

Evaluating the Safety of Pedestrians during Walking on a Road

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Abstract - Over the years there is a rise in the use of motor vehicular on the roads and due to which less space is available for pedestrians to walk and also pedestrians have to share the same Right of way with vehicular traffic which puts their lives in danger. So this problem can be solved by providing a facility for a pedestrian to walk safely on road and this can be done by collecting data like pedestrian volume, road share in a percentage of pedestrians and finding the busiest junction in a town and data has been collected by using videographic technique. After analyzing the data, 3 out of 2 junctions in a town has a pedestrian second highest road user. So at least a footpath must be provided around all three junctions in town. So the footpath will separate a pedestrian from a vehicular and safety of pedestrian may increase, so it will encourage many people to walk for shorter routes.

Key Words: Pedestrian, Junction, Pedestrian Traffic volume.

1. INTRODUCTION

A pedestrian is a person who makes a trip by walking. Walking is one of the most common modes of travel in India but pedestrians are always neglected during the planning and design of road networks. Also, pedestrians required ample space required, due to their diversity of attention, and also their behavior affecting the nature of their interaction with motorized traffic makes them vulnerable. Due to which among road users, pedestrians are the most vulnerable users of the road. Vulnerability of pedestrians increases due to lack of speed, mass, and protection as compared to other road users. According to National Crime Record Bureau's data, the total number of road accidents reported in India during 2020 is 3, 54,796. Out of 3, 54,796 road accidents caused 1, 33,201 deaths and injuries to 3, 55,050 (*Chapter – 1a Traffic Accidents*, 2020). Vehicle-wise road accident Deaths during 2020 of pedestrians is 8.8% which is 11,855 (*Chapter – 1a Traffic Accidents*, 2020).

Many initiatives have been taken to increase the safety of the pedestrians, a number of engineering solutions such as to cross the road safely (Ankit Bansal et al., 2018).

Bengaluru-Tender Sure under this scheme the streets in Bengaluru are made more pedestrian-friendly, and additional amenities are provided to the road users (e.g. pedestrian-friendly island) (Ankit Bansal et al., 2018). Chennai prioritize pedestrians by planning to increase the share of pedestrians and cyclists on its roads by 40 percent by the end of the year 2018 and footpath will be provided along 80 percent of the roads (Ankit Bansal et al., 2018). Hyderabad-Pedestrian Refuge islands in these the refugee islands are provided in Hyderabad are constructed in the middle of the closed crossroads (Ankit Bansal et al., 2018). These islands in Hyderabad are very different from the normal medians because they divide vehicular traffic as well as provide safety to the pedestrians who are crossing the road (Ankit Bansal et al., 2018). These islands make sure that pedestrians cross only from the designated areas of the road since they provide a halting space to pedestrians (Ankit Bansal et al., 2018). In Chandigarh, the pelican signal is provided to direct the pedestrian traffic to a designated point to cross a street (Ankit Bansal et al., 2018). Pedestrians can push a button on pelican signals which will flash the red sign to vehicles at appropriate times and will allow the pedestrian

The main objective of this work is to give guidelines for pedestrian safety in Songadh town. This is done on the basis of

the data such as Traffic volume count, Pedestrian volume count, and road share of different types of road users and based on the data collected suggest guidelines for the safety of pedestrians.

2. Literature Review

When the pedestrian is walking on the road, crossing the road is the most crucial part and here the most of the conflict between pedestrian and vehicle is arise and sometimes it leads to an accident which causes injury to pedestrian and vehicle driver and sometimes it also leads to death of a pedestrian. And it is very important for the pedestrian to select an appropriate gap so that pedestrians can cross the road easily and without any conflict with the vehicle driver. And to select an appropriate gap for crossing a road the waiting time is also important to select a good gap to cross a road for pedestrians.

During the study, the average waiting time of female pedestrians is 34.4 s, which is 88.0% longer than the average waiting time of male pedestrians of 18.3 s (Ferenchak, 2016). Results show that males exhibit more dangerous crossing behavior than females by waiting for shorter amounts of time, using the crosswalks less, and causing more conflicts with motor vehicles (Ferenchak, 2016). Waiting time ranged from a minimum of 19.0 s for pedestrians in their twenties to a maximum of 59.1 s for pedestrians in their seventies (Ferenchak, 2016). Ferenchak has concluded that gender and age both have a strong significant relationship with the safety-related behaviour is being observed (Ferenchak, 2016). It was founded by authors that found the female pedestrians and older people have higher accepted time gaps and crossing time (Papadimitriou et al., 2016)

When a pedestrian is crossing a road selection of gap is very important for the safety of both pedestrian and vehicle. It is observed that the majority of pedestrians have the gap acceptance is between 2 sec to 6 sec and the safety margin is between 1 sec to 4 sec (Jain et al., 2014). When the pedestrian accepted the inadequate vehicle gaps accepted by pedestrians during crossing the road it is observed that the pedestrian results in a higher probability of them exhibiting a change in their crossing speed (Kadali & Vedagiri, 2020).

When a pedestrian is crossing the road there is mainly two types of crossing movement which are perpendicular movement and oblique movement and their average crossing speed for perpendicular movement is calculated by the authors as 1.204 m/sec and for oblique movement as 1.08 m/sec (Papadimitriou et al., 2016). The crossing speed for males is found to be 1.287 m/sec and for females is 1.219 m/sec (Papadimitriou et al., 2016).

During the study in Delhi, it was observed that the car driver encounters pedestrians at midblock crossings, and pedestrians walking on the carriageway relatively frequently even on 4 lanes and 6 lanes arterial road is observed by the author (Jha et al., 2017). These roads can have vehicle speeds in excess of 50km/hr, especially in off-peak hours, and also a significant number of mid-block crossings per km were observed on 4, 6, 8 lane roads even when the speed of the observer was greater than 50 km/hr (Jha et al., 2017). The relationship between the probability of a vehicle hitting a pedestrian and the probability of a pedestrian death show that when the pedestrian is walking and then hit by a vehicle travelling at the speed of around 50 km/hr, there is a 50% chance of survival and anything which is above 50km/hr is considered as dangerous and speed above 70 km/hr is considered as critical (Budzynski et al., 2017).

Many studies have been done in order to improve pedestrian safety on the road and solutions/proposals are also being suggested by several authors. Such as to improve the pedestrian facility and enhance the safety of pedestrians on roads at various study locations of Chennai has been selected and data has been collected and based on the analysis of the data some suggestion is made by Subramanyam and Kumar such as 1) Instalment of rumble strips, 2) Construction of pedestrian islands, 3) Instalment of pedestrian sensors in a crosswalk and 4) Instalment of more perspicuous traffic signs and signal (Subramanyam & Prasanna Kumar, 2017).

In these study, it has been found that in Chandigarh city the situation of pedestrian facilities is very poor, and a study was done by Seh, Ram, and Sharma study reveals that there is the absence of visible cross marking in 60%, foot over bridge in 65%, Refugee Island in 75% (Seh et al., 2019). A scramble pedestrian phase can be used as a tool to overcome a situation that is for a safe pedestrian crossing which has been successfully employed all over the world (Seh et al., 2019). The pedestrian scramble phase generally means that it gives a signalized crossroads, pedestrians to walk in all four directions

and diagonally at the same time while automobiles in all four directions are stopped (*Pedestrian Scramble – City of Toronto*, n.d.). The authors also suggested that the Scramble pedestrian phase can be introduced on a pilot basis at some selected intersections in Chandigarh city and the signal design has been hypothetically modified incorporating EPP in two intersections of Chandigarh city (Seh et al., 2019). The authors also suggested that the street lighting around the crossing should be adequate so that cross marks are easily captured by the vehicle drivers to have to stop sight distance to avoid collision (Seh et al., 2019).

Another study done by Dass, Singhal, and Aggarwal has done an effort to gather information about how people think about the pedestrian facilities they use on a daily basis. (Dass et al., 2015). From the study at Foot Over Bridge in Ambala and Kurukshetra, it is observed that the lighting facility should be provided in the Kurukshetra railway station (Dass et al., 2015). In addition, the width of the stairs must be increased at both stations (Dass et al., 2015). One ramp at the ascent and descent also needs to be provided. Lift facility, if provided will enhance the use of foot over bridge (Dass et al., 2015). From the study at underbridge in Chandigarh, the researchers observed that sufficient lightening will aggravate the use of under bridge (Dass et al., 2015). Major emphasis is to be given to cleanliness and providing a lift/escalator facility. Another emphasis is to be given to providing sitting arrangements (Dass et al., 2015).

The authors believe that in Singapore, the lack of detailed urban design principles has created a barrier to the establishment of pedestrian-friendly surroundings, particularly in public housing neighbourhoods from the city's core urban landscape (Zhang et al., n.d.). These authors main recommendation was to shift from a car-based model to a people-centric design by reclaiming the space from vehicles (Zhang et al., n.d.). Thus it can be achieved by providing equal space and time for cars and pedestrians and it can be achieved through the particular initiatives suggested by authors such as 1) By removing bridges, ramps, and underpasses and replacing them with grade crossings (Zhang et al., n.d.). 2) At signalised intersections, pedestrians need to have equal rights and time as vehicles to cross (Zhang et al., n.d.). 3) Add pedestrian crossing at un-signalised junctions to prioritize pedestrians and scramble intersections in strategic areas (Zhang et al., n.d.). 4) Provide dedicated space for all modes of shares like pedestrians, bikes, cars, PMDs (Zhang et al., n.d.). This can be implemented as suggested by the authors by reducing the number of lanes

dedicated to vehicles of existing roads and converting them into bike lanes for new roads, planning carefully lane width and the number of lanes dedicated to cars, and providing dedicated lanes for bicycle (Zhang et al., n.d.).

In this research paper author has made an attempt to overview the level of safety provided on the crosswalks (Ankit Bansal et al., 2018). During the study, it has found that the majority of crosswalks are not fulfilling their intended purposes due to improper signage and markings, inadequate maintenance, and bad surface condition (Ankit Bansal et al., 2018). Another significant reason hampering the safety of pedestrians at crosswalks has been found to be an inappropriate provision of guardrails and pedestrian refugee islands (Ankit Bansal et al., 2018). Therefore authors have incorporated the safety measures like the provision of proper countdown timer signals at the crosswalks which will help pedestrians to make effective crossing decisions (Ankit Bansal et al., 2018). It is also recommended by the authors to provide 3D crosswalks which will facilitate the motorized traffic to slow down and give the right of way to pedestrians, thereby improving the pedestrians safety (Ankit Bansal et al., 2018).

Data Collection

For collecting data three junctions are selected in a Fort Songadh town because there is pedestrian and vehicular traffic is been observed using a junction to travel across through a town. Junction has been selected for study as Devgipura Char Rasta, Bus stand Char Rasta and Shalimar Char Rasta. Data has been collected using the videographic technique. Video has been recorded using an Android phone. Data has been collected for 1 hour per day per junction in the morning only due to the lockdown restriction in the town during the second wave a traffic movement is restricted after 12 noon. So due to this reason data is only collected in the morning hours only.

A) Devgipura Char Rasta

After the collection of data at Devgipura Junction it has been observed that the pedestrian is the third highest and pedestrian volume count is 99 pedestrian/hour and remaining road user data has been shown in the table below.

Table -1: Sample Table format

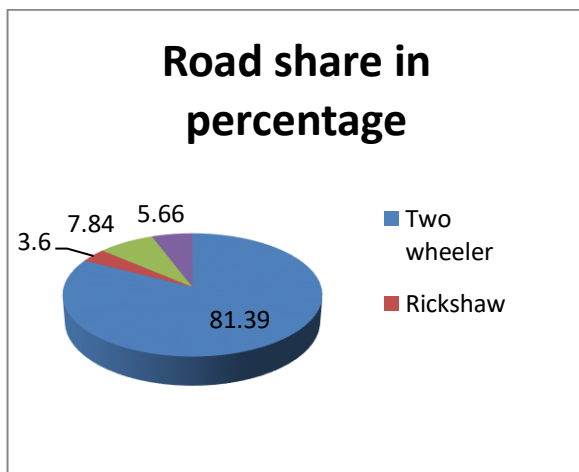
Sr.No	Mode of Transport	Volume count
1	Two wheelers	1422
2	Pedestrian	99
3	Rickshaw/chagda	63
4	Four wheelers	137
5	Cycle	26

And from the data above in table we can compute a road share in percentage for Devgipura junction as shown in below



Fig -1: Devgipura Junction

Chart



And from the pie chart we can say that pedestrian has the road share of 5.66 % at Devgipura junction. The data has been collected during a partial lockdown due to the second wave of corona virus and due to which schools were closed and hence due to which pedestrian recorded during survey was less and now the number of pedestrians may have been changed.

B) Bus Stand Char Rasta

After the collection of data at Bus Stand Char Rasta it can be concluded from the table below that the pedestrian is the second-highest user with a traffic volume count of 580 pedestrian per hour. And other road user's data are mentioned in the table.

Table -1: Sample Table format

Sr.No	Mode of Transport	Volume count
1	Two wheelers	2177
2	by Foot or pedestrian	580
3	Rickshaw/ Chagda	118
4	Bus	10
5	Four wheelers	164
6	Cycle	26

From the data above in table we can compute a road share in percentage for Bus Stand junction as shown in the form of pie chart.

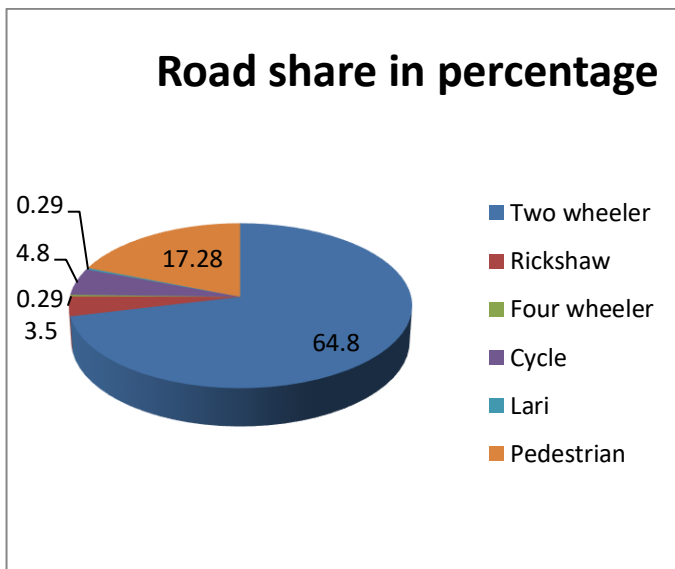


Fig -2: Bus stand Junction

Table -1: Sample Table format

Sr.No	Mode of Transport	Volume count
1	Two wheelers	2768
2	Pedestrian/by foot	850
3	Rickshaw/chagda	124
4	Bus	8
5	Four wheelers	27
6	Cycle	28

Chart



From the data above in table we can compute a road share in percentage for Bus Stand junction as shown in below



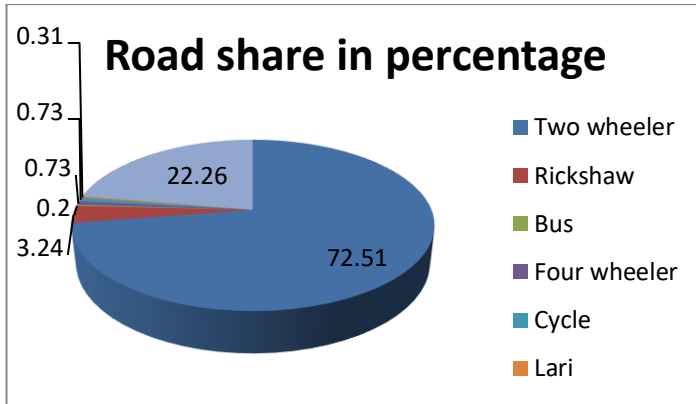
Fig - 3: Shalimar Junction

Chart

From the pie chart in last page it is mentioned that pedestrian has the road share of 17.28% at Bus Stand Char Rasta. The data has been collected during a partial lockdown due to the second wave of corona virus and due to which schools were closed and hence due to which pedestrian recorded during survey was less and now the number of pedestrians may have been changed.

C) Shalimar Char Rasta

After the collection of data at Shalimar Char Rasta it can be concluded from the table below that the pedestrian is the second-highest user with a traffic volume count of 850 pedestrian per hour. And other road user's data are mentioned in the table below.



From the pie chart above us it is mentioned that pedestrian has the road share of 22.26% at Shalimar Char Rasta. The data has been collected during a partial lockdown due to the second wave of corona virus and due to which schools were closed and hence due to which pedestrian recorded during survey was less and now the number of pedestrians may have been changed.

3. CONCLUSIONS

After the analysis of Data at various junctions such as Devgipura junction, Bus Stand junction, and Shalimar Junction the major findings are discussed as follows:

- After collecting data, Shalimar Junction has the highest pedestrian traffic was observed from other junctions like Devgipura and Bus Stand Junctions. The pedestrian traffic volume at Shalimar junction is 850 pedestrian/hour.
- Among different types of road users the road share of pedestrians is the second highest was observed at Shalimar junction and Bus Stand junction which are 22.26 % and 17.28 % respectively.
- But at Devgipura Junction pedestrian it is observed that pedestrian has a road share of 5.66 % which is the third-highest it is due to school being closed at the time of data collection due to corona virus.
- It is observed that the footpath at Bus Stand junction is encroached by food vendors.

Hence we can say that it is a significant amount of pedestrians who are using the road which cannot be ignored and facilities are also not provided to cater the pedestrian. So to encourage the people to walk we need to ensure their safety and give comfortable safe walking. And

also improve pedestrian safety in a town some suggestions or guidelines are given as below:

- Footpath should be provided around the Shalimar Junction as the highest pedestrian is observed during the study. With the footpath, a seating arrangement should also be given and also plantation of a tree alongside footpath which will provide shade to a pedestrian while they are walking.
- Zebra crossing facility must be provided around bus stand junction as the highest amount of pedestrians is crossing a road.
- All junctions such as Bus stand junction, Shalimar junction, and Devgipura junction in a town must be converted into signalised junction for a safer movement for pedestrians.
- All the junctions in a town must have a pelican signal with push-button for a safer road crossing of pedestrians through zebra crossing.

REFERENCES

1. Ankit Bansal, Tripta Goyal, & Umesh Sharma. (2018). Pedestrian Safety on Crosswalks in India - Need of the Hour. *Journal on Today's Ideas - Tomorrow's Technologies*, 6(1), 35–46. <https://doi.org/10.15415/jotitt.2018.61004>
2. Budzynski, M., Jamroz, K., & Mackun, T. (2017). Pedestrian Safety in Road Traffic in Poland. *IOP Conference Series: Materials Science and Engineering*, 245(4), 1–7. <https://doi.org/10.1088/1757-899X/245/4/042064>
3. Chapter – 1a traffic accidents. (2020).
4. Dass, S., Singhal, D., & Aggarwal, P. (2015). Study of Pedestrian Flow / Behavior on Indian Roads. *IOSR Journal of Mechanical and Civil Engineering*, 38–42.
5. Ferenchak, N. N. (2016). Pedestrian age and gender in relation to crossing behavior at midblock crossings in India. *Journal of Traffic and Transportation Engineering (English Edition)*, 3(4), 345–351. <https://doi.org/10.1016/j.jtte.2015.12.001>
6. Jain, A., Gupta, A., & Rastogi, R. (2014). Pedestrian Crossing Behaviour Analysis At Intersections. *International Journal for Traffic and Transport Engineering*, 4(1), 103–116. [https://doi.org/10.7708/ijtte.2014.4\(1\).08](https://doi.org/10.7708/ijtte.2014.4(1).08)
7. Jha, A., Tiwari, G., Mohan, D., Mukherjee, S., & Banerjee, S. (2017). Analysis of pedestrian movement on Delhi roads by using naturalistic observation techniques. *Transportation Research Record*, 2634(January), 95–100. <https://doi.org/10.3141/2634-14>
7. Kadali, B. R., & Vedagiri, P. (2020). Evaluation of pedestrian crossing speed change patterns at unprotected mid-block crosswalks in India. *Journal of Traffic and Transportation*

- Engineering (English Edition)*, 7(6), 832–842.
<https://doi.org/10.1016/j.jtte.2018.10.010>
8. Papadimitriou, E., Yannis, G., & Golias, J. (2016). Analysis of Pedestrian road crossing behaviour in urban areas. *Civil and Environmental Engineering: Concepts, Methodologies, Tools, and Applications*, 3(23), 1140–1155.
<https://doi.org/10.4018/978-1-4666-9619-8.ch051>
9. *Pedestrian Scramble – City of Toronto*. (n.d.). Retrieved February 16, 2022, from <https://www.toronto.ca/services-payments/streets-parking-transportation/traffic-management/traffic-signals-street-signs/types-of-traffic-signals/all-way-signal-crossing/>
10. Seh, A. Y., Ram, S., & Sharma, P. (2019). Research paper on Pedestrian Crossing Behaviour between Normal Traffic Conditions. *International Journal of Scientific Development and Research (IJS DR)*, 4(7), 91–96.
11. Subramanyam, B., & Prasanna Kumar, R. (2017). Improving pedestrian facilities in congested urban areas: A case study of Chennai city. *IOP Conference Series: Earth and Environmental Science*, 80(1). <https://doi.org/10.1088/1755-1315/80/1/012059>
12. Zhang, Y., Azzali, S., Janssen, P., & Stouffs, R. (n.d.). *Designing walkable neighbourhoods in Singapore using Form- based Codes*. 1–16.