TRIP GENERATION AND PARKING DEMAND OF SUBURBAN MOSQUES IN THE GREATER CAPE TOWN, WESTERN CAPE

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ABSTRACT

Research was done to determine the trip generation and parking demand of mosques in the greater Cape Town area of the Western Cape. The research focused on mosques in suburban environments. The mosques are split into two categories: mosques that are designated to host the congregational Friday midday prayer in addition to the daily prayers and mosques that only host the daily prayers. Surveys were conducted at such mosques and relationships between the number of vehicles generated and parked at the mosques and the characteristics of the mosques and their surrounding areas were determined. A resulting trip generation rate and parking demand rate were determined for the mosques. For mosques that host the Friday midday prayer, the peak hour occurred between 12:45 and 13:45 on a Friday. The vehicle trip generation rates were found to be 1.1 per Muslim household outside of walking distance to the mosque, 0.40 per prayer space available inside the mosque, 55 trips per 100 square meters of prayer floor space inside the mosque and 0.42 trips per worshipper inside the mosque. For mosques that do not host the Friday midday prayer, the peak trip generation occurred in the Saturday evening. The vehicle trip generation rates were found to be 0.06 per prayer space available inside the mosque and 8.6 per 100 square meters of prayer floor space inside the mosque. The parking demand was found to be equal to the trip generation rates of the mosques as the typical vehicle occupation was one person and nearly all worshippers travelled by vehicle in these suburban settings. The results contribute to the understanding of the traffic characteristics of mosques, but should not be applied to other metropolitan areas without taking into consideration local travel demand and mode choice characteristics.

1 INTRODUCTION

The Department of Transport (DOT) through the Committee of Transport Officials (COTO), provides a guideline document, the South African Trip Data Manual TMH 17 (COTO, 2013), published by the South African National Roads Agency Limited (SANRAL). This guideline provides South African trip generation data for most land uses, including places of public worship such as churches, in order to determine the effect of a change in land

use on the road network (COTO, 2013). Parking requirements are specified in the Town Planning Schemes of municipalities. The TMH 17 does not provide trip generation rates specifically for mosques. Specific trip generation and parking rates are required due to the fact that the patterns of uses of a mosque differ greatly from that of a church or a synagogue and will have different transport demand requirements. The Institute of Transportation Engineers (ITE) updated their Trip Generation Manual (9th edition, 2012) to include the trip generation rates of mosques. Table 1 shows the difference in trip generation rates of a church, synagogue, and mosque based on USA data (ITE, 2012).

Table 1: ITE Vehicle Trip Generation Rates (Source ITE, 2012)

Description	Unit (Square feet)	ITE Vehicle Trip Generation Rates		
		Weekday	AM	PM
Church	1000	9.11	0.56	0.55
Synagogue	1000	10.64	0.14	1.69
Mosque	1000	NA	1.63	11.02

Note: 1000 square feet = 92.3 square metre

Table 1 shows that there are significant differences in the trip generation rates of the different religious institutions in the USA. The trip generation rates in South Africa may differ from that provided by the ITE due to different levels of car ownership, mode choice, and number and distribution of worshipers. Therefore, it is important to develop specific local trip generation rates. This research attempted to determine the trip generation and parking demand rates of suburban mosques in the greater Cape Town area of the Western Cape. Urban mosques such as in the Central Business District were not surveyed, as they serve mostly pedestrians and do not cause specific traffic problems.

2 METHODOLOGY

The methodology followed was similar to that provided by the ITE Trip Generation Handbook (2012) and the TMH 17 manual (COTO 2013) on trip generation studies. The survey method was adapted to local conditions, characteristics and uses of mosques in South Africa. There are two categories of mosque in South Africa. Mosques in both categories host the daily prayers shown in Table 2 with the difference between the two categories being that the larger mosques host the weekly Friday midday prayer as well as well as the daily prayers. These larger mosques that host the congregational Friday midday prayers are referred to as Jumua mosques. (Alternative spellings include Jummah, Jumu'ah, Juma and Jama). Depending on the proximity of other mosques or the agreements made by the Muslim communities of the area, a specific mosque will be designated to host the Friday midday prayer in an effort to promote unity amongst the Muslim communities. These Jumua mosques have different trip generation and parking demand than community mosques (non-Jumua mosques) and the two types were surveyed independently.

2.1 Mosques in suburban areas

The focus of the study was on mosques located in suburban areas as it is unlikely that a new mosque will be built in a CBD or rural area. It was assumed that a new mosque would most likely be built in suburban areas. For the purpose of this study, a suburban area was defined as primarily residential area consisting of dwelling units as well as small businesses and shopping centres. The steps which were followed in this study are:

- The first step in a survey is to determine the critical day and time. The detail of determining the critical survey period from the different use patterns are provided in section 2.4.1 and was determined to be on a Friday between 12:45 and 13:45.

- The next step was to identify suitable mosques in the Cape Peninsula region and to determine if the identified mosque hosts the Friday midday prayers or not. The Imam (Leader) or custodian of the mosques was contacted and a suitable Friday was scheduled to survey without any additional special events, such as weddings or funerals which would affect the results of the survey.

- Thereafter, suitable independent variables to base the trip generation and parking demand rate on were selected. The details of selecting suitable independent variables are provided in section 2.4.2.

- More information was then gathered on the area in which the mosque was situated, in order to identify any factors that might influence the results of the survey. Factors included the estimated size and distribution of the Muslim population in the surrounding area and the proximity of the mosques to any local business district.

- After selecting a suitable sample size and identifying the suitable mosques, the mosques were surveyed. Further details on the surveying of the mosques and the counting method used are provided in section 2.4.3. Mosques in similar conditions and environments were later compared in order to establish relationships between the dependent and independent variables.

2.1.1 Mosques that host Friday midday prayers

When there are multiple mosques in close proximity, the largest mosque is usually chosen as a Jumua mosque to host the Friday midday prayers. These mosques were the most important to survey, as their operations affect the local street traffic operations.

2.2.2. Mosques that do not host Friday midday prayers

Non-Jumua mosques are usually small mosques that were built for the convenience and benefit of a small community, which may form part of a larger city-wide community. As a result, these small mosques do not have the functional capacity of the larger Jumua mosques and as such, do not host the Friday midday prayer. As a result, the vehicular trip generation and parking demand of non-Jumua mosques are much lower than that of Jumua mosques.

People living outside of walking distance to a mosque may perform their daily prayers at home.

2.2. Mosques in CBD and urban areas

The vehicle trip generation and parking requirements of mosques in metropolitan and local CBDs and dense urban areas were considered to be omitted for this study. It is assumed that most of the trips to mosques in these areas originating within walking distance to the mosques. It was assumed that worshippers in business districts would park their vehicles at their workplace or residential buildings and walk to the nearby mosque to perform their prayers, due to the general lack of parking in these congested environments. Walking to the mosque is considered a virtue, as it is part of the process to humble the worshipper in preparation for the prayers.

When a business district does not have a mosque located within the area, the mosques located on the outskirts of the business district would then have to provide for those worshippers. These mosques are predicted to require the most on-site parking as they would attract all the trips generated by the business district as well as the local area in which the mosque is located. These suburban mosques were thus the focus of the research.

2.3. Mosques in rural areas

Mosques located in rural areas such as farmlands, where the population figures are low, are usually small and referred to as prayer rooms. These mosques do not host the Friday midday prayer as it generally does not, by Islamic law, fulfil the minimum requirements of having 40 adult males present during the Friday midday prayer. Due to the small size of the population, it is assumed that the trip generation and parking demand of these mosques are low. Parking demand for these mosques could be estimated based on that of non-Jumua mosques located in suburban areas. However, this may be an overestimate. It can safely be assumed that traffic and parking problems in rural areas are typically less intense than in metropolitan areas, due to lower background traffic volumes and increased availability of land.

2.4. Details of the survey methodology

2.4.1. Choosing the critical survey period

Mosques in South Africa are mainly used as a place of worship. They also serve as community centres for community meetings, classes (lectures), funerals and weddings. Table 2 summarises the main uses of mosques in South Africa for both Jumua and Non-Jumua mosques. These uses include the five daily prayers spread throughout the day. On Fridays, the midday prayer is replaced by a special Friday midday lecture and prayer. The other specific uses of mosques (Eid-Ul-Fitr and Eid-Ul-Adha) are on the two annual Islamic holidays when a lecture followed by a prayer is given.

Table 2: Summary of mosque uses

Use	Frequency	Starting time	Duration
Jumua mosques			
Morning prayer	daily	Before sunrise	20 - 30 min
Midday prayer	daily	13:00	20 - 30 min
Afternoon prayer	daily	*Between 15:30 and 17:00	20 - 30 min
Nightly prayer 1	daily	After sunset	20 - 30 min
Nightly prayer 2	daily	+1 hour after sunset	20 - 30 min
Friday midday prayer	weekly	**Between 12:40 and 13:00	60 - 90 min
Eid-Ul-Fitr	annually	**08:00 /09:00	60 - 90 min
Eid-Ul-Adha	annually	**08:00 /09:00	60 - 90 min
Non-Jumua mosques			
Morning prayer	daily	Before sunrise	20 - 30 min
Midday prayer	daily	13:00	20 - 30 min
Afternoon prayer	daily	**Between 15:30 and 17:00	20 - 30 min
Nightly prayer 1	daily	After sunset	20 - 30 min
Nightly prayer 2	daily	+1 hour after sunset	20 - 30 min
***Eid-Ul-Fitr*	annually	**08:00 /09:00	60 - 90 min
***Eid-Ul-Adha*	annually	**08:00 /09:00	60 - 90 min

* Depending on the season

** Depending on the mosque

For Jumua mosques, the critical events taking place at the mosque that generates the most traffic are the two annual Islamic holidays and the weekly Friday midday prayers. Other events were considered insignificant in terms of trips generated and parking required, compared to these three events. The Islamic calendar has two main holidays throughout the year, namely Eid-Ul-Fitr and Eid-Ul-Adha, which are each equivalent to the Christmas holiday. Eid-Ul-Fitr is held at the end of the Islamic month of Ramadan and Eid-Ul-Adha is held during the 10th day of Thul-Hijja (the last month of the Islamic calendar). The Islamic calendar is based on a lunar calendar that fluctuates throughout the Gregorian calendar and as such, the holidays could fall on any day during the week or weekends. During these holidays there are special lectures and prayers held at the mosque between 8:00 and 11:00, depending on the mosque. During the Islamic month of Ramadan, the attendance increases for all prayers, including the weekly Friday midday prayers, held at the mosque. The increased attendance during the month of Ramadan is similar to the increase in attendance seen at the churches during the Christmas holiday. These events are not considered the design condition for trip generation and parking, being exceptional events.

The critical event at the mosque is the weekly Friday midday prayers, which takes place between 12:40 and 14:00, depending on the mosque. This event is considered the design condition as it is a regular occurrence. Attendance to the weekly Friday midday prayers is

considered compulsory on all adult Muslim males by Islamic laws. The Friday midday prayer, from 12:45 to 13:45, was thus chosen as the critical study period for Jumua mosques. Due to the attendance of the Friday midday prayers being compulsory for adult male worshippers, a greater number of people are expected to attend the prayer. Also, the Friday midday prayers take place during the weekdays and should, therefore, have a greater impact on the road network as it may fall into network midday peak period traffic.

The traffic characteristics of non-Jumua mosques (community facilities or prayer rooms) are significantly lower than that of the Jumua mosques. Table 3 shows the survey results of a non-Jumua mosque during a normal weekday and weekend to illustrate. The higher number of attendance over weekends takes place while the road network has adequate capacity and the impact is fewer than during normal weekday conditions.

Table 3: Survey results of a suburban non-Jumua mosque

Prayer time	**Average number of vehicles parked at the mosque**	
	Weekdays	**Weekends**
Morning prayer	7	9
Midday prayer	10	18
Afternoon prayer	12	15
Nightly prayer 1	0	34
Nightly prayer 2	2	22

From Table 3 it can be seen that there is a peak during the weekend for the first nightly prayer. The peak hour for non-Jumua mosques is between 18:30 and 19:30 on weekends.

2.4.2 Selecting a suitable independent variable

The ITE (2012) and the Ministry of Rural Affairs of Saudi Arabia's trip generation rates for mosques (Al-Fouzan, 2010) and other religious institutions are based on available floor space of the institution. The TMH 17 (COTO 2013) trip generation rates of churches and synagogues are based on available seats within the institutions.

This research looked at a range of different independent variables that would be easily measurable and would represent the trip generation and parking demand data, due to the uniqueness of mosques in South Africa. The independent variable used by ITE is floor space (area).

An equivalent variable would be the number of available prayer spaces in the mosque, as this would eliminate any floor space that would not attract any trips such as storage space, lobbies or ablution facilities. The prayer spaces are approximately 0.6 m by 1.2 m. This translates to 138 prayer spaces per 100 m^2 of prayer space.

Caution should be exercised when surveying these independent variables as they may have large margins of error (due to over or under utilisation) and may cause the vehicle count to be over- or underestimated.

The size of a mosque in South Africa is usually determined by the demand for the mosque. However, it was found that mosques in the Cape Peninsula region mostly operated over capacity: worshippers attend the Friday prayer regardless of the available floor space of the mosque. At the mosques that are operating over capacity, some members pray outside the prayer area in corridors, reception areas and courtyards due to lack of space inside the mosque.

Due to several mosques operating over capacity, it was deemed that the available floor space of the mosque or the number of prayer spaces would not be accurate independent variables against which to measure the vehicle trip generation rate. Therefore, a different independent variable was also investigated.

The alternative variable chosen was the number of Muslim households in the surrounding area. This variable was initially identified in the results of interviews done during the study of the trip attraction of mosques in the city of Al-Khobar, whereby the main attraction to a specific mosque during the Friday midday prayer was the proximity of the mosque to the homes of the people attending the mosque (Ratrout, 2009). This local information was readily available from the respective Muslim communities and was considered to provide accurate vehicle trip generation and parking demand data. It was postulated that for each Muslim household in the area, a maximum of one vehicle trip would be made to the mosque during the Friday midday prayer households that were located outside of walking distance (1 km) to the mosque. It was assumed that members of the same household attending the prayer would share the same vehicle. Factors that would influence whether a vehicle would be used to travel to the mosque consist of the proximity of the households to the mosque, and the income class of the households. Modal share was omitted to be conservative. These factors were not investigated in this research and it is recommended that further studies be done on these factors.

In the event that the prayer spaces inside the mosques are not demarcated on the floor, the results are also represented in terms of the third variable, the total prayer floor area. This is the variable used by ITE.

The trip generation rate and parking demand of the mosques were also expressed as a function of the number of worshippers attending the Friday midday prayer. This number of worshippers was based on the observations of the Imam or mosque management on the day of the survey. This independent variable measures actual usage and can be used as surrogate for the number of prayer spaces (or converted to floor space) for planning purposes to calculate traffic impact of full utilisation of a proposed mosque.

2.4.3 Counting method used when surveying the mosques

Due to the unusual parking arrangements of some mosques, for example shared parking with surrounding institutions such as schools and shopping centres, a different method to the counting methods proposed by the ITE and the DOT when conducting surveys was used. The counting method used is similar to that of the study done in the city of Al-Khobar, Saudi Arabia (Ratrout, 2009). When surveying the mosques, the vehicles parked on the mosque complex and the surrounding streets were counted before, during and after

the critical study period. The number of vehicles which specifically came to the mosque was then calculated as the difference between the number of vehicles parked during and the average number of the vehicles parked before and after the critical study period.

In order to determine where the vehicle trips originated from, the license plate number of the surveyed vehicles were recorded, and any vehicles' license plate number that did not correspond with the local municipality license plate code were assumed to have originated from outside the area that the mosque serves. These trips were assumed to be from those worshippers who work in the surrounding areas and attend the mosque closest to their workplace.

2.5 Parking demand

Parking demand is the number of parking spaces required, for the purpose of attending worship facilities in the period after the start of the proceedings. The percentage of drop-off trips observed during the critical peak hour was almost zero. Therefore drop-off parking was omitted. The parking demand for mosques in the Cape Peninsula was thus considered to be equal to the vehicular demand trips. Therefore one vehicular demand trip equals to the demand for one parking bay with the duration of occupancy directly related to the duration of attending the mosque. As a result, the parking demand would be based on the same independent variables as the trip generation rate and have similar values.

3 SURVEY RESULTS: JUMUA MOSQUES

Table 4 provides a summary of all the survey results.

Table 4: Survey results summary of Jumua mosques

Jumua mosque	Total house holds	No. of prayer spaces	Approximate prayer floor area m^2	No. of vehicles (Local)	No. of vehicles (Other)	Total vehicles	No. of worshippers
Blue Downs	110	200	144	68	37	105	240
Faure Street	Unknown	300	216	160	28	188	320
Macassar	120	300	216	63	29	92	330
***Faure Kramat**	85	1000	720	83	42	125	320
****Nolte Street**	**600**	**2000**	**1440**	**468**	**54**	**522**	**2150**

* Faure Kramat mosque has a large floor space relative to the households served as it is a shrine to Shaykh Yusuf of Macassar (1626 -1699) and a place of pilgrimage.
**Nolte Street mosque is in a predominantly Muslim area close to a local CBD

Table 5 shows the total vehicle trip generation and parking demand rates derived from the survey data based on the assumption that the parking demand and trip generation rate are equal for mosques. The peak hour for the trip generation rates is on a Friday between 12:45 and 13:45 and parking demand peaks at 13:00.

Table 5: Calculated trip generation rates and parking demand of Jumua mosques

Trip generation/parking demand per household				
Number of samples	**Directional Split (in:out)**	**Average rate**	**Range of rates**	**Standard deviation**
3	100 in : 0 out	0.86	0.77 - 0.95	0.08
Trip generation/parking demand per prayer space				
Number of samples	**Directional Split (in:out)**	**Average rate**	**Range of rates**	**Standard deviation**
4	100 in : 0 out	0.43	0.26 - 0.63	0.15
Trip generation/parking demand per 100 m^2 prayer floor area				
Number of samples	**Directional Split (in:out)**	**Average rate**	**Range of rates**	**Standard deviation**
4	100 in : 0 out	59.7	36 - 87	21.0
Trip generation/parking demand per worshipper				
Number of samples	**Directional Split (in:out)**	**Average rate**	**Range of rates**	**Standard deviation**
5	100 in : 0 out	0.39	0.24 – 0.59	0.12

The number of worshippers was also used to relate to the independent variables and found to be:

3.5 worshippers per household
1.1 worshippers per prayer space
150 worshippers per 100 m^2.

The ratios of vehicles from areas outside the mosque vehicle registration zone were calculated. Three of the mosques attracted between 32% and 36% of vehicles from outside, while two attracted only 11% to 15%, the latter being the Nolte Street and Faure Street mosques, where the number of businesses within walking distance to the mosque in the area are high.

4 SURVEY RESULTS: NON-JUMUA MOSQUES

The demand for attending non-Jumua mosques is lower. Therefore it is anticipated to have very few vehicles parked at the mosque during the critical survey period. Table 6 provides a summary of all the survey results.

Table 6: Survey results summary of non-Jumua mosques

Non-Jumua mosque	Number of prayer spaces	Approximate prayer floor area (m^2)	Total number of vehicles parked at the mosque
Sandvlei	130	93.6	7
Gustrouw	400	288	36
Broadlands	70	50.4	3

Table 7 shows the total vehicle trip generation and parking demand rates derived from the survey data based on the assumption that the parking rate and trip generation rate would be equal for mosques. The peak hour for the trip generation rates is on weekends between 18:30 and 19:30.

Table 7: Calculated trip generation and parking demand rates of non-Jumua mosques

Trip generation/parking demand per prayer space				
Number of samples	**Directional Split (in:out)**	**Average rate**	**Range of rates**	**Standard deviation**
3	100 in : 0 out	0.062	0.043 – 0.090	0.025
Trip generation/parking demand per 100 m^2 prayer floor area				
Number of samples	**Directional Split (in:out)**	**Average rate**	**Range of rates**	**Standard deviation**
3	100 in : 0 out	8.64	5.95 – 12.50	3.43

5 DISCUSSION AND CONCLUSIONS

5.1 Jumua mosques

Jumua mosques are designated as regional mosques for the Friday midday prayers to ensure unity among worshippers. The trip generation rates and parking demand for the Jumua mosques in this research are based on the current demand for the mosques, regardless of the supply capacity or size of the mosques.

It was found that as the number of households in the area increase, the number of vehicles parked at the mosques that originated from an area outside the area that the mosque serves decreased, with the exception of one mosque that was located just outside a local CBD. This allowed for a relationship to be established between the total number of vehicles parked at the mosque and the number of Muslim households in the area.

Site observations showed that all of the vehicles attracted to the mosque for the Friday midday prayer, park in the proximity of the mosque. The trip attraction could therefore be equated to the parking demand.

The directional split in the peak hour was 100:0, as the trips are generated in the hour before the start of the prayer, the vehicles are parked for the duration of the prayer and then depart at a slower rate after the prayer.

The average vehicle trip generation rate for the Jumua mosques in terms of the number of Muslim households in the area was 0.86 trips/household. This is also the parking demand, assuming that each Muslim family that lives outside of the walking distance to a Jumua mosque, and owns one or more vehicles, would take one vehicle to the closest mosque and park at the mosque for the Friday midday prayer between 12:45 to 13:45.

The average vehicle trip generation rate for the Jumua mosques in terms of the number of available prayer spaces was 0.43 trips/prayer space. However, due to 4 out of the 5 mosques that were surveyed operating over capacity, this trip generation rate may be an overestimation of the trip rate. The trip generation rate per worshipper of 0.39 is a better indication of the demand.

The average vehicle trip generation rate for the Jumua mosques in terms of total prayer floor area was found to be 59.7 trips/100 m^2 prayer floor area.

5.2 Non-Jumua mosques

It was found that the average vehicle trip generation rate for the non-Jumua mosques in terms of the number of available prayer spaces was 0.062 trips/prayer space. This could be valid as non-Jumua mosques operate below capacity.

The average vehicle trip generation rate and parking demand for the non-Jumua mosques in terms of the total prayer floor area was found to be 8.64 trips/100 m^2 prayer floor area. The peak hour for the trip generation rates is on weekends between 18:30 and 19:30. Non-Jumua mosques require much less parking than Jumua mosques due to the fact that people living outside of walking distance to the non-Jumua mosques are more likely to perform their prayers at home. As illustrated in the Broadlands mosque survey, this mosque with capacity of 70 prayer spaces had a demand for only three parking spaces.

Non Jumua mosques that have capacity in excess of 40 prayer spaces may however be designated as Jumua mosques if persistent overcrowding is experienced at current designated Jumua mosques. These mosques can host the Friday midday prayer as it generally can, by Islamic law, fulfil the minimum requirements of having 40 adult males present during the Friday midday prayer.

The typical town planning scheme will not distinguish between these categories of mosques. For land use control and traffic engineering management, all mosques should conform to the parking requirements and the traffic impact of a Jumua mosque and should base its trip generation rates on that of Jumua mosques.

6 RECOMMENDATIONS

From a design point of view, the use of the average trip generation rates or parking demand implies that the design conditions will be satisfied 50% of the time. Designs are typically based on the 85th percentile. An estimation of the 85th percentile of a normal distribution is given by adding the standard deviation to the average. The number of surveys in this research is too few to claim a normal distribution of the averages. However, to make a conservative prediction on trip generation and parking demand, the proposed design values are given in Table 8 as the average plus standard deviation of the surveyed values, which are rounded up to logical values. The final design values are based on the number of Muslim households, the number of prayer spaces and the prayer floor space. These values are recommended for all mosques with capacity of more than 40 prayer spaces.

Table 8: Proposed values for trip generation and parking demand for suburban mosques with a capacity of more than 40 prayer spaces

	Vehicle trip generation rate	Parking demand
Per Muslim household	1	1
Per prayer space	0.6	0.6
Per 100 m^2 prayer floor space	80	80

The design parameter that will be best suited for incorporation into town planning schemes or trip generation manuals is per 100 m^2 of prayer floor space.

Directional distribution is 100% in during the peak hour on Friday between 12:45 and 13:45 and parking demand peaks at 13:00.

Mosques with less than 40 prayer spaces (30 m^2) will generate less traffic than what is required for a traffic impact study. The nature and scope of such small mosques is to serve the immediate surroundings and worshippers who will walk to the mosque.

7 REFERENCES

Al-Fouzan, S.A., 2010. Parking provision requirements according to type of land use in major Saudi Arabian cities. Dirasat: Engineering Sciences, 36(2).

COTO. 2013. South African Trip Data Manual, TMH 17. Committee of Transport Officials. Pretoria: The South African National Roads Agency Limited

Institute of Transportation Engineers. 2012. Trip Generation Manual. 9th Edition. Washington D.C.

Ratrout, N.T., 2009. Estimating Grand Mosque Attraction of Vehicular Trips. Institute of Transportation Engineers. ITE Journal, 79(6), p.40.