

Evaluation and improvement pedestrians characteristics for selection section of urban area

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ABSTRACT

The pedestrians walking, crossing, environment and the influence of their movement with the traffic operations are the most important elements that must be taken into account in the design of roadways and intersections in the urban area. Thus the study seeks to evaluate the level of service (LOS) of sidewalks to identify the problems facing pedestrians in crossing and movements to suggest alternatives that would increase the safety, convenience, and efficiency of pedestrian's movement within the study area, according to scientific methodology, based on the study of traffic analytical. The study has had been chosen two locations in the Baghdad capital, are Aden and Sana'a un signalized intersections. Data were collect for traffic volume and walking speed for pedestrians as well as sidewalk width. Rate of flow and effective walkway width within Peak Hour Volume (PHV), with the aid of video technique method to cover engineering field survey and traffic, recorded data, due to workday (Monday, Tuesday, Wednesday), for the period from 20/11/2020 to30/03/2021. Data analysis was done by using the method of (highway capacity manual 2010) to determine (LOS) in the study area, rather than for roadside interview by designing a questionnaire form to identify the crosswalk users to get their opinions about the nature of the traffic facilities in the study area. The study concluded that (LOS) of pedestrians type (E&C) in Aden and Sana'a intersections respectively. The study conducted that when the excesses were eliminated from the walkway and provided buffer zones for pedestrians crossing. LOS will be increase to (B) and (C) respectively as well as the accident rate type vehicle pedestrians decrease by (20) percent, in the other hand marking and signing will be increase safety and convenience factors moreover provide appropriate time for vehicles and pedestrians crossing and movements.

Keywords: Pedestrian, Crossing, level of service, Unsignalized intersection.

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1. Introduction

Many dense metropolitan areas are now experiencing pressures and difficulties because of land constraints, including traffic congestion and a lack of public open space that is one of the most significant concerns confronting pedestrians. Apart from bicycling, walking is the most environmentally friendly mode of transportation. Increased vehicle traffic in cities has a detrimental impact on pedestrian safety and the environment as they walk and cross streets. These calls for the relevant authorities to look for the necessary solutions, to provide resources, moreover make vigorous efforts to provide facilities, which increase a safe environment for pedestrian movements and their crossing. Due to fact that the traffic accident type pedestrian-vehicle damage, reached very high levels, especially in the big cities, which is considered as the price of civilization. In highway planning and design, the intersection of pedestrians and traffic movements is a significant issue. Pedestrians are indeed a component of any highway environment, and their existence should be acknowledged in both rural and urban settings. Because urban pedestrians are more numerous, they have a

greater impact on highway design elements than rural pedestrians. As a result of the needs of crowded urban area traffic [1]. The facilities of sidewalks and walkways comprised terminals, steps, and pathways dedicated solely for pedestrians to meet the capacity and quality of service assessments of facilities servicing pedestrians [2, 3]. Every year, approximately 100,000 pedestrians are injured in motor vehicle accidents, with the majority of the injuries occurring near crossings. Even though many junctions have traffic lights and crosswalk markers to protect pedestrians, vehicle-pedestrian accidents still happen. Pedestrian injuries at junctions are especially common in urban areas, according to researchers. Pedestrians were mostly put at risk by turning automobiles [4]. Pedestrians and automobiles are the two major users of city streets. Elevated Skywalks are needed for pedestrian convenience and safety since they cause no delays for pedestrians and offer comfort in metropolitan settings [5, 6]. Separating pedestrians from wheeled vehicles is a long-standing concept that dates back to the Renaissance. The first contemporary application of the concept in cities, nevertheless, seemed to date from about 1800, once the first covered retail arcade opened in Paris. Separated retail arcades, forerunners of contemporary shopping malls, were built across Europe in the 19th century. In the 19th and early 20th centuries, several architects and city planners, like Clarence Stein, Ebenezer Howard, and Joseph Paxton, suggested ideas to segregate pedestrians from vehicles in different new projects [7, 8]. In Poland, several pedestrians have been killed or wounded while crossing the street. As a result, it provides an overview of creative ideas targeted at increasing pedestrian crossing safety: Among the pedestrian detection technologies are automated pedestrian detection and improved illumination systems [9, 10]. The capital city of Anambra, Awka, was used as a case study for pedestrian concerns. High pedestrian crossing traffic in critical parts of the roadway, as determined by direct observation, Peaking hour volume of pedestrians at the chosen sections, It has been shown that up to 34percent of pedestrians choose to cross on the road rather than utilizing the pedestrian bridge [11].

2. Definition of Study Area

Two sites have had been elected in the Baghdad, capital to be the study area for this research, namely Aden intersection, Sana'a intersection, which represents a variation of pedestrian activities and their movements, they are as follow:

2.1. Aden Intersection

It is located in the north of Baghdad governorate, which is characterized as a crowded area of pedestrians access rather than interference with vehicles for random movements. As a result, many traffic accidents type of pedestrian-vehicle appeared. Likewise, the randomness in crossing and movement led to a decrease in the operational speed of approaches, thus a decrease in the level of service (LOS), for the roadway section length and the intersection approach. Aden intersection type at grade intersection with four-leg, the north approach led to Al-Dabbash interchange, The approach has three lanes in each direction, lane width 3.5 m divided with median 2.5 m width. The southern approach leading to the Al-Atfiyah area is of the same dimensions, while the eastern western approach leads to the Al-Kadhimiya holy area. Finally, the western approach leads to the city center. As shown in Figure 1.

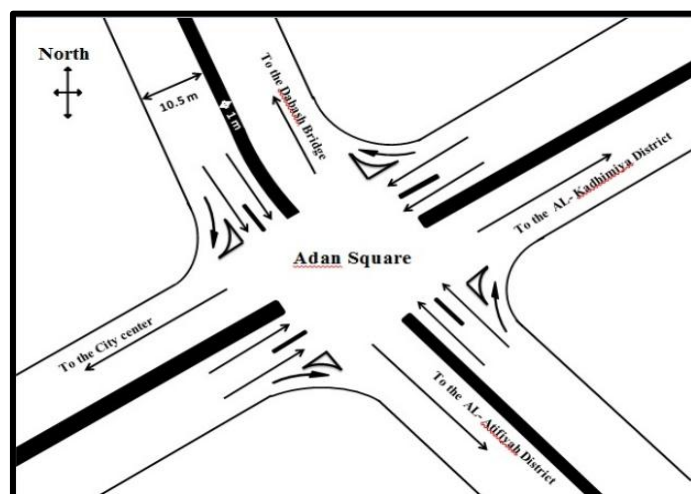


Figure 1. Aden Intersection layout

2.2. Sana'a Intersection

It is three legs unsignalized at grade intersection, which is characterized by increased traffic volumes and densities for pedestrians and vehicles. The intersection transfers traffic volumes between Al-Kadhimiya holy city and the city center. There are many conflict points between pedestrians and vehicles due to random crossing as well as the lack of safety zones for movement and crossing. Figure 2 shows the intersection layout.

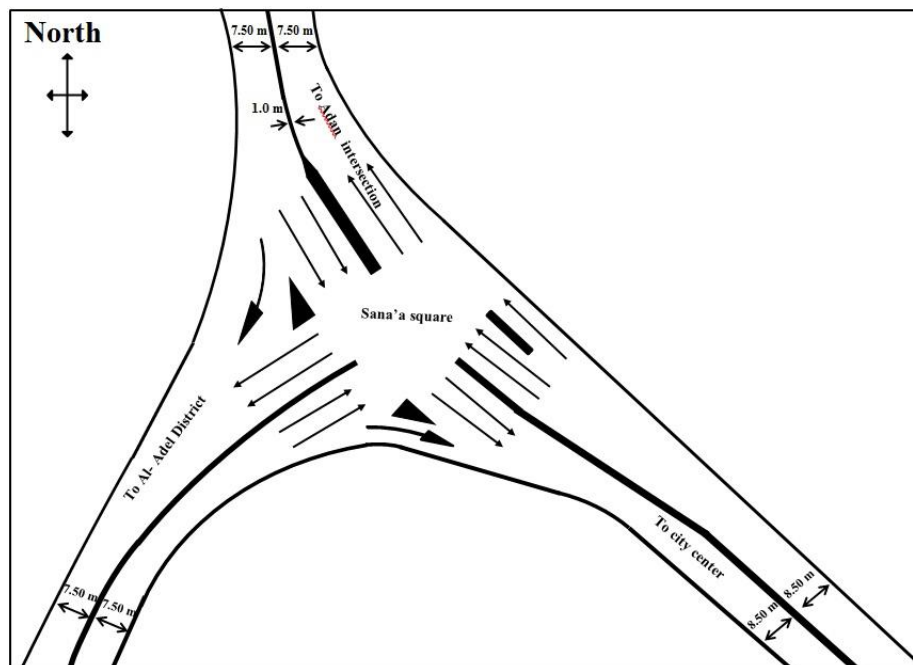


Figure 2. The Layout of Sana'a Intersection

3. Data Collections

Data were collected according to the field survey. Traffic volume for vehicles and pedestrians within peak hour volume (PHV) included for each location, the survey also content pedestrians speed in the study area in addition to the width of the walkway, the width of the approaches, and the roadway section. Traffic volume for pedestrians and rate of flow included too, with the aid of manual count method and video record. The data collection process took three months for the period from 20/1/2020 to 30/03/2021. Peak hour is estimated for each location by observing the roadway and intersections condition and environment, as well as assisting the traffic police officer, which are the traffic characteristics in the study area. thee Utilizing a questionnaire and observation, the researchers discovered that the average pedestrian walking pace is 3.3 feet per second and that the rate of senior walkers (65 years and older) is higher than 20 percent of all pedestrians [12]. Data organized according to Tables and Figures for each location as follow:

Table 1. Variation of traffic volume in Aden intersection within peak hour period

Approach	Time	Traffic Volume (Veh./15min)	Rate of Flow (Veh/hr.)	PHF
North	7:30-7:45	105	420	0.934
	7:45-8:00	100	400	
	8:00-8:15	110	440	
	8:15-8:30	115	460	
	Total	430		
South	7:30-7:45	103	412	0.938
	7:45-8:00	100	400	
	8:00-8:15	110	440	
	8:15-8:30	100	400	
	Total	413		

Approach	Time	Traffic Volume (Veh./15min)	Rate of Flow (Veh/hr.)	PHF
East	7:30-7:45	116	464	0.931
	7:45-8:00	99	396	
	8:00-8:15	111	444	
	8:15-8:30	106	424	
	Total	432		
West	7:30-7:45	102	408	0.936
	7:45-8:00	111	444	
	8:00-8:15	114	456	
	8:15-8:30	119	476	
	Total	446		

Table 2. Variation of traffic volume in Sana'a intersection within peak hour

Approach	Time	Traffic Volume (Veh./15min.)	Rate of Flow(Veh/hr.)	PHF
North	7:30-7:45	92	368	0.897
	7:45-8:00	98	392	
	8:00-8:15	87	348	
	8:15-8:30	107	428	
	Total	384		
South	8:00-8:15	100	400	0.905
	8:15-8:30	109	436	
	8:30-8:45	91	364	
	8:45-9:00	95	380	
	Total	395		
West	7:30-7:45	102	408	0.967
	7:45-8:00	107	428	
	8:00-8:15	105	420	
	8:15-8:30	100	400	
	Total	414		

4. Data analysis

Data were analyzed for the two locations of unsignalized intersections with aid of HCM 2010 criteria. Took into account the characteristics of intersections control, which are defined as type Two-way Stop controlled TWSC. The intersection approaches have no zebra-striped crossings, so the following criteria are applied to determine delay and level of service LOS. Intersecting sidewalk movements, people crossing the street, and pedestrian assessment of an acceptable gap are all involved in crossing an unsignalized intersection. It depends on the critical gap and available gap as shown in equation (1) [2].

$$t_c = \frac{L}{s_p} + t_s \quad \text{-----(1)}$$

Whereas:

t_c = critical gap for a single pedestrian (s).

s_p = average pedestrians walking speed (ft./s).

L = crosswalk length (ft.).

t_s = pedestrian start-up time and clearance time (s).

The study seeks to determine platoon size according to a field survey within the two unsignalized intersections. Equation (2), [2].

$$N_c = \frac{V_p e^{V_p t_c} + v e^{-v t_c}}{(V_p + V) e^{(V_p - V) t_c}} \quad \text{---(2)}$$

Where:

N_c = size of a typical pedestrian crossing platoon (P).

V_p = Ped. flow rate (P/s).

V = vehicular flow rate (veh./s).

t_c = single Ped, Critical gap.

To evaluate LOS for pedestrian crossing, group critical gap has been computed too, equation (3).

$$t_G = t_c + 2(N_p - 1) \quad \text{---(3)}$$

Where:

t_G = group critical gap (s)

N_p = spatial distribution of Ped. (p).

$$N_p = INT \left(\frac{8.0(N_c - 1)}{W_E} \right) + 1 \quad \text{---(4)}$$

$$W_E = W_T - W_0 \quad \text{---(5)}$$

Where:

W_E = Effective width of the crosswalk (ft.)

W_T = Total width of the walkway (ft.)

W_0 = Sum of widths and shy distance from observations on the walkway (ft.)

LOS for pedestrian crossing for each intersection depends primarily on pedestrian delay (d_p , as shown in equation (6).

$$d_p = \frac{1}{V} (e^{V t_G} - V t_G - 1) \quad \text{---(6)}$$

Where:

d_p = Average pedestrian delay (s)

Data have been processing and analyzed with aid of equations (1) to (5). The analysis considers East-west major approaches for Aden Intersection and North-South major approaches for Sana'a Intersection, then the results presented in Table 3.

Table 3. Useful parameters used to evaluate pedestrian crossing within study area

Intersection Name	Available Parameters										
	t_c sec.	s_p ft./sec	t_s sec	N_p	W_T ft.	W_0 ft.	W_E ft.	N_c	V_p Ped./sec	V veh/sec	t_G sec.
Aden	13.606	3.3	3.0	1.039	8.2	2.2	6.0	0.707	0.025	0.128	13.684
Sana'a	11.50	3.3	3.0	1.0	15.0	5.0	10.0	2.0	0.019	0.121	11.50

by analysis data listed in Table 3, with the aid of equation (6), LOS for pedestrian crossing within each unsignalized intersection can be obtained and concluded in Table 4.

Table 4. Evaluation LOS for pedestrian crossing within study area

Intersection Name	d_p Average pedestrian delay Sec.	Level of Service LOS
Aden	39.144	E
Sana'a	14	C

The decline in LOS reflects the random of the pedestrian is activities in movement and crossing as well as the conflict points between vehicles and pedestrians.

5. Conclusions

The research reached many conclusions, summarizing them as follows:

1. The analysis of the level of service for pedestrians at unsignalized intersections based on TWSC, one of the important methods because it takes many factors affecting the area of study.
2. The random of pedestrians activities in movement and crossing, as well as the conflict points between pedestrians and vehicles, decrease LOS of a pedestrian crossing in Aden & Sana'a unsignalized intersections to (E & C) respectively.
3. Organizing pedestrian movements and providing safe buffer zones with the aid of signing, marking, and lighting as well as allow the necessary times for them to cross and move, led to increasing LOS to (C & B) respectively.
4. According to questioner survey in the study area, processing and Organizing of movement and crossing, the probability of accident type vehicle-pedestrian will be decreased to 20 percent.

References

- [1] A. AASHTO, "Policy on geometric design of highways and streets," *American Association of State Highway Transportation Officials, Washington, DC*, vol. 1, no. 990, p. 158, 2001.
- [2] HCM, "Highway Capacity Manual," *Transportation Research Board. National Research Council. Washington D.C.*, 2010.
- [3] A. H. M. Alaidi, I. A. Aljazaery, H. T. S. AlRikabi, I. N. Mahmood, and F. T. Abed, "Design and implementation of a smart traffic light management system controlled wirelessly by arduino," *International Journal of Interactive Mobile Technologies*, Article vol. 14, no. 7, pp. 32-40, 2020.
- [4] R. A. Retting, R. Van Houten, L. Malenfant, J. Van Houten, and C. M. Farmer, "Special signs and pavement markings improve pedestrian safety," *Institute of Transportation Engineers. ITE Journal*, vol. 66, no. 12, p. 28, 1996.
- [5] D. Gupta and V. Patel, "Pedestrian simulation in congested urban area," *International Journal of Engineering Technical Research*, vol. 2, no. 3, pp. 111-115, 2014.
- [6] H. Salim, and N. A. Jasim, "Design and Implementation of Smart City Applications Based on the Internet of Things," *International Journal of Interactive Mobile Technologies (IJIM)*, vol. 15, no. 13, pp. 4-15, 2021.
- [7] P. Hall and C. Hass-Klau, "Can rail save the city? The impacts of rail rapid transit and pedestrianisation on British and German cities," 1985.
- [8] E. Q. Ahmed, I. A. Aljazaery, A. F. Al-zubidi, and H. Th., "Design and implementation control system for a self-balancing robot based on internet of things by using Arduino microcontroller," *Periodicals of Engineering Natural Sciences*, vol. 9, no. 3, pp. 409-417, 2021.
- [9] W. Czajewski, P. Dąbkowski, and P. Olszewski, "Innovative solutions for improving safety at pedestrian crossings," *Archives of Transport System Telematics*, vol. 6, 2013.
- [10] I. A. Aljazaery, S. K. Al_Dulaimi, H. T. S., "Generation of High Dynamic Range for Enhancing the Panorama Environment," *Bulletin of Electrical Engineering and Informatics*, vol. 10, no. 1, 2021.
- [11] C. D. Nwakaire CM, Udemba J., "The challenges and possible remedies to poor pedestrian safety considerations along and across Nigerian busy roads," *MOJ Civil Eng.*, vol. 2, no. 1, p. 36-41, 2017.
- [12] N. M. Roupail, J. E. Hummer, J. S. Milazzo II, and D. P. Allen, "Recommended Procedures for Chapter 13," Pedestrians," of the Highway Capacity Manual," 1998.