

The Effect of Social Parameters on Pedestrians' Characteristics

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ABSTRACT: Pedestrians are one of the main elements in transportation systems. So, their behaviours were investigated to find out the relationship between social parameters of a specific society and these characteristics. This study was conducted in Taif city-KSA as a case study to investigate the effect of Saudi customs on the pedestrians attitudes. General findings in relation to pedestrian age, gender, group size, and additional simultaneous activity while walking goes well with the available literature. The walking speeds are decreasing with the increase in age, group size, and the additional activity while walking. In addition, women are using the existing pedestrians' facilities much more than men and children. Also, they have less reductions rather than those for both men and children. In general, the privacy of Saudi society has significantly affected the behaviours of pedestrians. This may be a good guidance in the design of pedestrians facilities in such societies.

KEYWORDS: Pedestrians, Social Customs, Walking Trips, Walking Speed, Safety.

I. INTRODUCTION

Walking is the most efficient and effective mode of transportation for short trips. Moreover, every person is a pedestrian at some point in a day as all journeys necessarily start or end as a walking trip. The importance of pedestrian movements is understood globally and cannot be over emphasized, Kotkar et. al, [1]. The definition of "pedestrian" includes persons travelling on foot as well as those using some appliance or object to help them fulfil that action or to accompany them in fulfilling it; this definition includes pushing a pram, wheelchair, bicycle or moped (not riding), Arango, and Montufar, [2]. Pedestrian safety is one of the largest challenges to the implementation of safe system principles. There are many reasons for the low level of road safety in the pedestrian problem. For example, the roads are built for cars' mentality and the perceived costs of pedestrian safety treatments versus economic gains of vehicular traffic movement. In addition, the ongoing expansion of vehicle capacity on roads leads to ignoring the pedestrian movements with respect to overcoming traffic congestion of vehicles.

Generally, walking trips necessitate providing exclusive walk facilities such as, sidewalks and pathways, and also dedicated spaces for walking. The widths of these facilities are usually decided on the basis of pedestrian flow, which is governed by its relationship with pedestrian speed, Rajat et al. [3]. Therefore, walking speed is an important factor that must be investigated. One of the inherent factors affecting walking speed is the purpose of the trip which can be collected through interview only. The land-use activities of the surrounding area to the pedestrian facility can be used to estimate the walking speeds of pedestrians. The walking speed is also influenced by the personal characteristics of the pedestrian such as age, gender and his activity during walking. Moreover, walking in groups can also affect the walking speed. A lot of previous studies in different countries has investigated the mean speed of pedestrians and subsequently, the factors affecting this speed. The walking speeds of pedestrians reported by the various researchers are presented in Table 1.

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Table 1 Walking Speeds reported in Previous Studies

Author	Mean Speed (m/min)	Country
Tanaboriboon et al., [4]	74	Singapore
Koushki, [5]	65	Riyadh, Saudi Arabia
Koushki and Ali, [6]	71	Kuwait
Lam and Cheung, [7]	74	China
Tarawneh, [8]	80	Jordan
Finnis and Walton [9]	88	New Zealand
Kotkar et al. [1]	72	India

Previous studies like, Montufar et al. [10] revealed that walking speed of males walk is more than that for females, and this speed declines with age of the pedestrian. Moreover, walking in groups affects the walking speed significantly, Carey [11]. Fitzpatrick et al. [12] also observed that the walking speed of younger pedestrians is faster than that of older pedestrians.

It should be emphasized that, the movement of pedestrians is not only limited for the longitudinal movement along sidewalks of the roads. The movement of pedestrians across roads has to be highlighted since pedestrian crossings are the critical points in the traffic network that need to enable pedestrians to safely cross the road. The safety level depends on the type of pedestrian crossing. The differences between individual types of pedestrian crossings can be noted also in relation to other criteria such as the price, energy, environmental impact, accessibility, etc. When crossing the road, pedestrians could potentially behave in a number of ways. They could follow safe rules and procedures by e.g. waiting for the signal to indicate that they should cross or waiting for a large enough gap in the traffic to negotiate the road safely. Alternatively, they could, for example, cross without waiting the signal. They could accept small gaps in traffic and/or could walk to the middle of the road and wait there for a gap in the traffic. The same pedestrian may adopt different strategies on different occasions e.g. they are less likely to take care when the weather is bad or they are in a hurry, Martin A., [13].

The Saudi society has special customs and traditions so, these customs have direct effects on different aspects of life. Transportation systems and facilities are one of such aspects that influenced by these customs. Pedestrians are partners of urban roads so, the behaviours of these pedestrians have close relationships with the prevailing customs and traditions. On the other hand, the city of Taif is located in Saudi Arabia. It is famous for its touristic places and subsequently, many commercial centres are available to satisfy the tourists needs. Therefore, recreational and commercial land uses are the most existing activities in Taif city. In addition, educational and residential activities are also available. Moreover, a fundamental characteristic of the Saudi Society, is the high level of car ownership so, automobile dependence is relatively high. Therefore, pedestrians are at risk whenever they cross the roadways since, most of the motorist's attention is focused primarily on other motorists not on surrounding pedestrians. The degree of risk depends on the complexity of the vehicular and pedestrian traffic patterns and the information provided regarding the crossing location, direction, and duration. Data collected from Taif Traffic Administration show some statistics regarding the total pedestrian accidents as presented in Table 2.

Table 2: Statistics of Total Pedestrians Accidents in Taif City

Years	Total Pedestrian Accidents
2005	684
2006	799
2007	585
2008	578
2009	514
2010	555
2011	590
2012	458

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Moreover, the classification of these accidents based upon the time of their occurrence is also illustrated through Figure 1

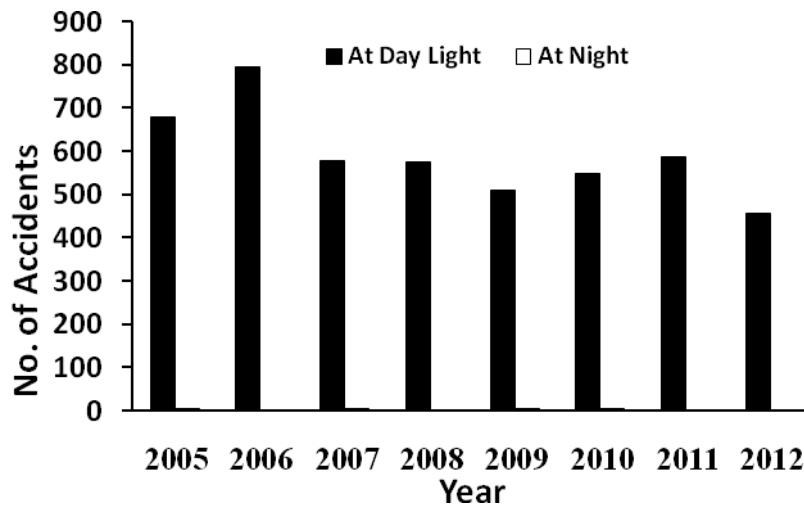


Fig. 1 Classification of pedestrians' accidents based upon the time of their occurrence in Taif City

Several significant steps have been taken to improve pedestrian safety in recent years, including the installation of a number of engineering treatments such as intersection safety cameras, pedestrian countdown timers, speed reader boards, and corner bulges, among other things. The purpose of the Pedestrian Safety Study is to help to gain a better understanding of the effectiveness of existing pedestrian safety treatments, and Therefore, optimal solution of a pedestrian crossing has to be selected based on a comprehensive and rational analysis.

II. PROPOSED METHODOLOGY

For the longitudinal movement of pedestrians, data were collected for the present study on 10 different locations in Taif city. Sidewalks and pavement widths were measured. In addition, traffic directions, land use characteristics and the existence of pedestrian facilities were also collected. On the other hand, the physical characteristics of the existing sidewalks in different selected locations were also surveyed where, the existing physical barriers and obstacles were highlighted. Many barriers were observed in different sidewalks of the investigated locations. These barriers include trees, garbage pins, stairs leading to the front yards' entrances, car ramps, projections in the front yards' walls, lighting poles, directional and/or regulatory signs and parked cars on the sidewalk. Moreover, a large number of corridors' vendors are occupying large areas along the sidewalks of the surveyed locations. Figure 2 shows some examples of these barriers. Personal characteristics of pedestrians, such as gender, associative activities such as carrying of baggage, walking using cell phone, and movements in groups of different sizes were noted and analyzed.

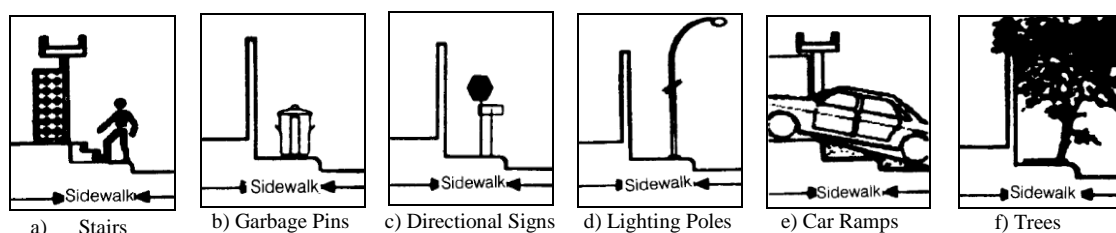


Figure 2 Existing Barriers and Obstacles for Pedestrians movements along the Sidewalks of the Investigated Streets

Table 3 shows the details concerning each selected site and the existing pedestrian facility (if any) is also highlighted.

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Table 3 Details of Study Locations

Site No.	Street	Location	Sidewalk Width (m)	Traffic Directions	Pavement Width (m)	Main Land Use	Pedestrian Facility (if any)
1	Abo Bakr	In front of mobiles market	1.5	One Way	9.0	C	Pedestrian Bridge
2	Abo Bakr	In front of King AbdelAziz Primary School	2.0	One Way	9.0	C and E	Non
3	Abo Bakr	In front of Qalb Al-Taif mall.	3.0	One Way	9.0	C	Non
4	Shobra	In front of Shobra Market	3.0	One Way	9.0	C and E	Non
5	Khaled Ibn Elwaleed	In front of Suq Elangry	1.0	One Way	7.0	C	Pedestrian Bridge
6	Hassan Ibn Thabet	Close to the intersection with Shihar st.	1.5	Two Way	7.0 in each direction	C	Pedestrian Bridge
7	Wady wej	In front of Elanood Park	4.0	Two Way	12.0 in each direction	R	Non
8	Elgal	In front of Elgal Park	2.0	Two Way	6.0 in each direction	R	Non
9	Elrodaf	In front of the Zoo	3.0	One Way	12.0	R	Non
10	Elsadad	In front of Elhokair Park	2.5	Two Way	7.0 in each direction	R	Non

E = Educational, C = Commercial, R = Recreational

The pedestrian speed data were collected at the selected locations by marking a longitudinal section of known length on the pedestrian facility and continuously recording the movement of pedestrians within this section for one hour during morning and evening peak periods. Preliminary surveys were conducted in order to find out the peak periods in each site since, they have varying land uses. The morning peak period was (6.30 – 7.30 a.m.) while, the evening peak period (7 – 8 p.m.) on a typical weekday. However, on a typically weekend day, the morning peak period was (11.00- 12.00 a.m.) and the evening peak was (8-9 p.m). The walking speeds of pedestrians are determined using the same adopted procedure by Rajat Rastogi et. al., [3]. The procedure is simply summarized in the following steps:

1. A random pedestrian about to enter the trap is selected, and the time taken by the pedestrian to cross the length of the section was noted to the accuracy of 0.01 s.
2. The walking speeds of pedestrians are estimated as a ratio of the known length of the trap and the time taken by the pedestrian to cross the trap.

The streets under consideration were surveyed and statistics about the pedestrians used those streets were analyzed. These statistics include classification of those pedestrians based upon their genders, ages, activities during walking and sizes of walking groups. It should be pointed that determination of the age of the pedestrians was a difficult issue. Therefore, both gender and age were categorized into Male, Female and children regardless their ages. It should be reported that the sample size of pedestrians that were considered in the analysis was ranging from 450 to 1500 persons depending on the existed land use.

On the other hand, cross movements of pedestrians within the locations that provided with pedestrian facilities were further analyzed in order to investigate the effectiveness of this facility. Through Table 3, it is clear that there are three sites provided with pedestrian bridges (overpasses) as a facility for pedestrians cross movements across these streets. Figure 3 shows a schematic diagram representing the existing alternatives for pedestrians to cross the roads of these three sites. The percentages of pedestrians using this facility as well as others not using such facility and directly cross the road surface are determined for each gender. Moreover, the time spent for each alternative was also recorded.

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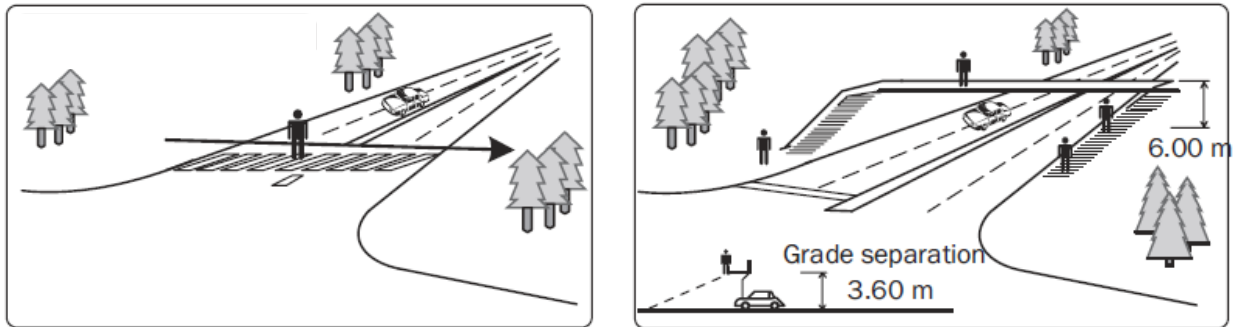


Figure 3 Investigated Alternatives of Crossing the Roads

III. RESULTS ANALYSIS AND DISCUSSIONS

Different characteristics of Saudi pedestrians (the case study), were observed and categorized as follows:

GENDER/AGE

Through each selected site, different observed pedestrian were categorized based upon their genders and the ratio of each gender was determined as shown in Table 4.

Table 4: Percentage of individual genders of pedestrians in different considered sites.

Category	Observation Day	Site Number									
		1	2	3	4	5	6	7	8	9	10
Male	ND	86	50	55	77	67	58	30	57	41	43
	WE	76	75	48	67	53	46	36	42	33	37
Female	ND	9	10	30	14	26	31	33	24	33	33
	WE	16	22	41	21	38	42	29	36	39	37
Children	ND	5	40	15	9	7	11	37	19	26	24
	WE	8	3	11	12	9	12	35	22	31	26

ND = Normal Day, WE = Week End

It is clear that males have higher ratios rather than that for females and children. This is matching with the Saudi social customs since, women movements outside home are governed by some restrictions. Moreover, the delivery of most of children to schools is conducted by the child's family through their own car. Not only that but also, the land use is also governing the ratios of different genders in each site. For example, pedestrians females are much more in commercial and recreational areas rather than educational areas. It is quite reasonable that different genders have varying walking speeds. This is valid through this study to the extent that the average male's walking speed was higher than that for females by 4% while, it was lower than that for children by 2%. Simultaneously, the average walking speeds of children exceeded that for females by 6%. This may be a good guidance in the design of facilities that are in use by higher proportion of either male or female pedestrians. The different recorded speeds at different investigated sites are shown in Figure 4

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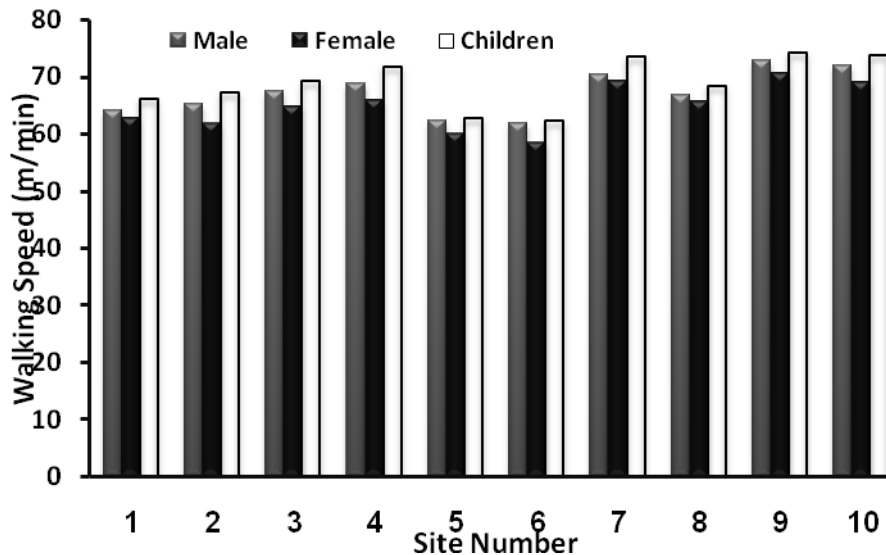


Figure 4 Recorded walking speeds on different genders in different investigated sites.

ACTIVITIES DURING WALKING

It was observed that a considerable ratio of pedestrians used to walk using the mobile phone as given in Table 5. In addition, ratios of pedestrians carrying luggages are much lower than those not carrying since, the prevailing habits of Saudi pedestrians to use their own cars during shopping and park close to the commercial areas as possible.

Table 5: Percentage of different pedestrians' activities during walking in different considered sites.

Category	Observation Day	Site Number									
		1	2	3	4	5	6	7	8	9	10
Not Carrying	ND	90	72	57	47	63	45	69	73	89	87
	WE	62	53	41	43	42	39	58	66	65	79
Carrying Luggage	ND	10	28	43	53	37	55	31	27	21	13
	WE	38	47	59	57	58	61	42	34	35	21
Walking Using mobile Phone	ND	30	20	35	27	19	28	14	16	11	15
	WE	25	24	32	28	17	31	26	22	19	17
Walking without using mobile Phone	ND	70	80	65	73	81	72	86	84	89	85
	WE	75	76	68	72	83	69	74	78	71	83

ND = Normal Day, WE = Week End

The walking speeds of pedestrians when carrying baggage on different pedestrian facilities are Recorded. It was observed that, there is a considerable reduction in walking speeds of pedestrians due to their activities. It should be pointed that the reduction in walking speed due to carrying a luggage or talking in a mobile phone was varying between 15 to 50% of that without any activity. It should be reported that, the size of a luggage is also an important factor but it was not considered during observations.

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WALKING IN GROUPS

Based on the conducted observations through all selected sites, it was revealed that Saudi pedestrians do not prefer to walk in groups. Hardly, a man can walk with one accompanying person, may be his wife, his son etc.,. Also, the woman used to walk with one of her family. Therefore, single pedestrians are the most common while, groups of two pedestrians recorded high ratios compared with groups of three or more pedestrians as shown in Table 6.

Table 6: Percentage of different pedestrians walking in groups different considered sites

Category	Observation Day	Site Number									
		1	2	3	4	5	6	7	8	9	10
Single	ND	59	51	26	60	50	34	22	27	24	22
	WE	48	48	37	52	42	35	28	30	25	23
2 Pedestrians	ND	33	35	43	33	40	49	35	31	36	38
	WE	46	43	53	38	44	54	52	45	49	46
3 Pedestrians	ND	6	12	27	6	9	17	39	38	37	35
	WE	4	8	7	8	11	9	14	17	17	20
More than 3 Pedestrians	ND	2	2	4	1	1	0	4	4	3	5
	WE	2	1	3	2	3	2	6	8	9	11

These ratios are much lower than those reported in the literature due to the different customs and attitudes of different countries.

On the other hand, walking speeds of different pedestrians' groups were recorded where, it was found that speeds reduced by an average of 7% for groups of two pedestrians with respect to single pedestrians. This average reduction has further increased to 18% and 25% for groups of three pedestrians and more than three pedestrians respectively as shown in Figure 5. This is quite expected since, walking in a group makes persons busy in talking with others and subsequently, reduced their walking speeds.

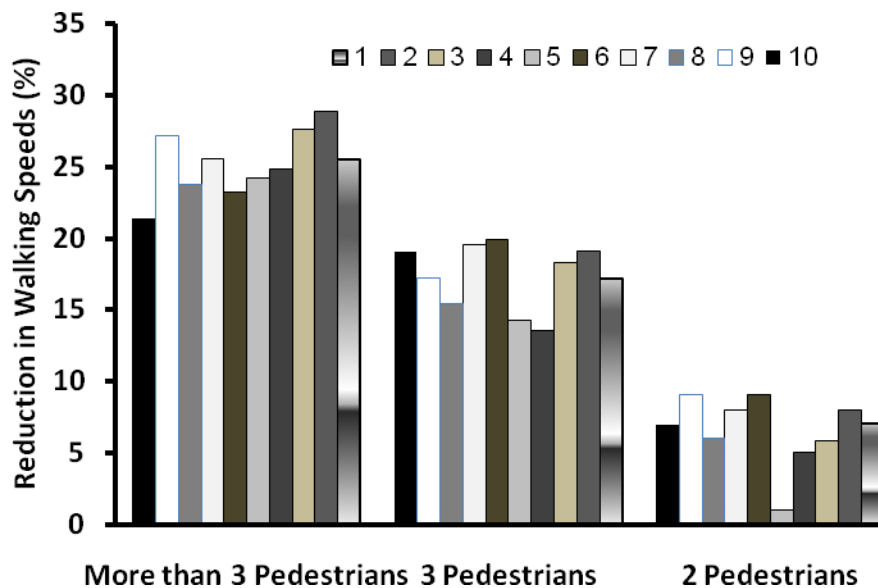


Figure 5 Reduction in walking speeds on different pedestrians groups with respect to the single pedestrian at different investigated sites.

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IV. CONCLUSIONS

The characteristics and behaviour of pedestrians in Saudi Arabia have investigated to study the close relationship between social customs and traditions with these characteristics. Through literature, it was found pedestrians in Saudi Arabia are slow compared with those in other countries. General findings in relation to pedestrian age, gender, group size, and additional simultaneous activity while walking (such as carrying baggage or talking on mobile phone) goes well with the available literature. The pedestrian walking speeds are decreasing with the increase in age, group size, and the additional activity while walking. In addition, walking speeds of women have less reductions rather than those for both men and children. In general, the privacy of Saudi society has significantly affected the characteristics and behaviours of pedestrians. This may be a good guidance in the design of pedestrians facilities in such societies.

REFERENCES

- [1] Kotkar K. L., Rajat R., and Satish C., " Pedestrian Flow Characteristics in Mixed Traffic Conditions", Journal of Urban Planning and Development, Vol. 136, No. 1, 2010.
- [2] Arango, J., and Montufar, M., "Walking speed of older pedestrians who use canes or walkers for mobility." Transportation Research Record 2073, Transportation Research Board, Washington, DC, pp. 79–85, 2008
- [3] Rajat R., Ilango T., and Satish C., " Design Implications of Walking Speed for Pedestrian Facilities", Journal of Transportation Engineering, ASCE, 137(10), 2011.
- [4] Tanaboriboon, Y., Hwa, S. S., and Chor, C. H., "Pedestrian characteristics study in Singapore", Journal of Transportation Engineering, ASCE, 112(3), pp. 229–235, 1986.
- [5] Koushki, P. A., "Walking characteristics in Central Riyadh, Saudi Arabia." Transportation Engineering, 114(6), pp.735–744, 1988.
- [6] Koushki, P. A., and Ali, S. Y., "Pedestrian characteristics and the promotion of walking in Kuwait City Center." Transp. Res. Rec.,1396, pp. 30–33, 1993.
- [7] Lam, W. H. K., and Cheung, C., "Pedestrian speed/flow relationships for walking facilities in Hong Kong", Journal of Transportation Engineering, ASCE, 126(4), pp. 343–349, 2000.
- [8] Tarawneh, M. S., "Evaluation of pedestrian speed in Jordan with investigation of some contributing factors." J. Saf. Res., 32(2), pp. 229–236, 2001.
- [9] Finnis, K. K., and Walton, D. "Field observations to determine the influence of population size, location and individual factors on pedestrian walking speeds." Ergonomics, 51(6), pp. 827–842, 2008.
- [10] Montufar, M., Arango, J., Porter, M., and Nakagawa, S., "Pedestrians' normal walking speed and speed when crossing a street." Transportation Research Record 2002, Transportation Research Board, Washington, DC, pp. 90–97, 2007.
- [11] Carey, N. , "Establishing pedestrian walking speeds", Portland State University, Portland, OR, 1–4, 2005
- [12] Fitzpatrick, K., Brewer, M. A., and Turner, S., "Another look at pedestrian walking speed." Transportation Research Record 1982, Transportation Research Board, Washington, DC, pp. 21–29, 2006.
- [13] Martin A. , " Pedestrian Attitudes, Behavior and Road Safety", A Research Project, Client: Ben Johnson, London Road Safety Unit, Transport for London, 2006