

# LEVEL OF SERVICE AT SIGNALIZED MIDBLOCK LOCATIONS FOR MIXED TRAFFIC CONDITION

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**Abstract** - This paper discusses the problems faced by the pedestrians due to ignorance during the planning, design and maintenance stage. Due to the increase population, traffic congestion has become a major problem for safe pedestrian crossings. This paper includes the study of pedestrian behavior at signalized midblock considering parameters such as safety, comfort, convenience and minimum delay. In this paper, level of service (LOS) is used to quality of pedestrian service at selected signalized midblock based on their crossing speed and delay. The parameter delay, speed, density, and flow are retrieved manually by mounting camera at certain elevation.

The present study is attempted to understand such delay due to crossing pedestrians at undesignated midblock locations through literature review

**Keywords:** Delay; Level of Service; Pedestrian; Midblock

## 1. INTRODUCTION

Walking is considered as one of the most significant modes to commute in Indian situation. It is seen that a large portion of the pedestrian issues are disregarded during design and planning stage. Until the mid-seventies, pedestrian traffic has scarcely been the subject of research where just pedestrian behavior was seen by watching and inferring simple theories and by inferring models to decide the behavior of pedestrians. Recently, where more advancement that is recently increased the technology became available and pedestrian models have been easily developed to understand their behaviors and to measure the quality of services. In spite of these advancements, no legitimate consideration is given to pedestrian facilities. Since no appropriate consideration is given to these facilities, pedestrian mishaps have transcendently expanded. Pedestrians are the most vulnerable road users where the fatality rate is very high in developing countries. In developed countries, sidewalks and midblock crosswalk are provided on an urban street segment as a part of the roadway segment where pedestrians are allowed to walk and cross the lanes. On the other hand, in developing countries, Walking facilities for pedestrians like footpaths or sidewalks are minimal, and in most of the cases, these facilities are not suitable for various age groups of pedestrians. Pedestrian crossing facilities like a foot over bridge or underpass are scarce. Even though if such facilities are provided, pedestrians used to cross at grade to save time or inadequate facilities. During such crossing operations,

pedestrian use force gap to cross the road and force the approaching vehicles to change the path or apply the break to avoid conflict. Interruption due to pedestrian crossing movement at the urban midblock section would impact the performance of an urban street segment. Such interruption cause delay to the vehicular traffic. The Highway Capacity Manual (HCM, 2010) defines six levels of services for each type of facilities, from A to F, where "A" denotes the best-operating conditions and "F" denotes as the worst operating condition. Same way, Indian Highway Capacity Manual (Indo-HCM, 2017) also designates six levels of services for mixed traffic condition. The present study attempted to estimate such delay due to crossing pedestrians at undesignated midblock locations. LOS has been defined based on delay incurred to vehicles due to the pedestrian crossing and V/C ratio.

The number of such un-protected mid-block pedestrian road crossing activities has been increasing in Indian context and growth of these activities may also result in pedestrian accidents. The increase in unprotected midblock pedestrian road crossings has been a significant effect on vehicular characteristics such as an increase in travel times and a decrease in vehicle speed. At signalized midblock and intersection, there is the complete right-of-way to pedestrians and vehicles as it results a decrease in pedestrian and vehicle conflicts as well as the severity of conflicts. In general, there are two types of crossings i.e. at-grade and grade separated. If the pedestrians are completely segregated (grade separated) with vehicular traffic, then there is no effect of pedestrian crossings on vehicular flow characteristics. The grade-separated facilities are provided exclusively based on the vehicle as well as pedestrian traffic intensity. If such grade separated crosswalks are too apart from each other, then pedestrians either change their road crossing choice according to their destination which will result in more travel time or pedestrian will use forced gaps to cross the roads. Also, due to poor construction of grade separated facilities and roadside development, pedestrians usually cross the road at unprotected mid-block locations under mixed traffic conditions. However, in mixed traffic condition, it is very rare to get adequate vehicular gaps to cross the road. Hence, pedestrians will exhibit non-complaint road crossing behavior, causing more interference with vehicles. It leads to a rigorous change in vehicular flow characteristics such as speed and flow. The present study is

carried out with the objective to study traffic flow characteristics at such sections.

## 2. LITERATURE REVIEW

**Teja Tallam, K. M. Lakshmana Rao –“ Pedestrian Level of Service at Signalized Midblock Locations for Mixed Traffic Conditions”**- Mid-block crosswalks act as connectors between adjoining activities based on a particular land-use type. At mid-blocks, under un-signalized conditions, there are higher chances of conflicts between the crossing pedestrians and approaching vehicles. This paper aims in understanding pedestrian characteristics or pedestrian behavior which is a fundamental in pedestrian planning process and finding the level of service for the pedestrians (PLOS) at selected signalized midblock.

**Avinash Chaudhari, Ninad Gore, Shriniwas Arkatkar - “Exploring pedestrian surrogate safety measures by road geometry at midblock crosswalks”**- Pedestrians mostly cross the road at the midblock section to access the place of their interest. During such crossing operations, pedestrian use force gap to cross the road and force the approaching vehicles to change the path or apply the break to avoid conflict. Such pedestrian activity causes interruption to vehicular flow and ultimately cause delay to the vehicular traffic. This paper attempts to evaluate pedestrian safety at urban midblock crosswalk using different surrogate safety measures, including vehicle crossing speed, post encroachment time (PET), yielding compliance of driver as well as pedestrian, and conflict rate. The number of conflicts were observed to increase as the average vehicle crossing speed increases, indicating that pedestrians are extremely vulnerable while crossing the road. This paper attempts to evaluate pedestrian safety at urban midblock crosswalk using different surrogate safety measures, including vehicle crossing speed, post encroachment time (PET), yielding compliance of driver as well as pedestrian, and conflict rate.

**B. Raghuram Kadali and P. Vedagiri -" Review of Pedestrian Level of Service "**-Pedestrian LOS at crosswalks is quite different from that on sidewalks. A measure of effectiveness (MOE) is usually adopted for evaluation of pedestrian facilities, and the MOE changes with the type of facility. Pedestrian delay and space at the corner are considered as MOEs for signalized intersections. The MOE might depend on pedestrian safety, delay, available vehicle gaps (crossing difficulty), and behavior of pedestrians as well as that of vehicle drivers at unprotected midblock crosswalks. This study sought to identify the importance of pedestrian LOS in the context of developing countries, particularly at unprotected midblock crosswalks. Review of the literature was carried out on the pedestrian LOS at various facilities such as the sidewalk, intersection and midblock crosswalk and highlighted the need for further pedestrian LOS studies at various facilities under mixed traffic.

**Haresh Kumar Dahyabhai Golakiya, Ashish Dhamaniya–“To Study Traffic Characteristics of Urban Midblock Section Influenced by Crossing Pedestrians under Mixed Traffic Conditions”** - Pedestrian is one of the important components in the urban transportation system and also vulnerable at un-protected mid-block locations under mixed traffic conditions. Pedestrian is one of the important components in the urban transportation system and also vulnerable at un-protected mid-block locations under mixed traffic conditions.

**Lakhan Verma, Prof. Shashikant Dhobale-" Traffic Study on Mid-Block Section & Intersection "-**

The present study carried out to study traffic characteristics like speed and capacity of such friction section and compared the same with the base section. This paper aims to study the necessity for higher geometric style, capacity, signals, route marking, street lighting etc. during this constant quantity study, level of service (LOS) of various phase has been much disbursed in post office destination points facing heaviest traffic issues.

**B. Raghuram Kadali and P. Vedagiri-" Pedestrian Crossing Treatment Warrants for Midblock Crosswalks Under Mixed Traffic Conditions "**- Pedestrian safety is generally assessed using frequency of crashes, based on historical data, for a given transportation facility. The present study carried out to study a wide range of applications in the design of new crosswalk facilities or in the improvement of existing pedestrian crosswalk facilities under mixed traffic conditions.

**Bhadradri Raghuram Kadali, Perumal Vedagiri -" Pedestrian Quality of service at unprotected Mid- block crosswalk locations under mixed traffic conditions: Towards quantitative approach”**- This study is aimed at identifying the factors contributing to the pedestrian QOS. The developed model may be useful for design and evaluation of the existing pedestrian QOS at unprotected mid-block crosswalk locations under mixed traffic conditions.

**Micheal Baltes, Xuehao Chu - "Pedestrian Level of Service for Midblock Street Crossings”**-Pedestrian road crossing behaviour is a serious threat to pedestrians at uncontrolled midblock crossing locations in the mixed traffic conditions. This paper showed that both the presence of pedestrian's signals and cycle lengths are statistically significant. This paper attempts to evaluate pedestrian safety at urban midblock crosswalk using different surrogate safety measures, including vehicle crossing speed, post encroachment time (PET), yielding compliance of driver as well as pedestrian, and conflict rate.

**Hareshkumar Dahyabhai Golakiya, Ashish Dhamaniya-" Evaluating LOS at Urban Midblock Section under the Influence of Crossing Pedestrians in Mixed Traffic Conditions"**- Vehicle and pedestrian interactions in urban areas have amplified in recent times because of rapid urbanization and vehicular growth. This amplified pedestrian-vehicle interaction and conflicts especially at crosswalks poses serious pedestrian safety concerns the present study attempted to estimate such delay due to crossing pedestrians at undesignated midblock locations. The study concludes that the pedestrian behavioral characteristics like the rolling gap, driver yielding behavior and frequency of attempt plays an important role in pedestrian uncontrolled road crossing.

### 3. CONCLUSIONS

LOS scores are developed using K-mean clustering analysis for the obtained speeds and are compared with the Indo HCM 2017 methodology. As the present PLOS the LOS scores mostly lie in between B and D, as the demand increases facilities has to be improved to cater to the future pedestrian volumes. Different techniques like Cellular Automata can be applied for microscopic analysis of the data. Further analysis can be considered using pedestrian age, gender, with or without baggage, purpose of the walking trip etc. Further research can be extended to develop criteria for PLOS at signalized midblock for different types of roads.

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