

A Look into Some Traffic Characteristics of Friday Mosques: Case Study of Jeddah City

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ABSTRACT. The traffic pattern on Fridays is characterized by being low to moderate when compared with other weekdays traffic. Large mosques however, attract many trips for people performing Friday Prayers, and thus can be considered a major generator of traffic on this day.

The purpose of this paper is to present the results of a transportation study conducted in Jeddah City with the aim of investigating the traffic characteristics at Friday mosques. A sample size of twenty five mosques was selected based on capacity and geographical distribution. The mosques' capacities ranged from 500 to 2750 persons. Specific data pertaining to traffic generated by each mosque were collected on Fridays by the study team over a period of six months. The collected data were of two types: 1) variables pertaining to the mosque characteristics which included capacity in terms of persons, number of vehicles generated, and mosque environment, number of vehicles generated, and mosque environment, and 2) variables which describe the characteristics of the people such as mode of arrival, vehicle occupancy, travel time, reasons for mosque choice, and frequency of visits.

The data were analyzed and a regression model was developed which relates the parking demand to the mosque capacity. Other findings of the study showed that the travel time of a high percentage of people is less than ten minutes and the primary reason for choosing the mosque is its closeness to the residence.

Introduction

Prayer constitutes the second pillar of Islam and is considered the foundation of religion. Besides the five daily prayers which are compulsory for every Muslim, Friday

Prayers is considered as the weekly convention of all Muslim Communities. This prayer falls at the same time as that of the noon prayer, and it takes place at large mosques.

The mosque is considered as the major dominant element in designing residential areas or towns. As a symbol of religion, the place where prayers are offered, and as a center of daily life of Islamic communities, it should be given the utmost consideration and highest priority in the various planning projects. Issues related to its accessibility, traffic circulation, and parking spaces are important planning elements^[1].

Weekend in Saudi Arabia takes place on Thursdays and Fridays, and the traffic volume on these two days is characterized by being low to moderate. However, on Friday many people perform congregational prayers at about noon time. Thus, Friday mosques become major generators of thousands of trips which take place between homes and mosques utilizing vehicular mode or walking.

Due to the peaking nature of traffic at noon time on Fridays, a high demand on parking spaces at mosques and surrounding areas arises. Many people utilize the streets near the mosques' vicinity for parking purposes. This phenomenon puts a burden on these streets by reducing their capacity and consequently causes congestion.

The purpose of this paper is to present the results of a transportation study, which was conducted in Jeddah city with the following two aims; 1) To measure the amount of traffic generated by selected Friday mosques, and 2) To investigate typical characteristics of the people performing Friday prayers as well as some features of these mosques.

The results and findings of this study can be utilized by transportation engineers and city planners as a policy tool in planning and parking requirements at Friday mosques in new residential developments.

Classification of Mosques

Islamic cities in general and Saudi cities in particular are characterized by the existence of many mosques which have different functional purposes. Generally speaking mosques are classified into three categories^[1] :

1) Small (local) mosques, which represent the nucleus of housing groups or residential clusters whose population ranges between 500 and 1500 inhabitants. The recommended walking distance from dwelling to such a mosque lies between the limits of 150 to 200 meters. These mosques are used for the five daily prayers.

2) Friday (congregational) mosques, which are located in the center of neighborhoods whose population ranges between 3000 and 8000 inhabitants and where such mosques are the dominant feature of the neighbourhoods. The recommended walking distance to a Friday mosque is in the range of 250 to 300 meters. The mosques are used for Friday as well as daily prayers.

3) *Eid mosques*, which are only used for prayer on feast days and related religious

ceremonies, at the town level. It is preferable to locate Eid Mosques on the outskirts of the town in large open spaces and, therefore, they would be accessible by vehicles. In case of towns whose population exceeds 100,000 inhabitants, there may be more than one Eid mosque, and in such a case the Friday mosque of the residential district may also be used as an Eid mosque.

Table 1 shows the number of mosques by each classification type in the largest five cities in the Kingdom of Saudi Arabia.

TABLE 1. Total number of mosques by classification in the largest five urban areas in Saudi Arabia.

City	Population in (Thousands)	Area in (Hectares)	No. of mosques by type			Total no. of mosques
			Small	Friday	Eid	
Riyadh	1417	49550	1247	423	6	1676
Jeddah	1312	30809	516	153	16	685
Makkah	700	5900	251	42	1	294
Madinah	500	24980	341	16	1	358
Dammam	419	44008	256	91	4	351

Source : Reference [2].

Characteristics of Friday Mosques

Friday mosques have several particular characteristics which need to be considered when conducting transportation studies. The following are some of the most important characteristics :

- 1) Friday mosques generate a substantial number of trips although the urban activities are minimal on this day.
- 2) Walking and private vehicles are the most observed travel modes which are used by the majority of worshipers.
- 3) The mosque is an important element of the social life of the community, thus some other activities such as public lectures usually take place at large mosques.
- 4) The amount of travel to mosques is a function of some factors. The size and location of the mosque are among the most important factors.
- 5) Parking facilities are usually limited at Friday mosques.

Methodology

The Municipality of Jeddah divides the city into approximately 55 districts having different residential densities. These districts were aggregated into 10 zones, which were considered as the analysis units in this study. The aggregation process was based on the geographical distribution of the mosques located in the adjacent districts in such a way that different mosque sizes are present in each zone. The mosques were selected randomly from each zone with a total of 25 mosques comprising the study sample size.

To collect the necessary data a special questionnaire was designed and addressed the following information; mode of arrival, vehicle occupancy, travel distance, frequency of visits to the same mosque and reasons for choosing the mosque. This questionnaire was distributed to the worshipers before they entered the mosque to perform their prayers and then it was collected immediately after the prayer.

The number of questionnaires which were distributed at each mosque were proportional to the mosque capacity. This proportionality was based on a guideline assumed for this study and it is shown in Table 2. However, the total number of questionnaires which were distributed during the course of the study was approximately 3500.

TABLE 2. Sample size of required questionnaire responses.

Capacity of mosque	Sample size
Less than 1000	10%
Less than 1500	9%
Less than 2000	8%
Less than 2500	7%
Less than 3000	6%
Less than 3000	5%

Data Collection

The study area, Jeddah city, is the second largest city in the Kingdom of Saudi Arabia. The latest population figures of the city indicate that there are about 1.5 million inhabitants. Due to its moderate weather during the winter time and the large number of shopping centers, the city is becoming an attraction center for the surrounding regions. The Ministry of Haj and Endowments is the governmental body that is in charge of maintaining and operating the mosques all over the Kingdom. Their branch in Jeddah city estimate the total number of mosques in Jeddah at 700. These mosques are distributed over 55 districts with different capacities ranging from 100 to 3000 persons per each mosque.

The sample size which covers this study was twenty five mosques, having different capacities. Table 3 shows these mosques and their corresponding capacities. The data pertaining to this study was collected through the following means :

1. Data pertaining to the mosques such as their capacities, sizes and location were obtained from the city's branch of the Ministry of Haj and Endowments.
2. Data concerning the people coming to perform prayers were collected through a questionnaire distributed to a sample of worshipers at each mosque by the study team. The condition of the mosque was also recorded at this stage.
3. Number of vehicles coming to each mosque was collected through field counting by supporting personnel.

TABLE 3. Capacity and number of counted vehicles for selected mosques in Jeddah city.

Mosque name	Capacity of mosque (No. of worshipers)	Number of vehicles
1) Bin Laden	2650	1300
2) Al-Shoaybi	2100	1000
3) Prince Metab	2800	1000
4) Al-Ferdous	1200	500
5) Al-Rawabi	1450	600
6) Al-Amodi (1)	600	250
7) Al-Shareef	750	300
8) Fatemah Al-Zahra	1650	500
9) Al-Johayni	550	100
10) Ibn Maleh	550	150
11) Al-Amodi (2)	1500	500
12) Al-Saber	1000	200
13) Prince Mohamed	1100	200
14) Hassan Enani	1200	500
15) Othman Bin Afan	630	200
16) Faraj Almosaed	1520	600
17) Abu Dawood	1100	400
18) Al-Qubah	1800	800
19) Kilo-Six	800	250
20) Al-Howiash	900	400
21) Al-Nour	600	230
22) Zaini	830	200
23) Al-Dahran	750	150
24) Al-Fetahi	2330	1200
25) Al-Akhawian	850	150

This study was conducted over a period of six months, which started in May and ended in October. The summer season with its high temperature and humidity falls within this period in Jeddah city.

Findings and Results

The total number of worshipers who responded to the questionnaire was about 2000 persons. However, out of these responses there were about 500 forms which gave limited information and accordingly were eliminated from the sample size. This means that our sample size is 1500 out of 3500 which leave us with about 43% response rate. This is an average of 60 responses at each mosque. The total number of vehicles which were counted during the study period at the twenty five mosques were about 12,000 vehicles with an average of 480 vehicles at each mosque.

The results of the analysis of the data collected are presented in the following sections. Figures 1 through 4 present the results obtained from the average of all 25 mosques.

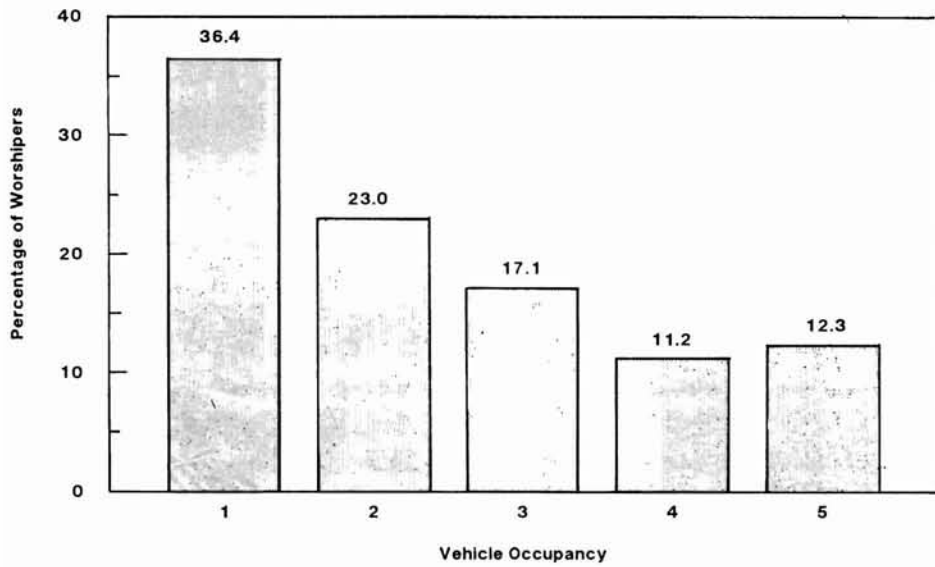


FIG. 1. Percentage of worshippers versus vehicle occupancy.

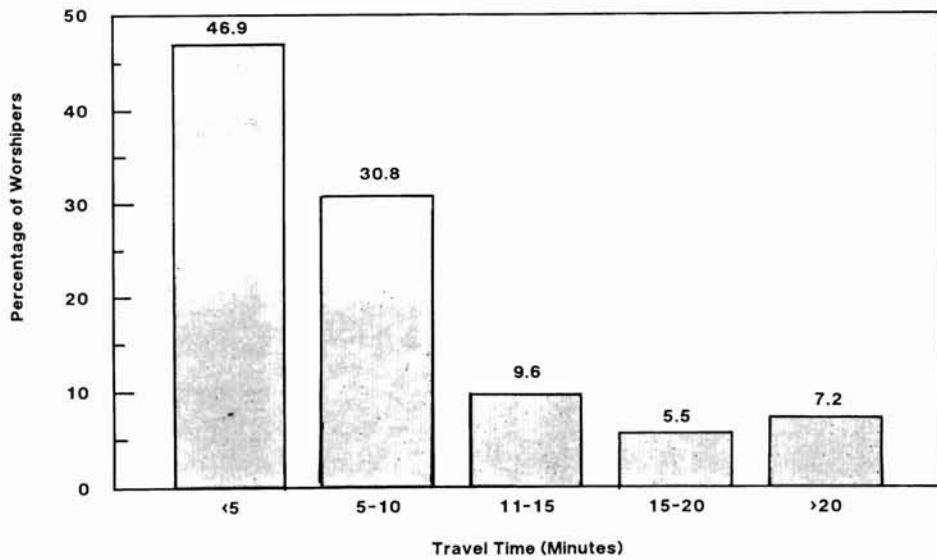


FIG. 2. Percentage of worshippers versus their travel time.

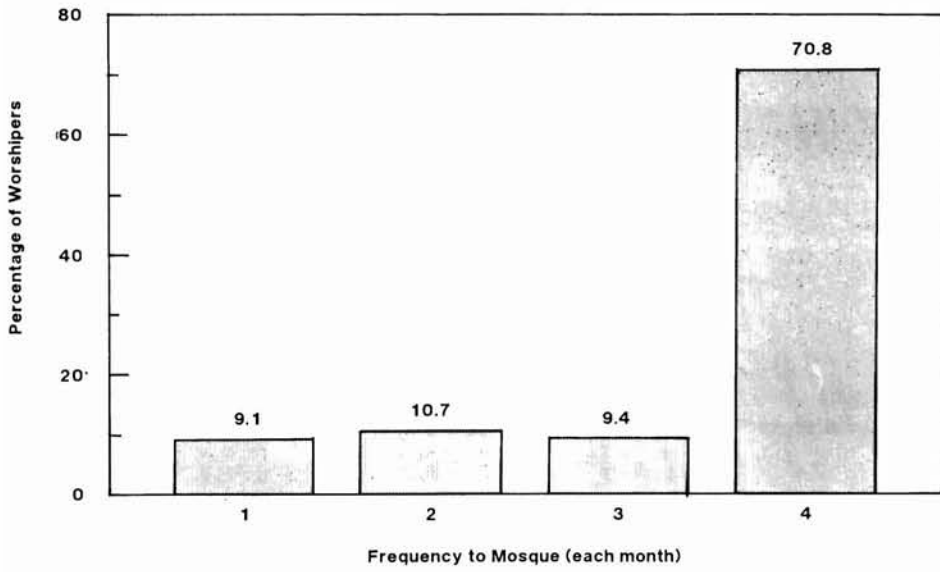


FIG. 3. Percentage of worshippers versus their frequency of visits.

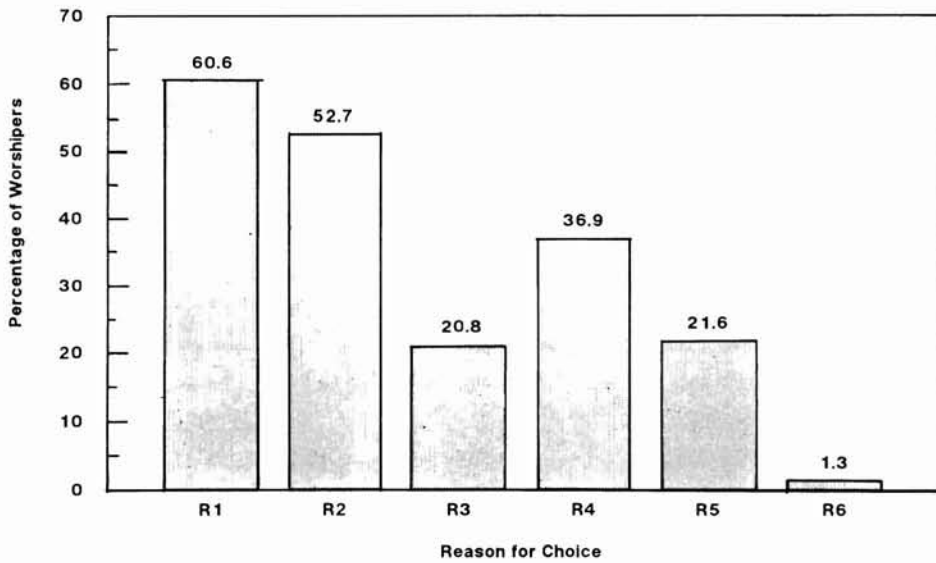


FIG. 4. Percentage of worshippers versus their reasons for choice of mosque.

1. Parking Demand

Table 3 shows the data collected which represents the capacity of each mosque and the total number of vehicles generated. This data is utilized to estimate the number of parking spaces which should be provided and may be recommended for Friday mosques. The method of least square error^[3] was used to obtain a simple linear regression equation from which the required number of parking spaces could be estimated as a function of mosque capacity. The following regression model was obtained :

$$\text{Number of parking spaces} = -153.7 + 0.497 \text{ mosque capacity}$$

$$(R^2 = 0.8951 \text{ and } t\text{-value} = 14.21)$$

2. Mode of Arrival

It is more rewarding for worshipers to reach the mosque walking, thus it is expected that the majority of the people are arriving on foot walking. However, since most of the data collection took place during the summer months when high temperatures prevail, the data has shown that above 40% of prayers came to mosques walking, while 60% used their vehicles.

3. Vehicle Occupancy

It is the responsibility for the household's head to accompany his children to perform Friday prayers. Figure 1 shows five different vehicle occupancy ranges with their corresponding percentage of worshippers. The figure indicates that vehicle occupancy of one person constitutes about 36% and an occupancy of two persons constitutes 23% of the total number of worshippers. Approximately 40% of vehicles had an occupancy rate of three persons or more.

4. Travel Time

The percentage of the worshippers with respect to travel time from their residence is shown in Fig. 2. The data show that about 78% of the people are within 10 minutes from their residence. This short travel time may be explained by the fact that most of the people are living within the zone of the mosque.

5. Frequency of Visits

This variable indicates how many times the person answering the questionnaire comes to this particular mosque each month. Figure 3 shows the percentage of worshippers and their corresponding frequency of visits to the mosque. Although the person can perform his prayers any where he wishes, this figure shows that about 71% are going to the same mosque each month. This high percentage can be explained by the fact that most people are going to those mosques located within their proximity.

6. Reason for Choice

This study assumes that worshipers choose which mosque they attend for different reasons. The questionnaire has listed six reasons from which the worshiper may

choose one or more. These six reasons are: 1) Closeness to the mosque – R_1 , 2) The prayer leader (Imam) – R_2 , 3) Availability of parking – R_3 , 4) Cleanliness of mosque and availability of air conditioning – R_4 , 5) Accessibility of the mosque – R_5 and 6) Other reasons – R_6 .

Figure 4 shows the different reasons for choices and the corresponding percentage of each choice. The primary reason for choosing the mosque is its closeness to the residence followed by the desire of the worshippers to be led by certain Imams. Cleanliness of the mosque and availability of air conditioning seems to be an important reason for choice.

Conclusion

Friday Mosques attract very large number of home based trips which require substantial parking spaces. Construction of large parking facilities near Friday Mosques is economically unjustified because Friday Prayers duration is of a short period, therefore concepts of Transportation System Management (TSM) should be utilized. Encouraging ride sharing programs and walking mode are just two examples of TSM solutions which could be implemented at no cost.

References

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- [2] **Ministry of Municipality and Rural Affairs**, *Atlas of Saudi Cities – Existing Situation*, First Edition, Riyadh (1987).
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نظرة في بعض خصائص حركة السير لمساجد الجمعة : حالة دراسية لمدينة جدة

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المستخلص . تمتاز الحركة المرورية في مدن المملكة خلال يوم الجمعة بالانخفاض النسبي مقارنة بأيام الأسبوع الأخرى ، إلا أن مساجد الجمعة تستقطب الكثير من الرحلات لمصلين يؤدون صلاة الجمعة ، وبالتالي يمكن اعتبارها المستقطب الرئيس للحركة المرورية خلال هذا اليوم .

تهدف هذه الورقة إلى تقديم دراسة نقل تمت في مدينة جدة كان الغرض منها تقصي خصائص الحركة المرورية المتجهة إلى مساجد الجمعة ، حيث تم اختيار ٢٥ مسجدًا كعينة لجمع المعلومات اللازمة لهذه الدراسة وكان الاختيار بناء على سعة المسجد والتوزيع الجغرافي في المدينة . وقد شملت العينة المساجد التي تتراوح سعتها بين ٥٠٠ و ٢٧٥٠ شخص . وقد جمعت المعلومات اللازمة للرحلات المستقطبة إلى المساجد خلال فترة امتدت ستة شهور . والمعلومات التي تم جمعها تنقسم إلى نوعين : (١) معلومات تتعلق بخصائص المسجد مثل سعته ، أعداد المركبات المستقطبة والخدمات المتوافرة في المسجد ، (٢) معلومات عن خصائص المصلين مثل واسطة التنقل ، معدل حمولة المركبة ، زمن الرحلة وأسباب اختيار المسجد وعدد مرات التردد عليه .

وقد تم تحليل المعلومات وأمكن استنباط معادلة انحدار خطي تربط بين كمية الطلب على المواقف وسعة المسجد . ومن النتائج الأخرى للدراسة ، الإشارة إلى أن زمن الرحلة لنسبة عالية من المصلين هو أقل من عشر دقائق ، وأن السبب الرئيس لاختيار المسجد هو قربه من المسكن .