

# Research On Unsignalized Intersection With Left And Right U-turn

NEERAJ AGARWAL

*Civil Engineering department, Krishna Institute of Engineering and Technology  
Ghaziabad - Meerut Highway, NH-58, Ghaziabad, Uttar Pradesh  
India- 201206*

## Abstract

The objective of this study is to determine the safety and operational effect of U-turns at unsignalized median openings. This paper addresses research results on access management strategies that increase U-turn volumes at unsignalized median openings that can be used safely and efficiently. The frequencies of accidents happening at low median openings and no satisfactory regression relationships relates to the fact on the alarming necessity of the volume of U-turn and left-turn maneuvers through the central opening to be developed. These Intersections are a composite region of a road section where vehicles can resolve to divergent directions. Traffic flow on the road has always been a dilemma on how to reach a destination at the earliest possible, at such situations the drivers do not follow traffic rules at signals especially, when red light is on and cross the intersection of the road. Due to these activities, rate of accidents are increasing day by day. Thereby, one individual's fault can affect the whole traffic mobility. In India, it is often not possible to extend full of the road on the ground due to area scarcity sideways as well as elevated constructions like metro via duct (flyover). Ever growing traffic volume and manual system of controlling intersection take off too many working hours on the road. Thus, this research points out to the fact on reducing congestion through existing roadway conditions and features an important aspect that, intersections are an integrated element of traffic system and can bring useful contribution in reducing vehicular delay due to traffic.

Another likely problem associated in the city is, it follows the all-way stop control intersection resulting in a massive congestion of vehicles at peak hours, which makes it challenging for the traffic police to control the vehicle flow nimbly. Therefore, to address all the above concerns this paper provides an ideology on restricted flow of the traffic to which a driver has to necessarily abide the traffic rules at intersections, traffic signals without taking an alternative stream for red light at intersection and decrease the rate of accidents on road. Also, provided a way to increase length of traffic mobility and lessen travel time.

**Keywords-** Median openings, Intersections, U-turn, Vehicles, Traffic congestion

## I. INTRODUCTION

Transportation system is a mode for movements and medium for reaching destinations. Improper transportation system not only creates barriers to economic events but also obstruct the development. As the developing countries are facing overpopulation and poor economic condition, they also need to develop their economic activities to meet the needs of their people, and for this reason, they need to have good transportation facilities. Due to uncertain decisions of the authority to cope up with the problems and improvements of the city area, they go for unplanned measures which often triggers traffic problems and environmental degradation. In modern times, motor vehicles play a major role that we cannot ignore their benefits in our daily life and nevertheless the consequences of using them. An resident from urban area spend most of their time by shuffling between workplace and home. Although, the invention of these motorized vehicles was to help us travel a long distance in a short period, with the passage of time they have become the reason for our delay in reaching our destined places. Therefore, Planning and management of urban road networks are essential.

In recent times, traffic congestion or traffic flow has become one of the biggest problems of metropolitans' cities where traffic motilities are enormous than other cities. Traffic congestion often occurs due to non-movement of motor vehicles on road for long time and due to few irresponsible drivers or citizens who prefer doing something else in the middle of the road like talking on mobile phones, speaking with fellow mates or to have some fun on roads etc., which often creates trouble to the people around.

Traffic jam has become the major global and a commonly faced problem for both developed and underdeveloped countries. If we consider local and international traffic situation, we observe that almost every country irrespective of their economical situation are combating with traffic congestion chaos with few exceptions. In urban areas, traffic congestion is much common scenario than rural areas. For the people living close to the roads and for the travelers, traffic congestion is disturbing as well as potentially dangerous. Traffic congestion is the result of the gap between transportation demand and supply. Traffic congestion can be held responsible not only for harming our health but also for not gaining full potential in our economic sector. Based on a survey conducted on Ireland company called Eireann, it has been losing €18 million annually, and the reason behind these losses found to be astonishing as they were unable to adjust their schedules of material in and out movement due to the increased traffic congestion. Similar to Eireann many other companies are unable to cope with revenue due to delay in delivery of material in the market.

As per an old saying, a Country with good transportation system has a better economy. A country can be judged by the condition of their transportation system because the growth of the country depends on its transportation, which defines the efficiency and economy of the country. If current traffic congestion observed across the world, it will be alarmed by the fact that both developed & under developed countries around the world is suffering from this curse. For instance, traffic circumstances at Bangkok have been attaining inferior scenario since the government announced a policy to refund tax for first-time car buyers. According to Transportation Institute mobility report in the year 2011, congestion in the United States has increased corporeally over last 25 years with huge loss with regards to time, fuel, and money.

Sao Paulo in Brazil is known to endure the world's worst traffic jams where people are perplexed for two or three hours every day in traffic jam. It is so far seen that many critical congestion areas in developing regions have poor traffic management systems that if any of these hits a congestion, the road network can result in a massive traffic jam for elongated time periods. Work organization faces problems from their workers due to frequent traveling between workstation to the house include lateness, absenteeism, more turnover, less employee performance and added cost in the budget. In this economy based society, the progress of any organization depends mostly on the performance of the employees. If they can work in their full potential, then that organization is bound to achieve its targeted progress. Otherwise, it is not possible. We can figure out the picture of the relation between economy and employees. The Confederation of British Industry of UK notified that 200 million days were wasted as a result of illness in 1998 resulting at a loss of \$10.2 million to industry. A study on large southern cities of Sweden shows that noise pollution created by traffic congestion has become one of the major problems for the residents of Sweden. Therefore, if the employees have a healthy condition both physically and psychologically then it will be easier for the organization to reach its success and in a way, it will help the country to progress. The swift and enduring development have triggered in extreme levels of traffic congestion and extraordinary hassles on infrastructure and service provision within the country's urban areas.

In India vehicular traffic is increasing day by day as a result, traffic problems have become far more dangerous. people have become more dependent on personal vehicles and public transport system. So, it is easy to say that the capacity of the existing road is not enough to bear the increased amount of private and public transport. Upgrading new transport routes for more efficient use of limited space is critical for ensuring people's mobility, improving their quality of life and boosting economic growth.

Constructing new roads is not an option. Because if somehow traffic jams are reduced, soon the number of vehicles will increase and same problems will show up again at least as bad as they originally were. So an innovative solution has to be considered. Through this paper the author tried to provide a solution on improving the existing road network facilities.

#### A. *Problems associated with roadways in traffic jams*

- There is lack of coordinated control of buses and no route commitment resulting in long hours on road, aggressive competition on roads, rough behaviour of bus crews, unsafe driving practice, dangerous boarding and landup by passengers in the middle of roads, nosing of buses etc. are the daily happenings.
- Drivers are not capable enough to understand traffic signs, warning signs, informatory signs etc. Most of the cars are driven by local drivers so uneducated drivers not understanding the signs are a big problem.
- The traffic system of the city is in worst condition as the vehicles can't move on the main roads of the city due to congestion specifically school going students, as a result elderly citizens faces severe trouble due to disorderly movement of vehicles.

## II. STUDY FEATURES

With the growing population, the number of transportation modes has also increased. Increased mode of transportation is the major cause behind the increased congestion. In the present study, it has been observed that intersections are one of the leading causes responsible for traffic congestions and major road accidents in the past nine years and, it has become a typical scenario for developing country like India. Therefore, it is a prime need to reduce the number of intersections to avoid accidents and traffic congestion at important points. Usually a common thinking of human being is, when a traffic congestion is identified, the traveler tries to dig out a short and faulty way to reach the destination at the shortest time possible.

Therefore, in order to mitigate few of the above situations, the following are applicable for n number of junctions meeting at one intersection

- The spacing between median openings should be adequate to allow for the introduction of left-turn lanes.
- Median openings should reflect street or block spacing and the access classification of the roadway.
- Full median openings should be consistent with traffic signal spacing criteria.
- The spacing of openings should be consistent with access management classifications criteria.

According to a research reported in *NCHRP Report 348 (5)* indicates that several states have set median opening spacing criteria that range from 100 to 800 m (330 to 2,640 ft). These criteria are mainly applicable in suburban and rural environments. The spacing ranges from 113 m (370 ft) at 48 km/h (30 mph) to 278 m (910 ft) at 88 km/h (55 mph). However, as per *TRB Circular 456* median openings generally should relate to the street or block spacing.

- At least 60 m (200 ft.) when two low-volume traffic generators are involved,
- The greater of 60 m (200 ft.) or the established median opening spacing interval when one major traffic generator is involved.

The following formula have been formulated to calculate the approximate number of accidents per year at the intersection

$$N=0.000783(V_d^{0.455})(V_c^{0.633})$$

where,

N = Expected number of intersection accidents per year

$V_d$  = ADT volume entering the intersection from the divided highway (veh/day)

$V_c$  = ADT volume entering the intersection from the crossroad (veh/day)

## B. Geometric Design Parameters/Principles

The geometric design of a MUT intersection introduces some unique design elements not typically present at a conventional intersection. These elements include:

- A wide median is required to facilitate the median U-turn movements. Characteristically, this median is uniform throughout the intersection and main Crossing Street, but there are certain design variations reducing the length of the wide median or locate the median on the minor street.
- A large wider vehicle path at the U-turn crossover to accommodate trucks and allow for efficient movements through the U-turn by passenger vehicles.
- Design elements provide positive guidance through design features and signs to reduce chances of driver error and discourage prohibited turns.
- Signing, marking, and geometric design promotes safe and efficient movements that would otherwise be unexpected or not familiar to motorists.
- Corridor-wide access strategies and management considerations to properties along the median street promotes safe and efficient access to these functionalities.

## III. DESIGN GUIDANCE

For accommodating U-turns, MUT intersections could be used on divided streets or complete roads with special provisions. The following sections will discuss on the geometric design guidance of MUT intersections

- Main intersection turns lanes
- U-turn crossover with two-way crossovers or single-directional crossovers
- Median widths and loons
- Right-of-way requirements
- Design vehicle accommodations
- Spacing between the main intersection and U-turn crossovers
- Spacing between crossovers along a MUT corridor of intersections
- Pedestrians and bicycles
- Transit

## IV. SOLUTION

Although travel time will increase, in the end, it will save time that would be lost during congestion. Therefore, if the old flow is diversified on to new proposed route, waiting time at intersections shall be reduced in turn leads to less or no traffic congestions at the junctions.

Directional Midblock Median Opening Without Left-Turn

- This design prevents overlapping of U-turns.
- Midblock access is provided for vehicles to (a) make a U-turn and (b) reach driveways on the opposite side of the street.
- Since only major-road traffic is involved, delays to vehicles making U-turns will be less than where an intersection is present.
- If U-turn traffic would otherwise proceed downstream to an intersection with a median opening, then this treatment should reduce VMT.
- Since vehicles making a U-turn only need to enter, but not cross the opposing roadway, a minimum gap of only 4 to 6 sec will be required.
- There are only four conflict points, which is less than at a three-leg or four-leg intersection.

- Providing central openings for U-turns between intersections reduces the number of turning maneuvers at the intersections.
- Accident rates at midblock central openings are lower than at three- or four-leg central openings.

Instead of using concrete wall at the intersection, a rolling barrier provides more help in reducing accidents and extended durability. These rolling barriers can be removed easily from the intersections, also most flexible during emergency times for easy movements of soldiers.

For pedestrians, foot over shall be constructed as this will decrease the risk of pedestrian’s life.

**V. DISCUSSION**

The following are the images for rolling barrier allocations at intersections

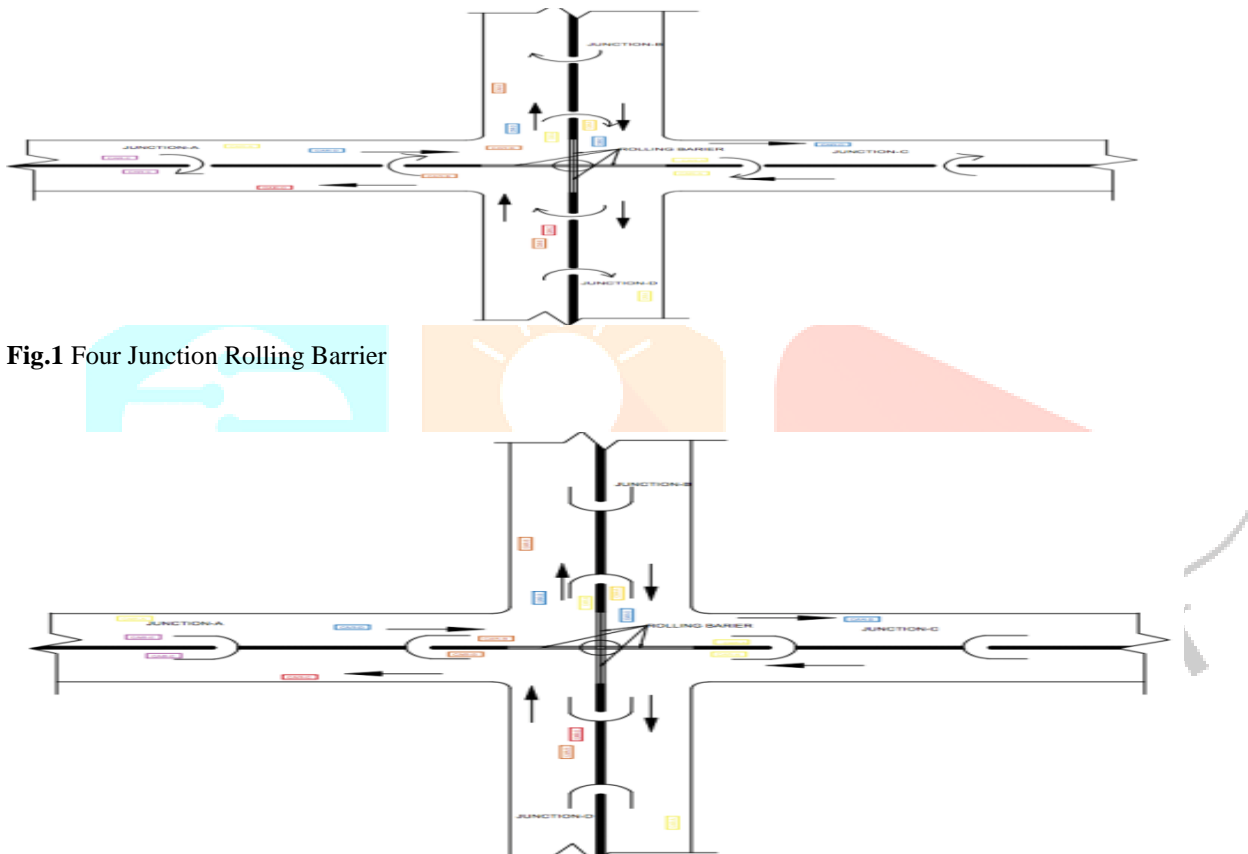


Fig.1 Four Junction Rolling Barrier

Fig.2 Rolling barrier at larger Space

The following discussion helps to understand the movement of vehicles at four junction and higher space, taking example of five different colored cars for better understanding.

Example of car A (Yellow) - If Car A, wants to go from junction A to junction D then driver has to take left turn from junction A to junction B, then take U-turn and change their flow of direction then take again, left turn from junction B to junction C and then take U-turn to change flow of direction then take left turn to reach their destination.

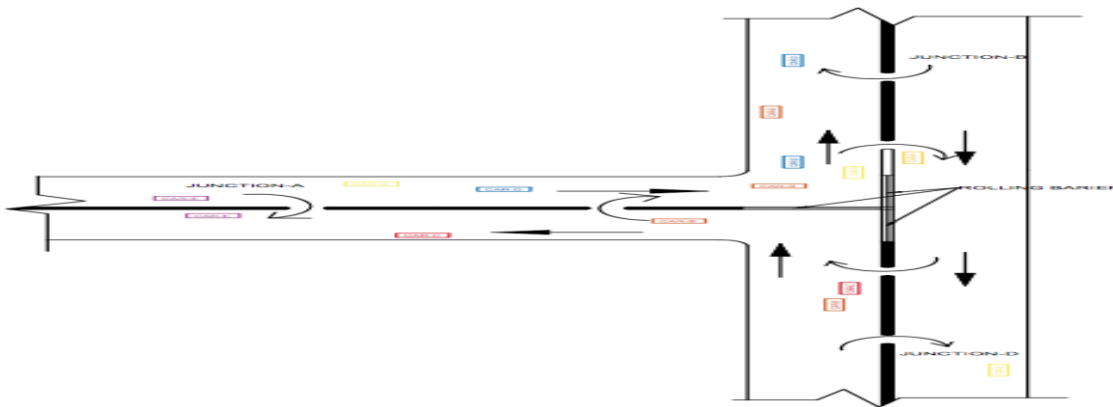
Example of car B (Orange) - If Car B, wants to go from junction D to junction B then driver has to take left from intersection, then by using U-turn change the direction of flow then again take left from intersection to reach their destination.

Example of car C (Red) - If Car C, wants to go from junction D to junction A then driver just to take left from intersection to reach their destination.

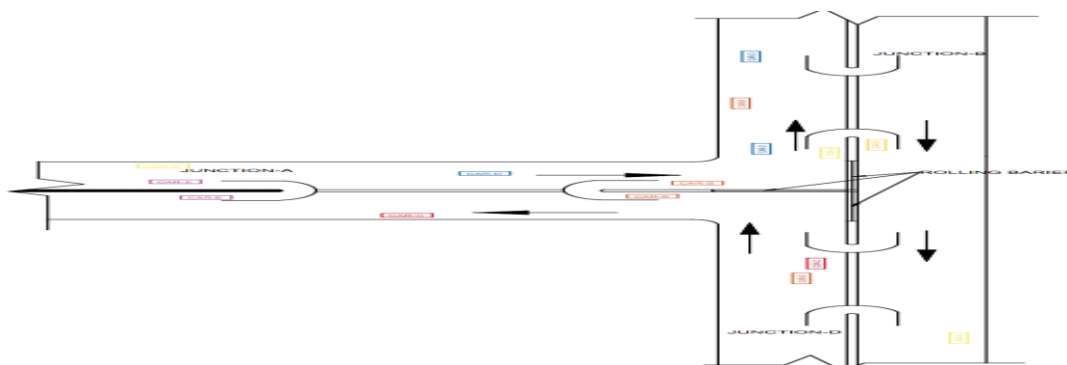
Example of car D (Blue) - If Car D, wants to go from junction A to junction C then driver has to take left turn from intersection then by the use of U-turn change the direction of flow then again take left turn from intersection to reach their destination.

Example of car E (Pink) - If Car E, wants to change flow of direction then driver by the use of U-turn change the direction of flow

to reach their destination.



**Fig.3** Three Junction Rolling Barrier



**Fig.4** rolling barrier at larger Space

The following discussion helps to understand the movement of vehicles at three junction and higher space, taking example of five different colored cars for better understanding.

Example of car A (Yellow) - If car A wants to go from junction A to junction D then driver has to take left turn from intersection then take U-turn and change their direction of flow and then move straight to reach their destination.

Example of car B (Orange) - If Car B wants to go from junction D to junction B then driver has to take left from intersection then by the use of U-turn change the flow of direction then again, take left from intersection to reach their destination.

Example of car C (Red) - If Car C wants to go from junction D to junction A then driver just to take left from intersection to reach their destination.

Example of car D (Blue) - If Car D wants to go from junction A to junction B then driver has to take left turn from intersection to reach their destination.

Example of car E (Pink) - If Car E wants to change flow of direction, then driver by using U-turn can change the direction of flow to reach their destination.

**REFERENCES**

1. T.U. Chowdhury, Shahriar Mohammad Raihan, Abrar Fahim, and M.A. Afrahim Bhuiyan, "A Case Study on Reduction of Traffic Congestion of Dhaka City: Banani Intersection," *International Conference on Agricultural, Civil and Environmental Engineering (ACEE-16)*., vol 18-19, April 2016 Istanbul, Turkey
2. Md. Abu Taleb and Sham suzzamanMajumder, "Impact of Flyovers in Dhaka City of Bangladesh on the Affected People in the Adjacent Area," *IACSIT International Journal of Engineering and Technology*., Vol. 4, No. 1, pp.103-106, Feb. 2012.
3. Hong-Qiang Fan, Bin Jia, Xin-Gang Li, Jun-Fang Tian, and Xue-Dong Yan, "Characteristics of Traffic Flow at Nonsignalized T-Shaped Intersection with U-Turn Movements," *TheScientific World Journal*., Vol 2013 (2013), Article ID 856416, available on" <http://dx.doi.org/10.1155/2013/856416> [online]
4. HAO Yanxia, yang xiaoguang, "Research on the Delay in Signalized Intersection with Left turn Special Phase". *procedia-social and behavioral sciences*., [Vol 96](#)(6), Pp 2211-2218, Nov 2013,
5. NCHRP report 524, "Safety of U-Turns at Unsignalized Median Openings." National cooperative highway research program, 2004.
6. J. Lu, P. Liu, J. Pernia and J. Fan, "Operational Evaluation of Right Turns followed by U-turns at Signalized Intersection (6 or more lanes) as an Alternative to Direct Left Turns", Department of Transportation, University of South Florida, Florida, 2004.
7. Federal highway administration Research and Technology "median u-turn intersection" 2009. Available from <https://www.fhwa.dot.gov/publications/research/safety/09057>.
8. Junqiang, Leng&Hantao, Zhao & Qian, Zhang, "Research on the Impact of U-turn Location on Operation Efficiency at Intersection" 2009. Available from [research gate](#).
9. Stacie L. Phillips, Daniel L. Carter, And Joseph E. Hummer, Effects of Increased U-Turns at Intersections on Divided Facilities and Median Divided Versus Five-Lane Undivided Benefits 2004.

