12	Yes
9	Iman	92	8	2	10	No
	Average	47	5		15	

The data were analyzed using statistical techniques using MS Excel spread sheets. The relationship between the dependent variable and the selected parameters were established. Furthermore, the trip generation (attraction) rate models for the peak period of kindergartens were developed. This trip generation models would be discussed in comparison to the Malaysian Trip Generation Manual. Models for predicting trip generation rates for kindergartens in Johor Bahru were developed in this study. The study periods selected also contained the peak hour. The peak hours occurred between 7.00 a.m. to 9.00 a.m. on morning sessions and 4:00 p.m. to 7.00 p.m. in the evening for all study sites.

3.0 RESULTS AND DISCUSSIONS

A trip generation rate is developed by measuring the traffic volume at an existing land use and relating it to some easily measurable characteristic of that land use [6]. The Malaysian Trip Generation Manual reports trip rates at kindergartens based on the floor area of the establishment, the number of students for two different time periods i.e. the peak-hour of the generator and the peak hour traffic on the adjacent street. A critical review of the trip rates reported in Trip Generation Handbook also suggested that floor area cannot reliably predict vehicle trip ends [10]. A recent study stated that trip generation analysis involves estimation of the total number of trips entering or leaving a parcel of land as a function of the socioeconomic, locational, and land use characteristics of the parcel [11]. Trip generation rates were studied for three parameters a) number of students b) number of staff at the facility and c) number of kindergartens within 3 KM radius.

The hourly Peak Hour vehicle trips for the Generator at the study sites were compared with the number of students, number of staff and number of kindergartens within 3KM and are shown on Table 2. No clear relationships between trips to number of kindergartens and between trips to number of staff was found. The regression value in between range from 0.4 to 0.6 indicates weak relationship. Moreover, this study only considered on the probability value (P-value) is less than significant level of two (02) percent will be hypothetically accepted. Thus, these parameters can be rejected to develop prediction models on trip generation for peak hours. However, statistical analysis on number of peak hours trip based on number of students showed different result compared to others. The result revealed that the R² values were higher and the coefficients of the variable were significant. Since the parameter was significant hence, the prediction of trip generation models (for AM, and PM Peak Hours) based on number of students were developed

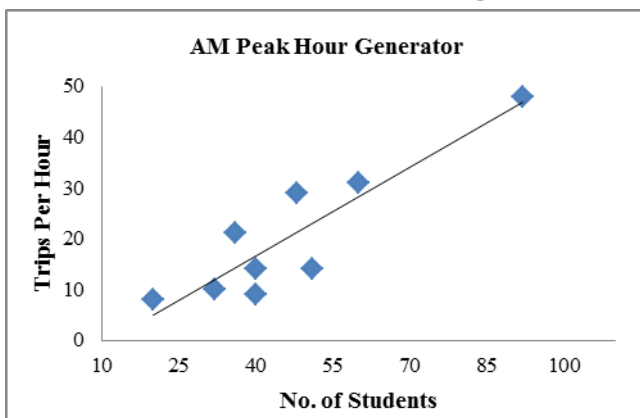


Figure 2 Relationship between trip making and number of students at AM peak hour generator.

Prediction of AM Peak Hour Trips
 $= 0.58*(\text{No. Of Students}) - 6.69$ (Eq.1)

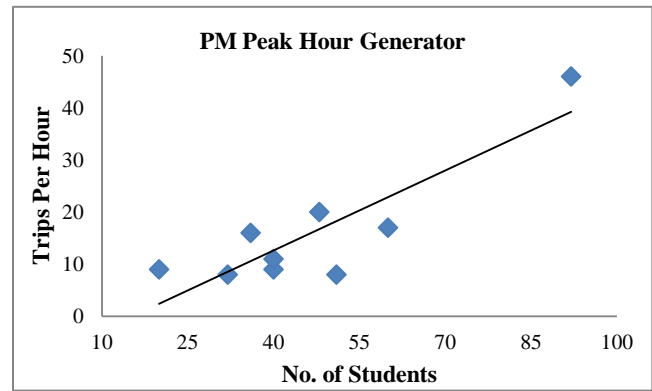


Figure 3 Relationship between trip making and number of students at AM peak hour generator.

Prediction of PM Peak Hour Trips
 $= 0.57*(\text{No. Of Students}) - 12.47$ (Eq.2)

4.0 CONCLUSIONS

According to Malaysian Trip Generation Manual trip rates at Kindergartens are based on the floor area of the establishment, the number of students and the peak-hour traffic on the adjacent street. But somehow it was found that there are only three (03) data points used in the Malaysian Manual for the Kindergartens. The data collected at the study sites were used to determine the trip generation rates based on the number of students, number of staff and number of schools within 3 KM radius of kindergartens. Statistical analyses revealed that the vehicle trip rates at the kindergarten have weak relationship based on number of staff and number of school within 3 KM radius. However, the regression value for peak hour trip based on number of students showed that the value was strong and the coefficient of the independent variable was significant.

Table 2 Statistical analysis for the AM and PM peak hours

Parameters	Regression, R ²		Statistical Significance	
	AM	PM	AM	PM
No. of Students	0.808	0.719	0.001	0.004
No. of Staff	0.532	0.619	0.025	0.011
No. of Kindergartens within 3 KM	0.659	0.469	0.008	0.042

The study results were also compared with the Malaysian Trip Generation Manual as shown in Table 3. The study was able to develop a better relationship between the number of students and the Peak Hour Trip Generations (for both AM and PM peak hours).

Table 3 Comparison of the study findings with the Malaysian trip generation manual²

Parameter	This Study		Malaysia Manual ²	
	AM	PM	AM	PM
No. of Students	0.808	0.719	N/P	N/P
TSF- Floor Space	N/P	N/P	0.66	N/P

N/P is Not provided.

The comparison showed that the rates mentioned in the Trip Generation Manual were based on insufficient data. Linear regression models developed through this study are capable of predicting daily trip generation by the “Kindergarten” land use type. The trip generation rate models developed in this study will facilitate transportation planners and traffic engineers to better estimate anticipated trips to be attracted to kindergartens. Therefore, the developed models could be used by the professionals for the Johor Bahru, Malaysia local environment.

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