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THE EVALUATION OF PEDESTRIAN FACILITIES ON HAJJ CROWD BETWEEN ARAFAT AND MUZDALIFAH PEDESTRIAN STREET

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Abstract

Makkah is the holy city of Muslims which is located in the southwest of Saudi Arabia. It is the being visited by pilgrims from all nationalities every year for the annual Islamic Pilgrimage (*Hajj*). *Hajj* is the fifth pillar of Islam which is the largest annual religious pilgrimage event in the world. The Hajj management authority specifies that the current pilgrimage's performance is challenging due to the increase of pilgrims every year. Pedestrian conflicts and uncomfortable walking environment are the crucial issues that have been identified, which are due to insufficient pedestrian facilities. Hence, this paper presents the pedestrian facilities assessment between *Arafat* to *Muzdalifah* road. The objectives of the study are to determine the available pedestrian facilities for pilgrimage from *Arafat* to *Muzdalifah*, and to suggest the suitable solution for pedestrian facilities in every 5 minutes walks. Meanwhile, qualitative methods of site inventory and observation were applied to gather the related data on the selected study area. Possible pedestrian facilities design is suggested for the purpose of future *Hajj* improvement.

Keywords: Pilgrims, Hajj, crowd, pedestrian facilities

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INTRODUCTION

The meaning of *Hajj* (Meaning of Hajj), a program of movement from *Arafat* to *Muzdalifa*

The annual Islamic Pilgrimage (*Hajj*) is a unique religious gathering for millions of Muslims worldwide to be at one place (city of Makkah, Saudi Arabia) within specific days every year. Generally, *Hajj* is one of the five pillars of Islam, and it is a set of worship act to be performed in and around Makkah at least once of a Muslim's lifetime who satisfies a particular condition. Felemban et.al (2020), stated that *Hajj* is the massive gathering of Muslim events with around 3 million pilgrims visit Makkah every year. The Hajj pilgrimage consists of several religious rituals with complex movements. Moreover, the journey of *Hajj* usually completes over five days, and Makkah has hosted the annual pilgrimage for the last 14 centuries. According to the current statistics by the General Authority for Statistics in Kingdom of Saudi Arabia (GASTAT), the pilgrims number are expected to increase every year (Alabdulkarim et al., 2016) .

Understanding crowd management in the context of *Hajj*

In the normal condition of *Hajj* gathering , the massive pilgrims crowd had led to uncomfortable environment and uncompromised safety during the pilgrimages (Alabdulkarim et al., 2016). Crowd presence had reduced the physical bubble space of an individual and resource struggling (Gifford.2007). Pilgrims' behaviour particularly the changes of body sway had cause repetitive crowding disasters (Alnabulsi & Drury, 2014). Kingshott (2014) specified that the crowd behaviour is vary depending on social, religious, emotional, cultural composition and intentions. Handling huge pilgrim crowd's movement in the holy city is complicated (Rahman et al,2017). Upon arriving to the Holy City of Mecca, the pilgrims are bounded by specific religious obligations and event during the Hajj pilgrimage which required to be completed within specific time limit. As for consequence, in some cases, the huge crowd event had led to fatal accidents among the pilgrims. Fruin (1993) stated that crowd management is understood as a systematic planning for the arranged movement and assembly of members as people. Therefore, the improvement on pedestrian facilities provided is essential to ensure smooth flows of the pilgrim's event and comfort. In fact, providing an excellent service for pilgrims is among the main concern of Saudi's *Hajj* management (Yamin & Albugami, 2014). The fact that it is quite challenging to alter the pilgrim's facilities considering the pilgrims health, safety, and security, however, this effort will bring benefit to the future pilgrims.

LITERATURE REVIEW

Pedestrian movement and traffic condition during Hajj

Makkah is still expanding, and the Hajj pilgrims is expected to rise up to 5 million according to the vision of 2030 (Saeed et al., 2021). However, due to Covit-19

pandemic, the Saudi government had announced that there is no Hajj in 2020 until further notice. To handle the pilgrim crowds, the Saudi government has constructed three mobility types that connect the old city of Mecca to the new districts by the current tunnel networks, namely i) vehicle-only, ii) vehicle and pedestrian, as well as, iii) pedestrian-only tunnels. Based on Figure 1, during the *Nafrah* of pilgrims, the pedestrian’s movement and vehicles from *Arafat* to *Muzdalifah* experience severe bottlenecks due to huge pilgrim crowd’s arrival in *Muzdalifah* after the dawn of “*Fajr*”. As a result, the *Hajj* pilgrims experience discomfort and stressful condition, as they are required to reach the next destination within stipulated time.

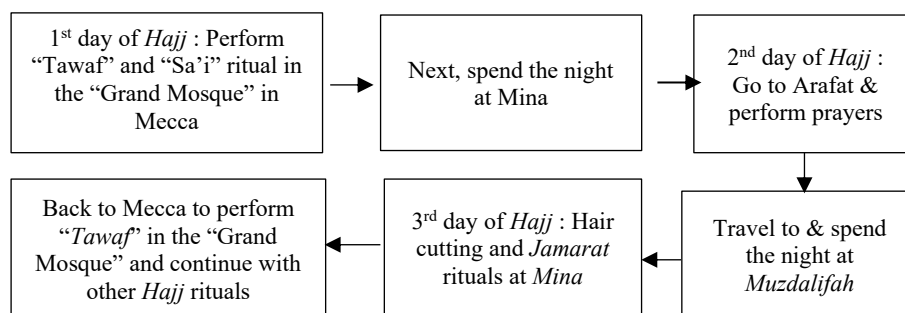


Figure 2: Main Activity of performing Hajj in *Mina*, *Arafat* and *Muzdalifah*

Source: Adapted from Yamin & Albugami (2014)

The *Arafat* is the most crowded site during the 2nd day of *Hajj*. Hence, the existing facilities at Hajj areas turn more congested due to overcrowding of pilgrims and causing limited pedestrian movements (Owaidah, et.al (2019). Abdelghany et al. (2012), estimated that the peak pedestrian flow rate between *Arafat* and *Muzdalifah* had reached 500,000 pilgrims per hour and expected to increase by years. Friberg & Hjelm (2015), emphasized that pedestrian overcrowding may lead to rushes, traffic and human bottlenecks, counter flows, stop-and-go waves, crowd turbulence, and panic among the pilgrims. Therefore, the *Hajj* traffic department had developed traffic plans, to reduce the traffic congestion, including *Nafrah* from *Arafat* to *Muzdalifah*, by constructing expensive corridors along roads for wagons (Alkharoubi, 2020). Unfortunately, this issue still remains until today. The *Hajj* authorities has specified four roads for pedestrians and five roads for vehicles to reduce the issues of critical pedestrian-vehicles conflict within the *Arafat-Muzdalifah* Road. During this time, around half a million pedestrians choose to walk to *Muzdalifah*. At sunset, a massive traffic jams with slow vehicle movement causes some passengers decide to walk for the rest of the distance.

The significant of pedestrian facilities during Hajj

Kaya (2009) emphasizes that one of the important approaches to solve the crowd tragedy is to improve the level of services on pedestrian facilities aspect. Moreover, the level of street friendliness, pedestrian safety (Sangeeth & Lokre, 2019), comfort, attractiveness and accessibility (Quednau, 2018) are strongly influenced by the pedestrian facilities provided at particular areas. Hence, it is important for the Saudi government to consider these aspects, particularly for such important event of *Hajj* pilgrimage. Indeed, street walkability increases when the street offers comfortable, safe and accessible pedestrian infrastructure to its users, (Litman (2016), Kinyingi, Mugwima & Karanja, 2020). When the street offers comfortable environment with smooth pedestrian flow and easily accessible street, the pilgrims would have more time to focus on their *Hajj* activities, without being distracted by other factors such as being lost or anxious while performing *Hajj*. Additionally, the *Hajj* crowd had resulted to stress (Alsolami, Embi, & Enegbuma 2017) and decreased of positive emotion (Kim, Lee, & Sirgy, 2015), which affect the pilgrims' satisfaction. In this study, it can be suggested that the pedestrian street for *Hajj* does not necessarily attractive. However, factors such as safety, comfortable and accessible need to be taken seriously, to ensure the *Hajj* pilgrimages efficiency.

RESEARCH METHODOLOGY

Qualitative research method of site inventory and analysis were applied to achieve the aim and objectives of this paper. Observation was made based on the prepared site inventory checklist, formulated based on previous literature reviews. Google earth mapping is produced to investigate the existing facilities on one of the walkway roads between *Arafat* and *Muzdalifah* (Saunders et al., 2018). The case study focuses on *Nafra* access roads, from *Arafat* to *Muzdalifah* (Figure 4.1). By analyzing the current facilities between *Arafat* and *Muzdalifah*, the researchers will have the ability to determine the existing services between the two locations (Langley & Klag, 2019).

Site inventory and analysis

Figure 4.1 below demonstrates the selected pedestrian route from *Arafah* to *Muzdalifah* which are divided into eleven (11) segments with 400m to 500m length each (Meenakshi, 2011; Garau, Annunziata and Yamu, 2020). Each segment was divided based on the comfortable walking range of 5 to 10 minutes walking suggested from numerous walkability study. The assessments look into either the nearest facilities provided are easy to reach or vice versa. Azmi, Karim and Amin (2012), suggested that the accepted threshold for walking to local facilities is within 400 m, while 800 m is a suggested threshold for walking to a town centre. Hence, in this study, the range of 400m to 500m were applied for

walking threshold to the pedestrian facilities provided for selected route of this study.



Figure 4.1: The location and key plan for Nafra, from Arafah to Muzdalifah
Source: Google Map (2021)

Availability and Access to Pedestrian facilities

Table 4.1 below presents the findings for each pedestrian facility provided along the selected street from Arafat to Muzdalifah for 400m to 500m range of walking.

Table 4.1: Findings on pedestrian facilities available at selected pedestrian street

Region number	Length	width	Toilets complex	Bench (Charis)	Water fountain	Health Center	Axis with the disability Road	Informational	Shaded chair	Close to the train
1	400	30	√	√	√	√	x	√	x	x
2	400	30	√	√	√	x	√	√	x	x
3	400	30	√	√	√	√	√	x	x	x
4	400	30	√	√	√	x	√	√	x	x
5	400	52	√	√	√	x	√	x	x	x
6	460	22	√	√	√	x	√	x	x	x
7	450	22	√	√	√	√	√	√	√	x
8	450	22	√	√	√	x	x	x	x	x
9	400	52	√	√	√	x	x	√	x	x
10	400	52	x	√	√	x	x	x	x	x
11	490	52	√	√	√	√	x	x	x	√

*√ - available , x – not available

Sources: Author (2021)

Pedestrian lane

Table 4.1 evidenced the pedestrian lane width provided along the route were inconsistent where segment one until four were designed with 30 m in width. Meanwhile, the fifth, and nine to eleventh were designed with 52 m in width, segment 6 until 8 demonstrated of 22 m width. The pedestrian lane inconsistent with width because certain segments were merged together. Hence, resulted in

larger pedestrian lane of 52m width, for instance segment number 5, 9, 10 and 11. Figure 4.2 illustrates the merging of pedestrian segments of number 5 and 9.



Figure 4.2: The dotted red line illustrate the merging of two sidewalk for segment no. 5 and no.9

Based on the observation, the merging of two separated pedestrian lanes shared the same pedestrian facilities and services which includes benches, water cooler, signage and lighting elements. Hence, it can be suggested that different paving material could be applied for two pedestrian lane segment that merged together to avoid discomfort and conflict among pedestrian. The safety of pilgrim is also uncompromised in *Hajj* condition as the crowds are rushing to reach the stipulated destination within limited time. Nashar (2018) highlighted that pedestrian comfort is measured through their freedom to change the body directions at any time and to walk freely whenever they feel like it without any conflict. Harun, Nashar and Bachok (2020), emphasis that street walkability is associated with other attributes such as visual quality, attractiveness, safety and comfort. In this context, safety and comfort of pilgrim are two important that need to be taken into consideration. Based on the arguments, the existing pedestrian lane width provided does not provide comfort to the pilgrims (Figure 4.3).



Figure 4.3: Pedestrian crowd along the route from *Arafat* to *Muzdalifah*



Figure 4.4: Pilgrims wait for their turn to use the toilet provided

Toilet complex

Table 4.1 evidenced only segment no.10 is not equipped with toilet facilities. However, the observation indicated that more toilets should be added to ease the pilgrims' *Hajj* journey and to minimize waiting time to use the toilet (Figure 4.4). Walking affordances are varied based on the different group ages and backgrounds. Older people have slower walking pace as compared to the younger group age. In a case of emergency, people with slower walking pace might face discomfort and difficulties. Azmi, Karim, & Amin (2012), supported that the maximum walking distance for the elderly from Asian countries or are only 190 meters, 191 m to 380 m of walking distance for children. Maximum distance for adults is from 381 m to 600 m. Over 600 meter is considered as uncomfortable distance to walk.

Benches, shaded chair and water fountain

Based on Table 4.1, the benches and water fountains are available and functional at every segment from *Arafah* to *Muzdalifah*. However, shaded chairs are only available at segment no.7. Hence, it can be indicated that the presence of shaded chair is essential, particularly in a country that experience both rainy and hot humid climate (Figure 4.5). In hotter and more humid cities, walking affordances may end up shorter in open and unshaded street. Hence, improving the walking environment by installing overhead canopies or shades can significantly increase the pedestrian comfort and willingness to walk. Indeed, shading elements in any form is essential to offer pedestrian comfort from hot and humid environment or climate (Babu, Subbaiyan & Tadepalli, 2016), helps to decrease paving heat and temperature including low albedo materials (Kasim et.al, 2019).



Figure 4.5: Pilgrims are resting under uncovered bench during rainy season



Figure 4.6: Aluminum bench material is unsuitable for hot and humid climate



Figure 4.7: Water fountain stop point provided for the use of pilgrims

In terms of water fountain, each segment has been provided with water cooler station which provides free water for the pilgrims to boost up their energy especially during hot and humid climate.

Healthcare centre, signage and proximity to train station

The presence of healthcare centre is essential to *Hajj* journey particularly during an emergency case. According to Table 4.1, few segments provided with the healthcare facilities including segment no.1, no.3., no.7 and no.11. However, the color selection for the healthcare building does not attract the pedestrian eyes and some pilgrims might overlook the healthcare building. To add, the healthcare centre signage font is unreadable from the other pedestrian lane area (Figure 4.8). The information signage on availability of pedestrian facilities and location were provided only at certain checkpoint. Nevertheless, the signage condition of font size and colors are not attractive and readable to the pilgrims (Figure 4.8). Hence, bright and contrast color for signage font can be applied to improve the signage legibility and to make it more visible for the pedestrians. The object with higher contrast, enable pedestrians to read the signage easily (Rapport, 1990). The signage readability is very crucial for those pilgrims that are not familiar with the area. This statement is supported by study conducted by Bohari, Bachok and Osman (2014), that familiarities is one of the important measures to influence the pedestrian walking speed and avoid lost in a particular destination. If the walking speed increase, less walking time is required to reach the destination.



Figure 4.8: Unattractive health centre and signage condition provided at selected segment of pedestrian route

Finally, based on Table 4.1, the results showed that only segment 11 is the nearest checkpoint to the train station, with only 400m to 450m distance away. Countries that experience hot and humid climate rely more on public transport commuters. Hence, few more checkpoints to the commuters would ease the *Hajj* journey considering the pedestrian comfort and safety of walking. As majority of pedestrians and public transport commuters depends mainly on walking as primary mode of daily travelling, it is essential for the authority to improve on pedestrian facilities and provide better public transport system. Indeed, other

studies also suggested that besides safety and accessibility, street infrastructure is one of the important design elements to ensure the pedestrian comfort. In this context the pedestrian refers to the pilgrims who is performing the *Hajj*.

Conclusion

In summary, based on the presented findings and analysis, majority of the existing pedestrian facilities provided are insufficient to support the numbers of pilgrims that keep increasing by years, coming from different countries and age groups. Modern facilities for *Hajj* are adequate for just two million people. On the other hand, since pedestrian walking affordances are vary depending on age and pilgrim's background, this research suggests the common walking radius to access the pedestrian facilities provided. The distance use to conduct the analysis, is by considering pedestrian's comfort, security, and safety for pilgrims during their movement between the holy sites which are *Arafat to and from Muzdalifa, as well as to and from Mina*) (Haase et al., 2016). It is hoped that the implication from this research would help to improve the existing condition of the busiest routes during *Hajj* pilgrimages to increase the pedestrian comfort and safety in the near future.

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