RESEARCH ON BEHAVIOURAL ANALYSIS OF TRAFFIC AT SELECTED INTERSECTION OF RAJKOT CITY

Vivek Kamani[1], **M.R.Bhatt**[2]

[1] *Student , Department of Civil Engineering ,Atmiya Institute of Technology and Science- Rajkot ,Gujarat,India*
[2]*Assistant Professor , Department of Civil Engineering ,Atmiya Institute of Technology and Science-Rajkot ,Gujarat,India*

ABSTRACT

In urban areas, traffic is a major problem. Traffic behaviour is analyzed for the provision of proper facilities at desired locations, as well as to improve the safety of road user and pedestrians while crossing the road. This paper presents the analysis of Traffic behaviour from a study conducted at Rajkot city. The effect of pedestrian characteristics like age, gender and that of carrying baggage and luggage as well as their crossing patterns were examined. Pedestrian flow characteristics like crossing time and waiting time also analyzed. Crossing patterns were observed for different age group and gender. The effect of different types of vehicles on traffic is also examined by considering various factors like waiting time and crossing time of vehicles. The main motivation of this study is to investigate the pedestrian road crossing behaviour at the intersection under mixed traffic condition. Traffic behaviour at intersection has been modeled by the Pedestrian crossing speed using multiple linear regression (MLR) technique.

Keyword : - *traffic behaviour , pedestrian crossing behaviours , pedestrian crossing pattern*

1. INTRODUCTION

For any Transportation system it is efficient to have continuous movement of vehicles and passengers without any disturbances, but all the time it is not possible to have continuous movement without any disturbances. So it is required to analyze the movement of vehicles and pedestrians. If we analyze the traffic of vehicles and pedestrians then we can remove some deficiency and improve the efficiency of transportation system. Traffic Behaviour Gives the idea about the type of traffic i.e. it may be vehicles traffic or pedestrians traffic or mixed traffic. If we know about the behaviour of traffic by analysis of traffic then and then we can provide some possible solution to reduce the traffic conjunctions to decrease the accident, pollution, time delay, cost of journey. Various Factors like speed, Size, Shape, Weight, Velocity, and Acceleration, of all the vehicles are not same, Which Create Different types of traffic on that route. i.e. Traffic for long time or Traffic for short time , Traffic of large space or Traffic of Small space. So the type of vehicles affect on vehicles waiting time and vehicles crossing time. Pedestrians may be of men , women , kids , old people .based on age , gender , crossing patterns , etc. traffic behaviour may be different for different people. Waiting time and crossing time of various pedestrians are also different for peoples. In mixed type of traffic, vehicles and pedestrians both are there. Most problems are happen with this type of traffic. In this type of

traffic both pedestrians and vehicles are there so various behaviors of both of them affect on waiting time and crossing time of pedestrians and vehicles.

2. LITREATURE REVIEW

A. Mamidi Kiran Kumar , V. Kamakshi Prasad,(2015),” Driver Behavior Analysis and Prediction Models:A Survey”

In today's life, every human is in hurry to reach their destination like home, office, college, shopping mall, restaurant, etc as quickly as possible. To reach their destination quickly people use vehicles on road use and drive them in faster mode which results in road accidents. Driver behavior is a major cause for the road accidents. To address this problem, drive behavior analysis and prediction models need to be developed. In this paper we have discussed some of existing driver behavior models. These models are classified as two types: Driver behavior analysis and driver behaviour prediction models. In this paper we have carried out a detailed survey about the driver behavior analysis models and the driver behavior prediction models.

In conclusion, A survey has been conducted on driving behavioranalysis and prediction models till date. A more precise definition of driver behavior analysis models would focus on various methods to understand the driver behavior, and also give information regarding driver driving information. The driver behavior prediction models give predictions of the drivers’ driving nature whether the driving is safe or not. This paper enlightens various behavior models, which may help the researchers to carry out similar research work in this field in future..

B. Serag M.S,(2014),” Modelling pedestrian road crossing at uncontrolled mid-block locations in developing countries”

In this literature, The aim of this research is to investigate and model pedestrian road crossing behavior at uncontrolled mid-block in Egypt as one of the developing countries. In particular, two aspects of pedestrian crossing behaviors at mid-block locations have been examined, namely the size of traffic gaps accepted by pedestrians and the decision or not to cross the street, as well as the related determinants. A field survey was carried out at nine uncontrolled mid-block locations in different streets in three Egyptian cities. The locations were chosen with various street crossing widths to test the influence of this variable as it has not covered in previous pedestrian models. In this survey, pedestrian crossing decisions were videotaped in real traffic conditions. The survey period was 30 minutes for each location. Ten JPEG files were obtained from each second of video recording with the help of Snapshot Wizard software. The data collected included traffic characteristics (speed, type, etc.), individual characteristics (gender, age etc.), as well asindividual behavior (frequency of attempt, rolling gap, etc.). A lognormal regression model was developed in order to examine the effect of various parameters on the size of traffic gaps accepted by pedestrians. It was found that the accepted gaps depend on the speed of incoming vehicle, the pedestrian rolling gap, the frequency of attempts a pedestrian makes before crossing, the crossing width, and the age of the pedestrians. A binary Logit model was also developed in order to examine the effects of various parameters on the decision of pedestrians to cross the street or not. The results suggest that pedestrians’ decision to cross the street depends on the size of traffic gap, the vehicle speed, the pedestrian rolling gap, and the frequency of attempts before crossing .

In conclusion, A field survey was carried out at nine uncontrolled mid-block locations in different streets in three Egyptian cities. The purpose was to investigate pedestrian road crossing behavior under mixed traffic condition in urban areas. These behavioral characteristics are very useful to control pedestrian jaywalking behavior and for improving pedestrian safety. A lognormal regression model was developed in order to examine the effect of various parameters on the size of traffic gaps accepted by pedestrians. It was found that the accepted gaps depend on the speed of incoming vehicle, the pedestrian rolling gap, the frequency of attempts before crossing, the crossing width, and the age of the pedestrians. A binary Logit model was also developed in order to examine the effects of various parameters on the decision of pedestrians to cross the street or not. The results suggest that pedestrians’ decision to cross the street depends on the size of traffic gap, the vehicle speed, the pedestrian

rolling gap, and the frequency of attempts before crossing. The results of this research show that pedestrians rely mainly on rolling gap and accept small traffic gap size without much waiting at the curb, which proves that the behavior of pedestrians in Egypt is particularly non-compliant and often risk-taking, which is usual in many developing countries. Pedestrians' individual characteristics were found insignificant in crossing choice; only pedestrian's age and frequency of attempts were found to affect gap acceptance. It was found that pedestrians accept vehicular gaps with respect to vehicle speed rather than vehicle type. This can be justified by the fact that small vehicles may come with higher speeds and heavy vehicles may come with less speed. One of the new variables in the gap acceptance model is the crossed width between the curbs. It was observed that pedestrians may accept smaller gaps with short crossing distance. This is attributed to the fact that they reach the opposite curb in shorter safe time. Nevertheless, this variable was not significant in the crossing choice model.

C. Akash jain , Ankit gupta , Rajat rastogi,(2014)," PEDESTRIAN CROSSING BEHAVIOUR ANALYSIS AT INTERSECTION" International Journal for Traffic and Transport Engineering, 2014, 4(1): 103 – 116

In this literature, Pedestrian crossing behaviour is analyzed for the provision of proper pedestrian facilities at desired locations, as well as to improve their safety while crossing the road. This paper presents the analysis of pedestrian crossing behaviour from a study conducted at Roorkee city (Uttarakhand state in India). The effect of pedestrian characteristics like age, gender and that of carrying baggage and luggage as well as their crossing patterns were examined on pedestrian flow characteristics like crossing speed and waiting time. Crossing patterns were observed for different age group and gender.

In conclusion, among the crossing patterns more pedestrians crosses the roads in perpendicular direction and very few of them crosses the roads in two stages. The average crossing speeds at different study locations are varied with respect to various pedestrians' characteristics like gender, age category, baggage handling condition, traffic moving on road. Among them males and children have the higher crossing speeds. There is no significant variation in pedestrian's speeds due to handling of baggage. The pedestrian crossing behaviour analysis is the important factor for deciding the assurance of pedestrian safety on roads and the pedestrians waiting time can be used to decide the need of pedestrian facility in the area.

D . Mariya Khatoon, Geetam Tiwari, Niladri Chatterjee,(2013)" Binary Probabilistic Models for Pedestrians' Crossing Behaviour and Risk at the Free Left Turn: Delhi, India" Proceedings of the Eastern Asia Society for Transportation Studies, Vol.9, 2013

In this literature, Free left-turn lanes are common at major signalized intersections of Delhi to create additional capacity, and to facilitate continuous flow to left-turning traffic. The present study aims at examining the pedestrians' risk and road crossing behavior at free left-turns. Two most used binary probabilistic models, namely Logistic and Probit, were fitted to the data-set. Pedestrians cross the free left-turn when gaps are available within the traffic flow. Analysis of the data suggests that pedestrians' waiting time prior to the crossing of free left-turn is very less. Gap size is a significant parameter. Pedestrians' characteristics and type of conflicting vehicle do not influence their crossing behavior. Most of the pedestrians cross the free left turns with the gap size less than the adequate gap size. Both the univariate binary response Logistic and Probit regression models have been found to give similar results for the selected case.

In conclusion,Free left-turns provide very less waiting time but results in high risk to a pedestrian who crosses at the intersection. About 63% pedestrians crossed a free left-turn within one second of waiting. All the parameters (pedestrians' characteristic and type of conflicting vehicle) except the gap size available to pedestrian, are not contributing significantly in pedestrians' road crossing behaviour. The univariate Logistic and Probit regression models give comparable results to estimate pedestrian road crossing behavior at the selected free left-turn. Adequate gap size to cross the selected free left-turn obtained is 5.9 sec. Logistic regression model predicted that about 99% pedestrians crossed the free left-turn with a gap size less than the adequate gap size. Whereas, Probit regression model predicted that about 97% pedestrians crossed the free left-turn with a gap size less than the adequate gap size. Free left-turns are often introduced to reduce traffic congestion. However, the study shows the negative impact of free left turns on pedestrians. Therefore free left turns either should be controlled by traffic light or with speed control measures which ensures lower speed of turning vehicles, reducing the risk to pedestrians. Thus, a pedestrian actuated signal, traffic-calming devices such as raised pedestrian crossing to reduce vehicle speeds, synchronization within signal system or other crossing facility must be provided to ensure safe and convenient pedestrian crossings at these turns.

E . B Raghuram Kadali , P Vedagiri ,(2004)," Modelling pedestrian road crossing behaviour under mixed traffic condition". European Transport \ Trasporti Europei (2013) Issue 55, Paper n° 3, ISSN 1825-3997

In This literature,Pedestrian road crossings have become a major issue in road traffic flow, especially in urban areas where there is no controll for pedestrian road crossings. Pedestrian road crossing behaviour is a serious threat to pedestrians at uncontrolled midblock crossing locations in the mixed traffic conditions. Due to increase in motor vehicle growth there is an increase in the regulation of motor vehicles only and the regulation of pedestrian is completely neglected. This increases the uncontrolled road crossing behaviour of pedestrian. The main motivation of this study is to investigate the pedestrian road crossing behaviour at the uncontrolled midblock location in India under mixed traffic condition. Pedestrian road crossing behaviour at uncontrolled midblock has been modeled by the size of vehicular gaps accepted by pedestrian using multiple linear regression (MLR) technique. Also choice model has been developed to capture the decision making process of pedestrian i.e., accepted or rejected vehicular gaps based on the discrete choice theory. Suitable study stretch, which a four lane divided urban arterial in Hyderabad, India, was selected for data collection. The collected data consists of 4198 gap data points which include both accepted and rejected vehicular gaps. Pedestrians' road crossing behaviour has been explained in terms of minimum gap acceptance value by using a rolling gap (pedestrian roll over the small vehicular gaps). It has also been explained by the binary logit model with the help of vehicular gap size, frequency of attempt and rolling gap. The study concludes that the pedestrian behavioural characteristics like the rolling gap, driver yielding behaviour and frequency of attempt plays an important role in pedestrian uncontrolled road crossing. These inferences are helpful for pedestrian facility design and controlling pedestrian safety issues at uncontrolled crossings.

In conclusion,In this study the pedestrian behavioural aspects are considered at the microscopic level which includes variables such as observation duration at curb and median, number of observations at curb and median, observation duration while crossing, number of observations while crossing, speed change condition, crossing path change condition, frequency of attemptand rolling gap. These behavioural characteristics are principally dynamic for gap selection and gap acceptance under mixed traffic condition. These behavioural characteristics are very useful to control pedestrian jaywalking behaviour and for improving pedestrian safety. As pedestrian waiting time increases at the curb or median they may lose their patience and this leads to increase in the rolling gap behaviour to cross the road. Rolling gap behaviour is observed more with younger age groups, so the increase in age results in increase in accepted gap size.

F . B. Raghuram Kadali and Dr.P. Vedagiri(2012),"Pedestrians' Behavioural Analysis During Road Crossing" Proceedings of International Conference on Advances in Architecture and Civil Engineering (AARCV 2012), 21st – 23rd June 2012 Paper ID TRA106, Vol. 1

In This literature, Pedestrian gap acceptance is one of the most important components in microscopic traffic characteristic in pedestrian road crossing. Pedestrian road crossing needs a mathematical model of pedestrian gap acceptance behaviour, to capture exact behaviour of pedestrian during road crossing. In this paper, a gap acceptance model was developed based on the discrete choice theory. A binary logit model is considered to examine pedestrian behaviour on pedestrian road crossings. To develop this model, survey conducted at mid-block location at Ameerpet in Hyderabad. These real data are used to set up explanatory variables and to estimate the model. The probabilities of crossing the road an each pedestrian, it is the response to an encounter are identified for a variety of pedestrian physical characteristics, vehicular characteristics, pedestrian tactics and traffic conditions. Results shows that the most important explanatory variables included in the model are vehicular gap size, frequently attempting gap, rolling gap and vehicle speed plays main role in pedestrian gap acceptance while crossing the road. It is felt that the model performed well, the behaviour of the pedestrians' is well captured by pedestrians' tactics. It is useful technique for identifying the most hazardous situations and locations within an area, for pedestrian facilities planning relevant safety measures. It should be further studies required to know the heteroscedasticity between the pedestrian physical characteristics and fine tuning the model .

In conclusion,This paper studied and explained the pedestrians' gap acceptance behaviour at mid- block location without any pedestrian facilities by using binary logit technique. Thirteen factors are considered in the modelling; out of which four are identified to be significant enough to be included into the binary logit model. The main application of these results indicates those pedestrians are safe at un- marked road crossing with effect of included factors in the model. The result indicates that pedestrians' decision to cross the street depends on the traffic gap, frequency of attempting gap, rolling gap and vehicle speed. It was found that pedestrians crossing decisions are strongly associated with the pedestrian rolling gap condition and available gap size in the traffic stream. It is also

found that there is no significant effect of pedestrian physical characteristics on gap acceptance behaviour. On the argumentative, traffic flow conditions were found to be the most vital component of pedestrian crossing behaviour. The frequently attempting gap is significantly contributing on pedestrians' decision making process. In the present study vehicle speed also shows significant contribution on the pedestrian gap acceptance behaviour.

G . Miho Iryo-Asano , Wael Alhajyaseen , Xin Zhang , Hideki Nakamura " Analysis of Pedestrian Speed Change Behavior at Signalized Crosswalks "Road Safety & Simulation International Conference

In This literature, Pedestrian–vehicle conflicts are one of the most important safety concerns at signalized intersections. In Japan, more than one-third of traffic fatalities are pedestrians, and most accidents occur as pedestrians cross a road. In this study, continuous pedestrian speed profiles were analyzed at signalized crosswalks considering the impact of the crosswalk geometry and signal timing. A methodology is proposed to identify significant sudden changes of pedestrian speeds. Such speed changes cannot be predicted by drivers, which can lead to safety hazards. The locations and timings of these sudden speed change events were analyzed, and the influencing factors were evaluated. Five signalized crosswalks at three intersections in Nagoya City were videotaped for analysis. Individual pedestrian maneuvers were extracted with image processing software. Empirical analysis showed that sudden acceleration events were observed at the entrance points to the pedestrian–vehicle conflict area, which highlights the significance of these events to pedestrian–vehicle conflict analysis. A multinomial logit model was developed to estimate the probability of a pedestrian making a sudden speed change as a function of different influencing factors. The results implied that the entering speed, necessary speed to finish crossing before the onset of the pedestrian signal red phase, and crosswalk length have a significant impact on speed change choices. This paper presents important suggestions to understanding pedestrian maneuvers in detail from the viewpoint of safety.

In conclusion,A simple demonstration based on the empirical data showed that sudden speed changes may have a significant impact upon the decision-making of approaching vehicles in conflict. - A methodology to extract instant and significant speed change events is proposed. This method is useful for clearly and statistically identifying potentially dangerous locations and timings. According to the empirical analysis, the location distribution of acceleration events is concentrated at the entrance points to the pedestrian– vehicle conflict area for both far-side and near-side pedestrians.

3. RESEARCH METHODOLOGY AND DATA COLLECTION

To analyzed the behavior of pedestrians and vehicles it is required to have data of number of pedestrians , age ,gender , crossing patterns of pedestrians and avg. waiting time and avg. crossing time of pedestrians. Same thing is required for the vehicles analysis.for that it is required to have data of type of vehicles , number of vehicles , etc. Depending on the prevailing roadway conditions and abutting land use, two different methods were adopted for collection of traffic data for this study. Where the abutting land use patterns were favorable for placing the video camera at the suitable location to cover the traffic movement on selected stretch of road, the video graphic method was used for collection traffic data all the road stretches considered under this study were operating under mixed traffic condition. However, the average composition of traffic varied from one location to the others.

Table -1: various factors which affect on traffic behaviour

Sr. No.	Parameters	Sr. No	Parameters
1	Type of pedestrians	8	No. of 2w
2	Age of pedestrians	9	No. of 3w
3	Genders of pedestrians	10	No. of cars
4	Pedestrians crossing patterns	11	No. of buses
5	Pedestrians with or without baggages	12	No. of lcv + hcv
6	Avg. waiting time of pedestrians		
7	Avg. crossing time of pedestrians		

4. DATA ANALYSIS

The analysis of traffic data shows the relation of crossing time of various pedestrians with respect to their age , gender , crossing patterns etc. normally every pedestrian have not the same behavior on crossing and same as every vehicles have same crossing patterns.So after collecting the data of pedestrians and vehicles the analysis is done on the basis of various parameters which shows the total numbers of pedestrians and among them how much males and females are there and also as per age , how much child , young , middle aged , old pedestrians are there.Same thing is analysed for vehicles like how many total numbers of vehicles passing through that location in fixed time period , amoung them how many vehicles are 2w , 3w , cars , buses , lcv , hcv etc. Linear regression model is developd for the analysis of the behavior of traffic at fixed location consist of all those factors of traffic behavior.

Classified Volume Count Of Pedestrian:

- Mavdi Chowk Intersectionintersection

LEG A: - Direction towards to Madhapar Chowk Intersection
LEG B: - Direction towards to Gondal Road
Leg C: - Direction towards to Umiya Chowk
Lag D: - Direction Towards to BapaSitaram Chowk

4.1 Analysis Of Pedestrians By type of pedestrian:

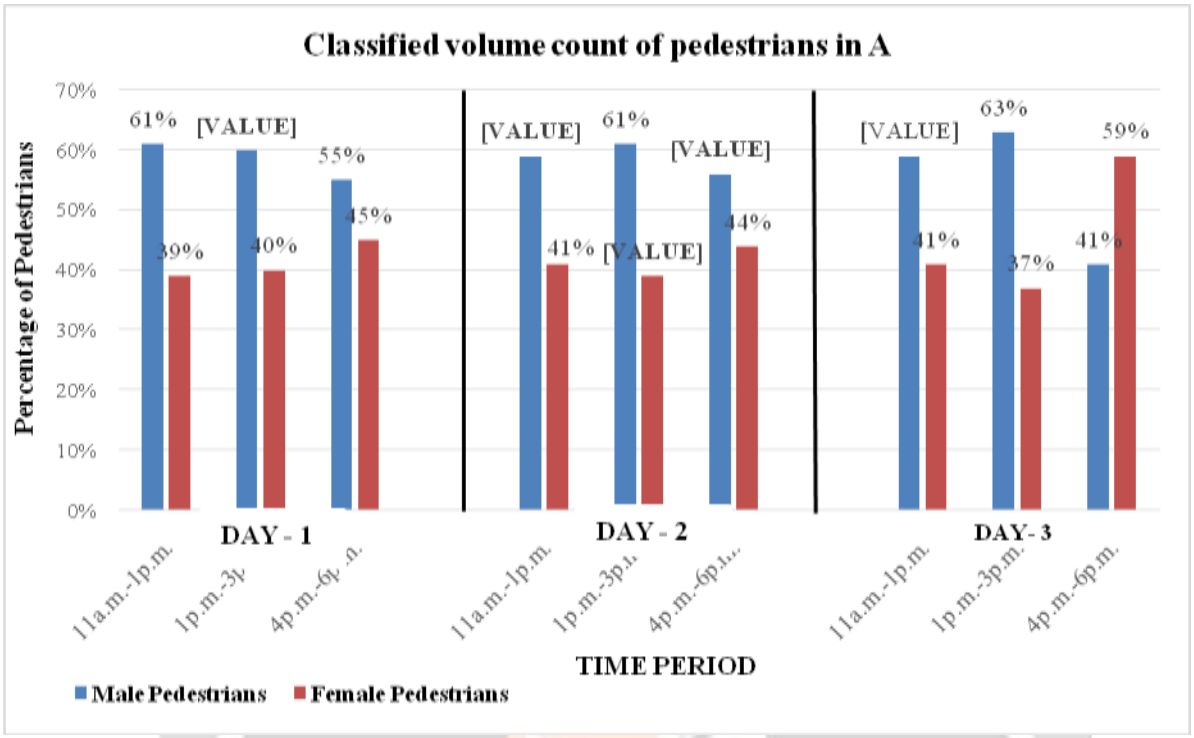

Figure 4-1 Classified volume count of pedestrians in lag A

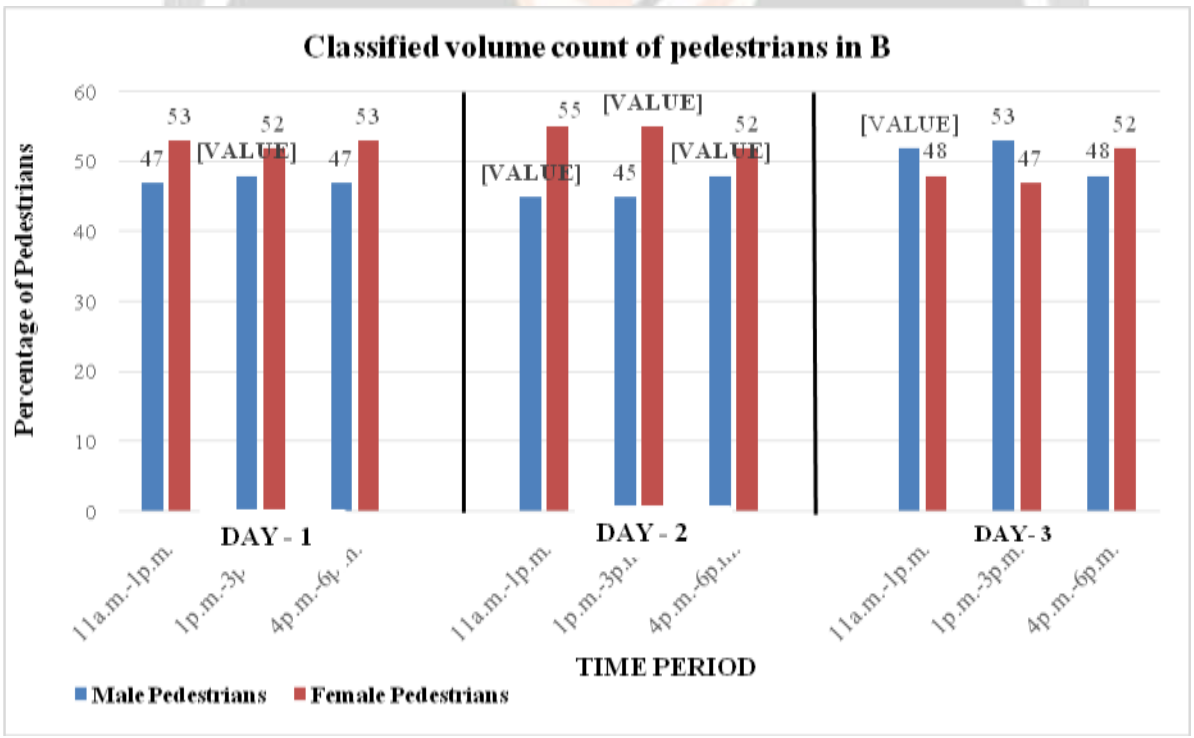

Figure 4-1 Classified volume count of pedestrians in lag B

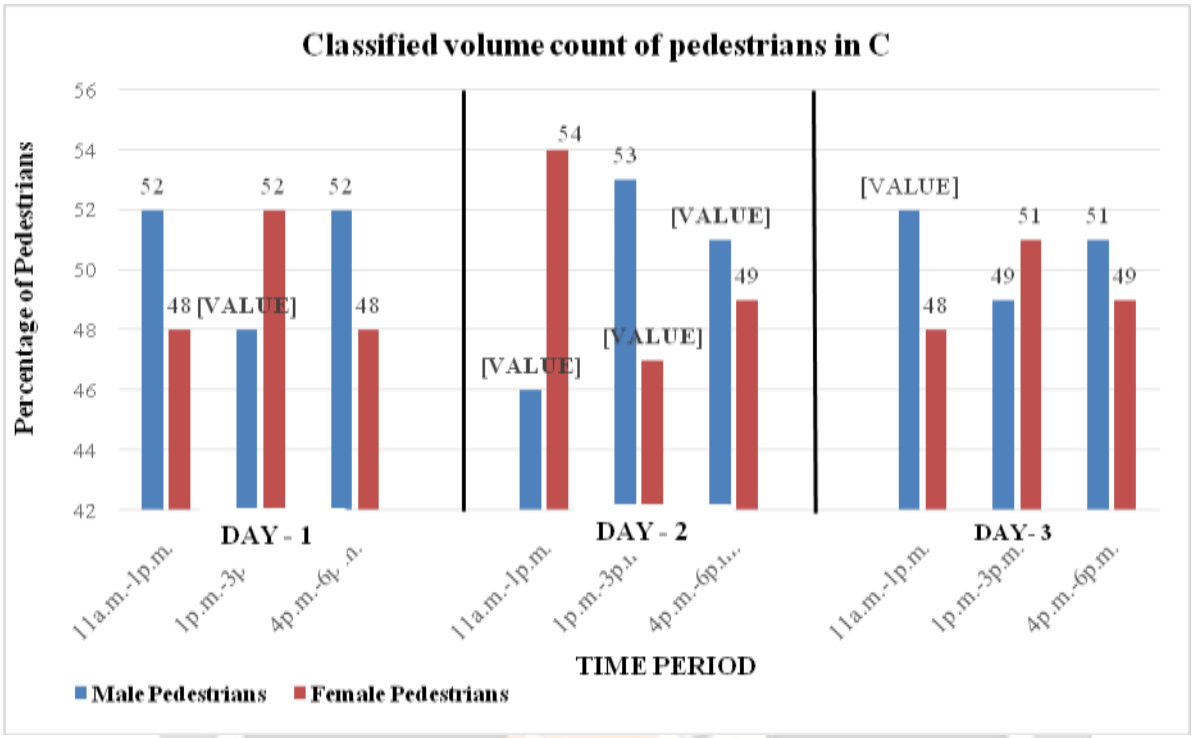

Figure 4-3 Classified volume count of pedestrians in lag C

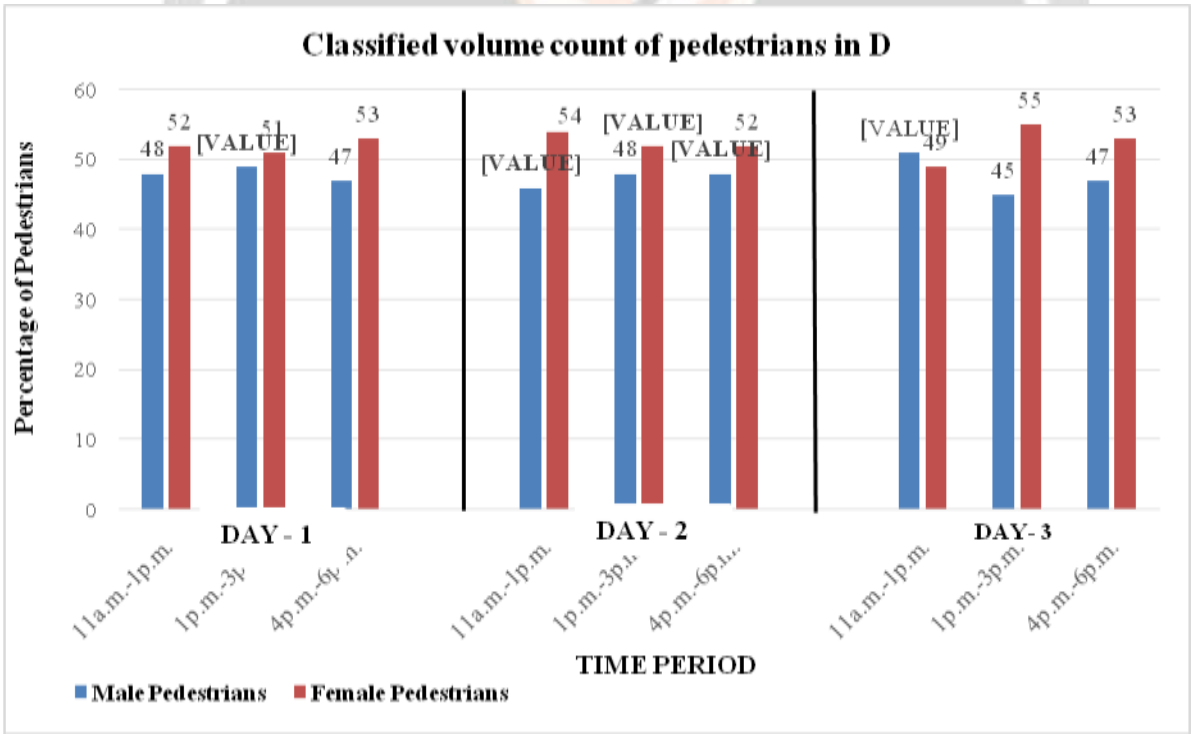

Figure 4-4 Classified volume count of pedestrians in lag D

4.2 Analysis Of Pedestrians By Age Group:

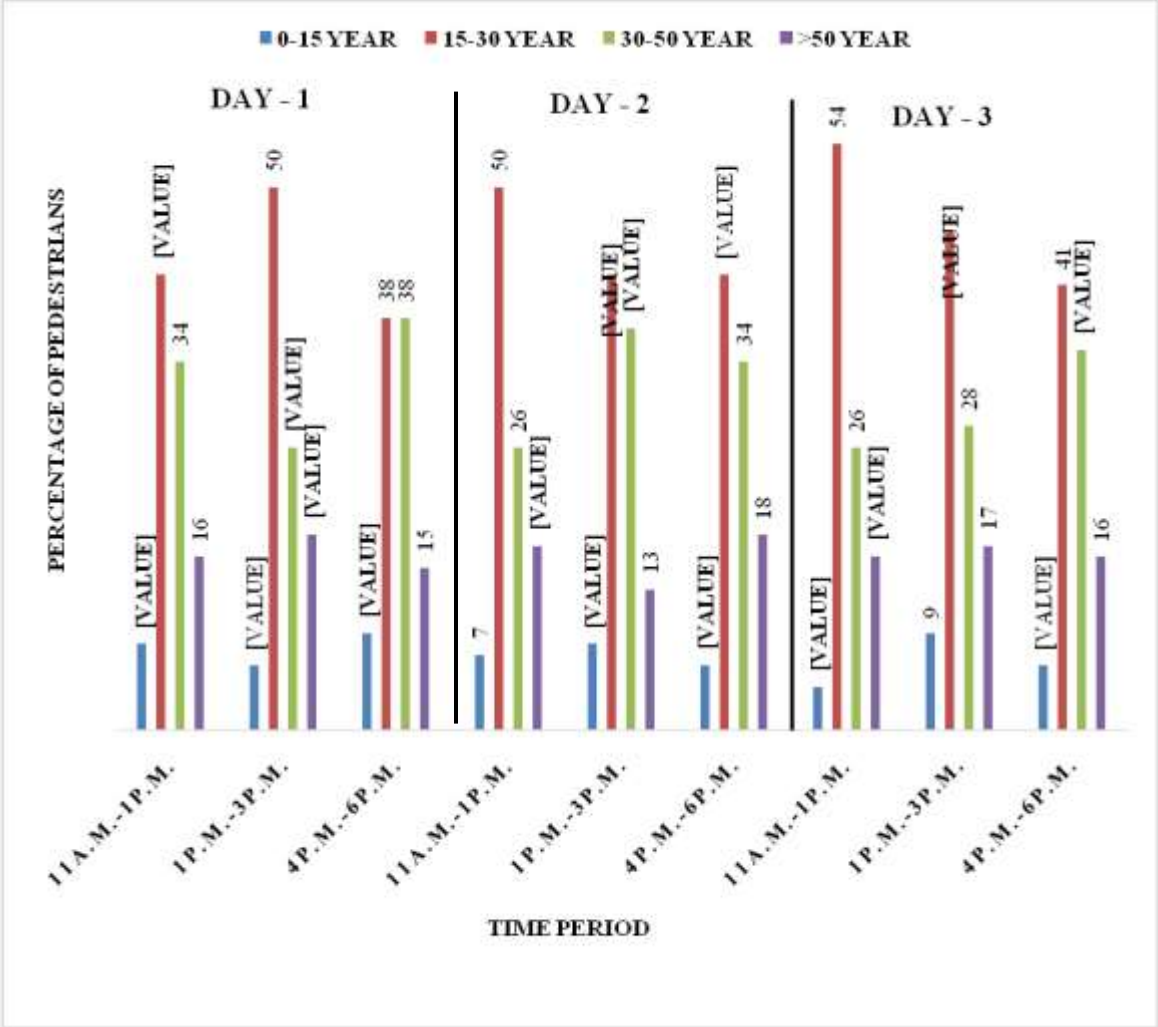

Figure 4-2 Analysis of pedestrian Age Group in LAG A

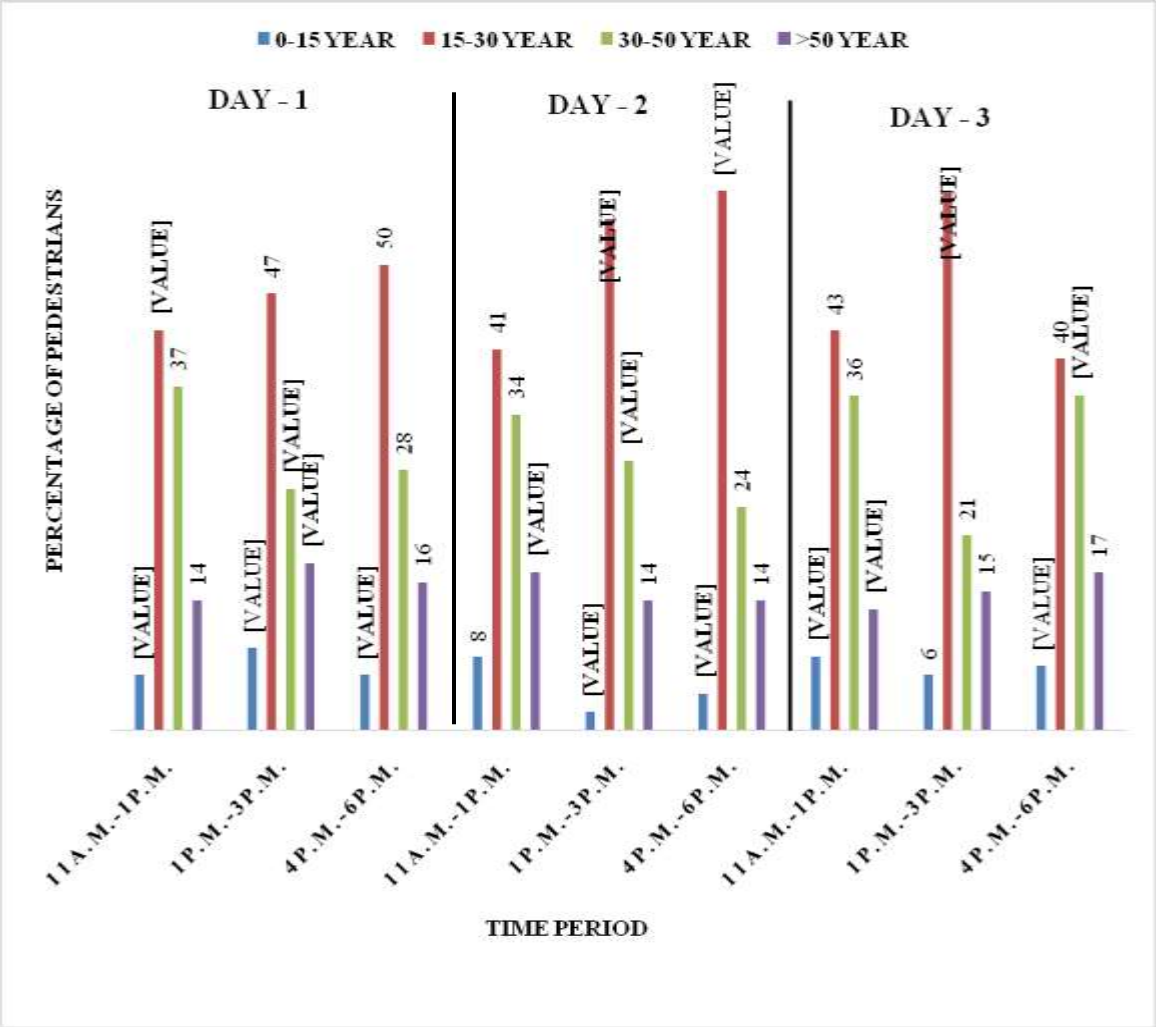

Figure 4-6 Analysis of pedestrian Age Group in LAG B

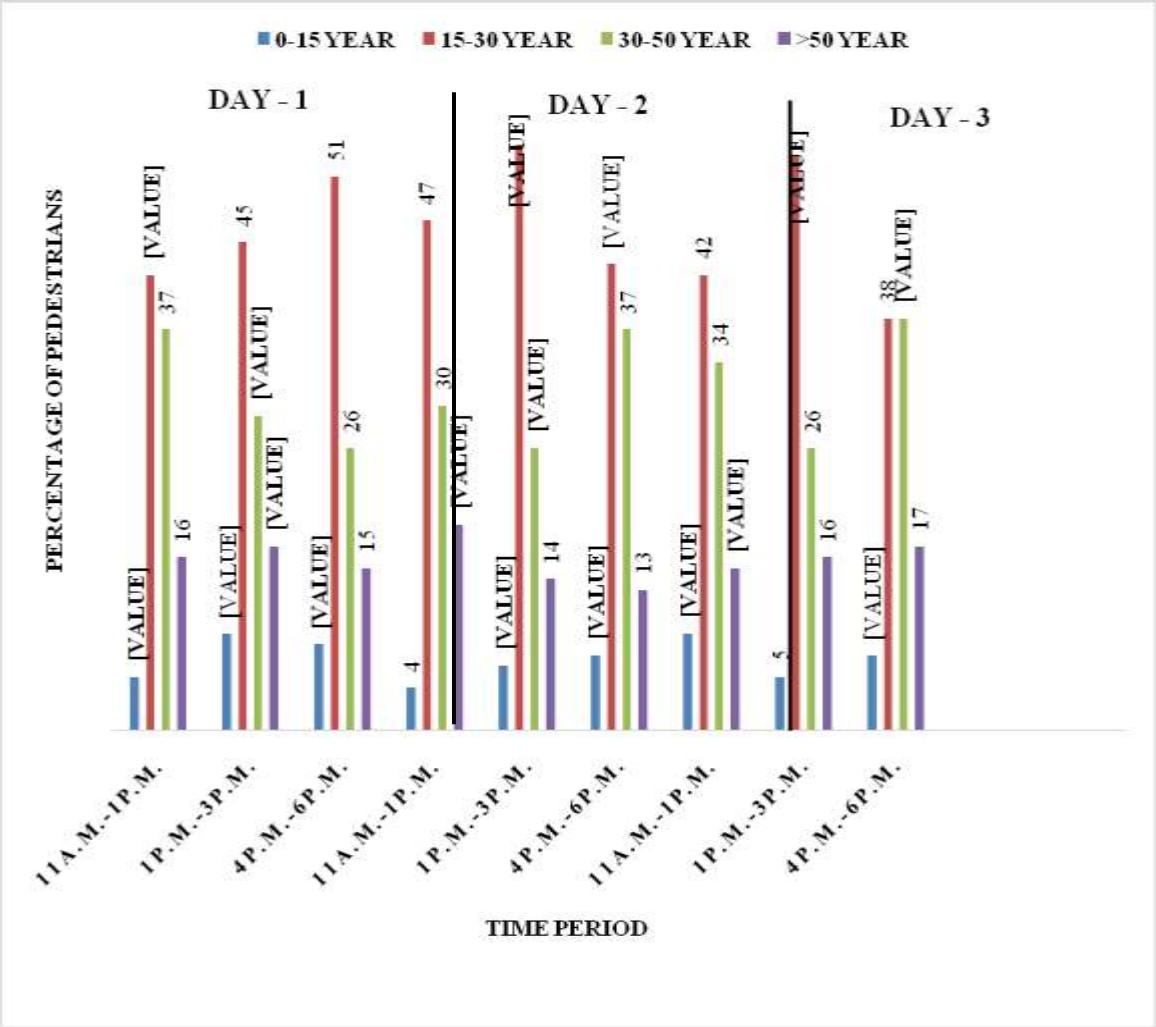

Figure 4-7 Analysis of pedestrian Age Group in LAG C

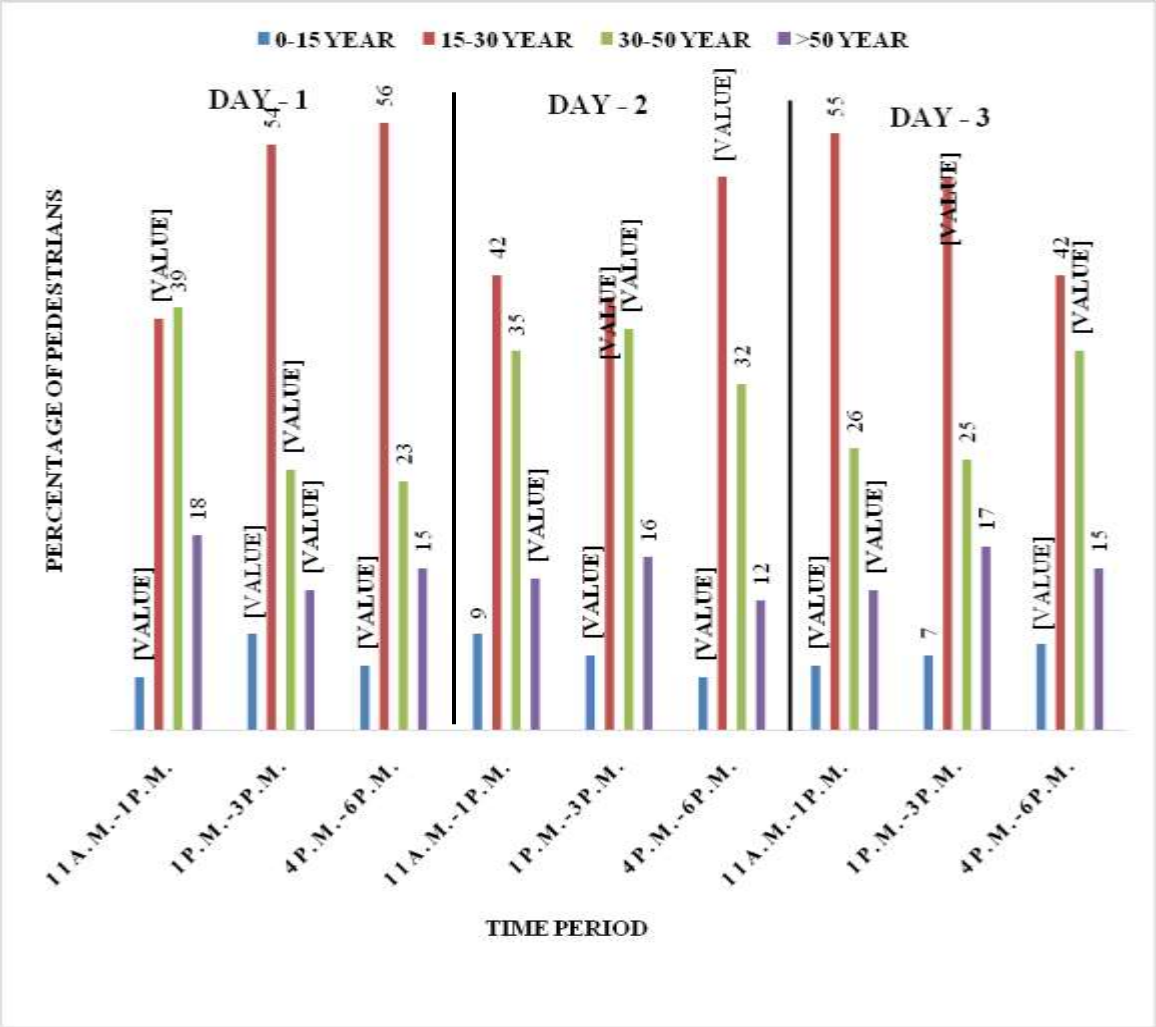

Figure 4-8 Analysis of pedestrian Age Group in LAG D

4.3 Analysis of Pedestrian Crossing Direction:

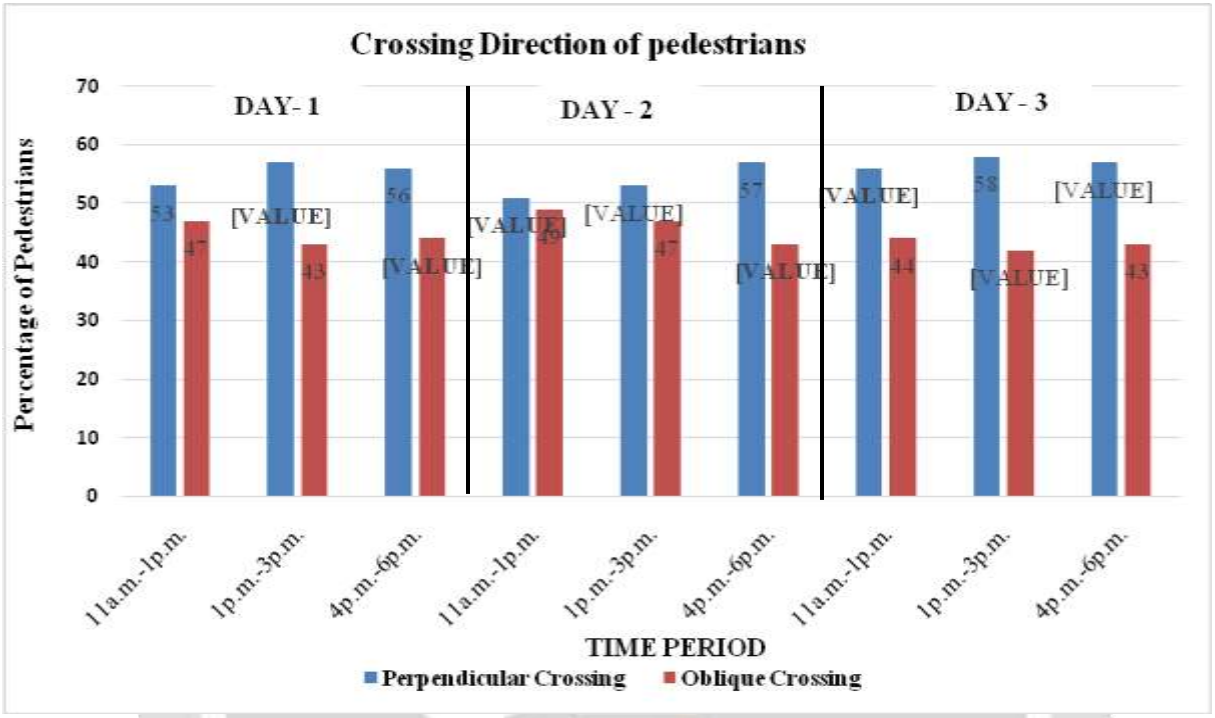

Figure 4-9 Analysis of Pedestrian Crossing Direction in LAG A.

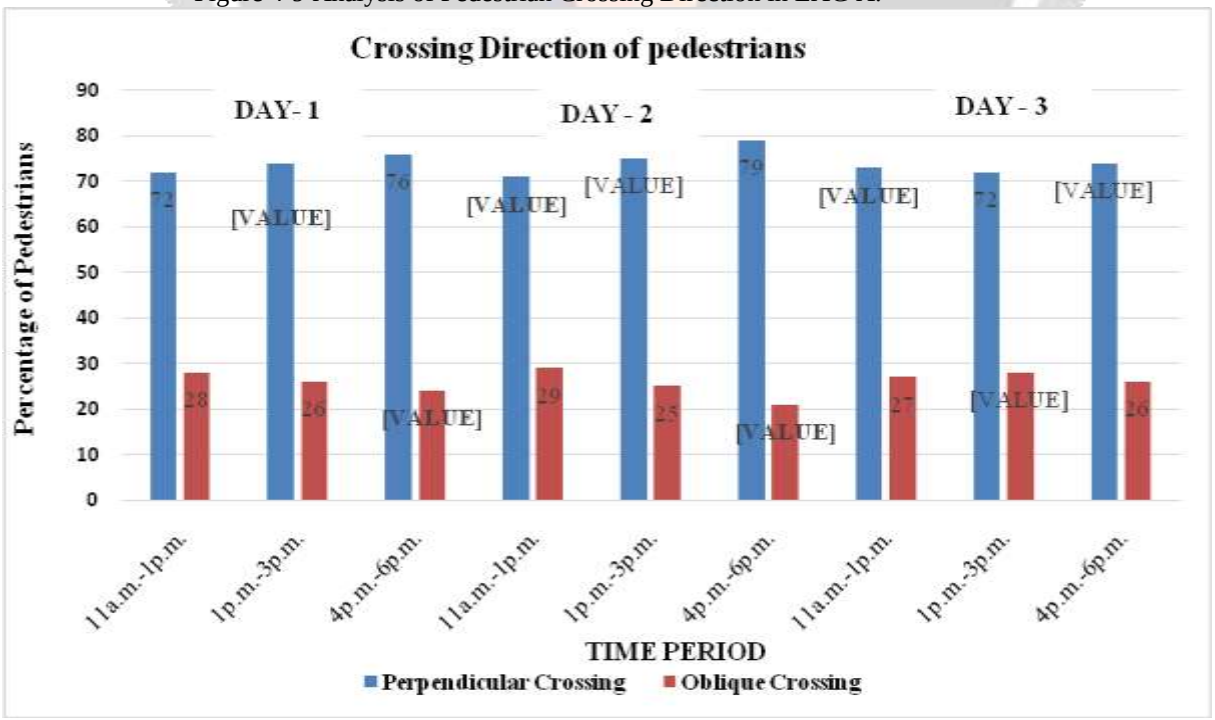

Figure 4-10 Analysis of Pedestrian Crossing Direction in LAG B.

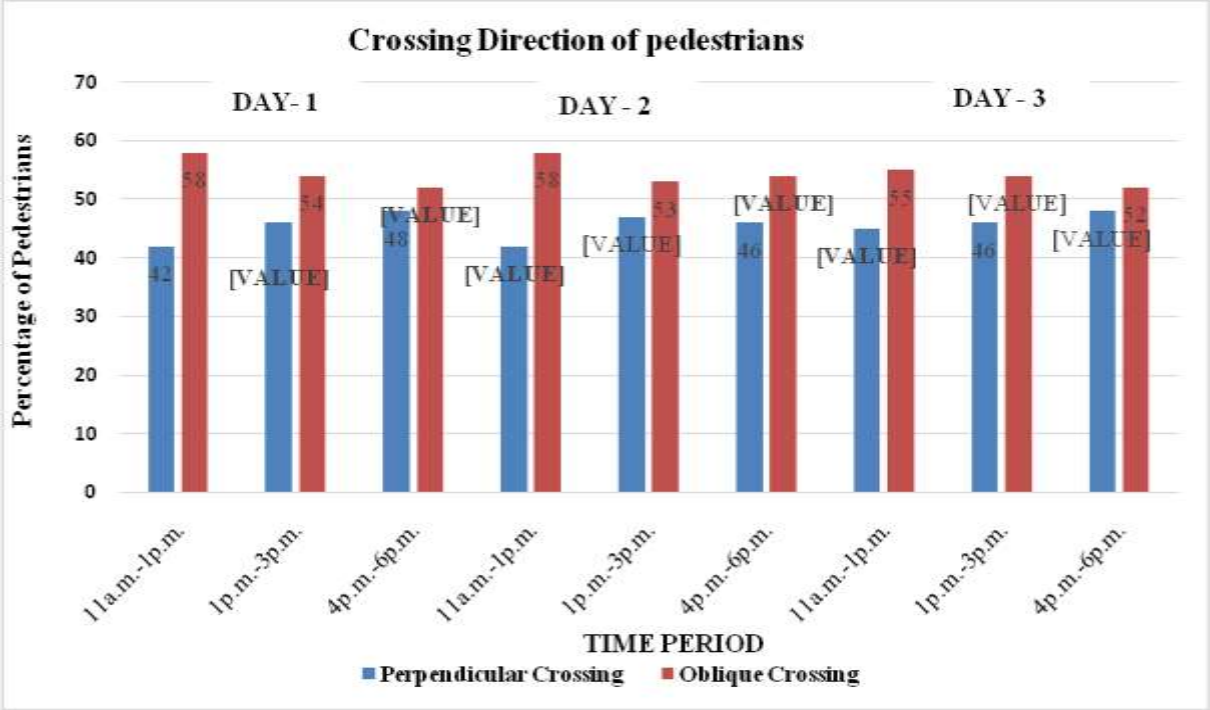

Figure 4-11 Analysis of Pedestrian Crossing Direction in LAG C

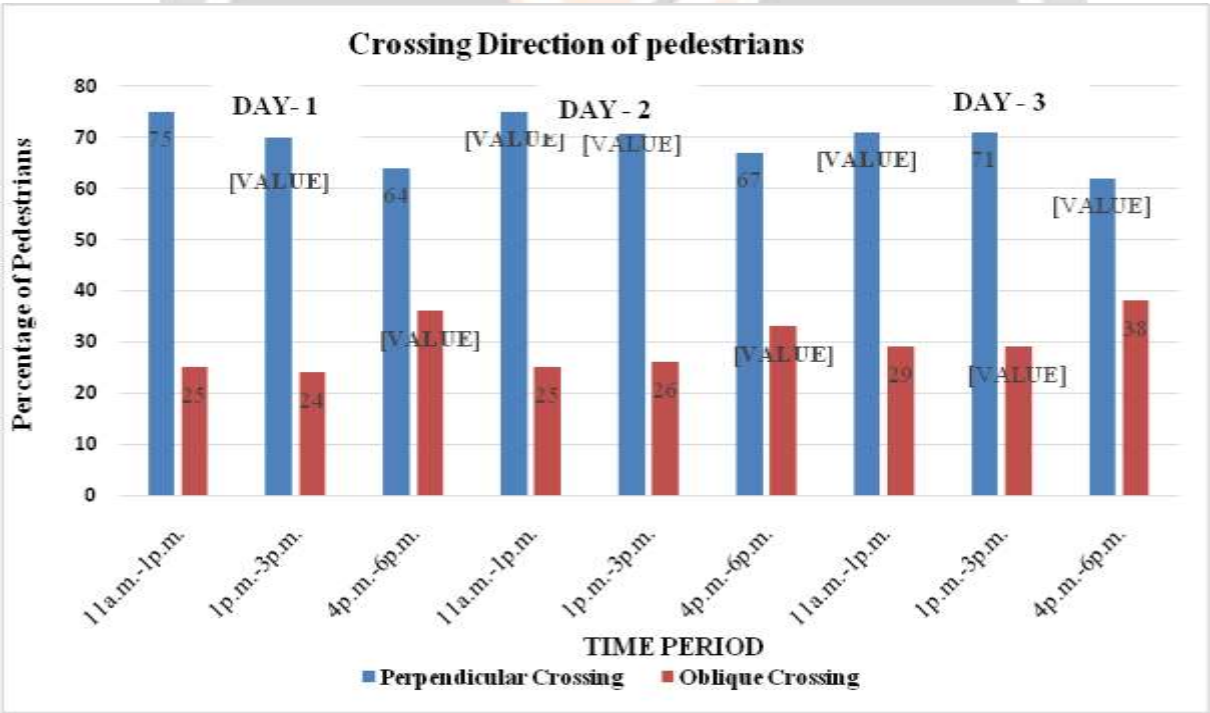

Figure 4-12 Analysis of Pedestrian Crossing Direction in LAG D

4. CONCLUSIONS

This study was conducted to analyzed the behavior of traffic at intersection which shows the relation of various parameters on crossing speed of pedestrians . the speed is not same for all the pedestrians at all the place. Generally male pedestrians have more speeds compare to female pedestrians and also speed of child and young is also more compare to old and middles aged pedestrians. Female pedestrians do not accept small gaps and require more time to cross.

5. REFERENCES

[1]. R Mamidi Kiran Kumar , V. Kamakshi Prasad,(2015)," Driver Behavior Analysis and Prediction Models:A Survey" International Journal of Computer Science and Information Technologies, Vol. 6 (4) , 2015, 3328-3333

[2]. R Serag M.S,(2014)," Modelling pedestrian road crossing at uncontrolled mid-block locations in developing countries" international journal of civil and structural engineering volume 4 , no 3 , 2014

[3]. R Akash jain , Ankit gupta , Rajat rastogi,(2014)," PEDESTRIAN CROSSING BEHAVIOUR ANALYSIS AT INTERSECTION" International Journal for Traffic and Transport Engineering, 2014, 4(1): 103 – 116

[4]. R Mariya Khatoon, Geetam Tiwari, Niladri Chatterjee,(2013)" Binary Probabilistic Models for Pedestrians' Crossing Behaviour and Risk at the Free Left Turn: Delhi, India" Proceedings of the Eastern Asia Society for Transportation Studies, Vol.9, 2013

[5]. R B Raghuram Kadali , P Vedagiri ,(2004)," Modelling pedestrian road crossing behaviour under mixed traffic condition". European Transport \ Trasporti Europei (2013) Issue 55, Paper n° 3, ISSN 1825-3997

[6]. R B. Raghuram Kadali and Dr.P. Vedagiri(2012),"Pedestrians' Behavioural Analysis During Road Crossing" Proceedings of International Conference on Advances in Architecture and Civil Engineering (AARCV 2012), 21st – 23rd June 2012 Paper ID TRA106, Vol. 1

[7]. R Miho Iryo-Asano , Wael Alhajyaseen , Xin Zhang , Hideki Nakamura " Analysis of Pedestrian Speed Change Behavior at Signalized Crosswalks "Road Safety & Simulation International Conference