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# A Literature Survey On Signalized And Non-Signalized Corridors

**Roohi Naeem**[1]
University of Engineering and Technology, Pakistan
Email: Roohi_naeem@ymail.com

**Rana Muhammad Shoaib**[2]
Nation University of Engineering & Technology, Pakistan
Email: urbandesigners.pk@gmail.com

**Zunair Ahmed**[3]
University of New South Wales, Australia
Email: Planner.zunair@gmail.com

**Abdul Razaq**[4]
University of Engineering and Technology, Pakistan
Email: Abdulrazaq3805@gmail.com

**ABSTRACT**
Random traffic flows and the influence of traffic signals at intersections often cause significant variations in travel times. This has implications for signal control planning and design. This study aims to compare the variability between signalized and unsignalized corridors in Lahore and identify the challenges faced by road users. The study was conducted through a literature survey that collected data on trip purpose, frequency, travel time, and transportation mode choice from various sources. Results show that signalized corridors have lower accident rates and shorter travel times compared to unsignalized corridors. Unsignaled corridors, on the other hand, offer better access and lower fuel costs. Although signalized corridors are more effective in managing traffic flow and improving safety, further research is needed to explore alternative solutions such as roundabouts that can improve mobility and sustainability. The results of this study can serve as a reference for transportation planners and policy makers in designing a more efficient traffic system. This study also suggests the need for further evaluation of traffic control in various urban contexts to optimize safety and efficiency.

**Keywords:** signalized corridors, unsignalized corridors, traffic safety, travel time, air pollution.

## INTRODUCTION

Worldwide, the growth in the number of motorized vehicles has resulted in a significant increase in traffic congestion, air pollution, and accident rates (Blumenberg et al., 2018). According to a World Health Organization (WHO) report, around 1.35 million people lose their lives to traffic accidents every year, making it one of the leading causes of death among the productive age group (Islam et al., 2022). The situation is further exacerbated by rapid urbanization, with more than half of the world's population now living in urban areas. This urbanization not only increases the number of vehicles in circulation, but also puts pressure on the often already inadequate transport infrastructure. This creates a vicious cycle of worsening congestion and pollution, which in turn adversely affects public health and quality of life.

In Pakistan, especially in Lahore, traffic problems are becoming more pressing. Both signalized and unsignalized corridors often experience tremendous congestion, which can result in inefficient travel times and increased greenhouse gas emissions (P. J. T. Fernandes, 2017). In many areas, road users such

as pedestrians, cyclists and motor vehicle drivers face high risks due to the high number of accidents at intersections (Hu et al., 2018). In addition, the impacts of motorized air pollution are increasingly being felt, with many health reports of respiratory problems and heart disease associated with poor air quality. This suggests the need for a more in-depth analysis of the effectiveness of traffic corridors in the area, as well as potential solutions that could be implemented.

Previous studies have examined the impact of traffic signals on the safety and efficiency of traffic flow. For example, research by researchers showed that signalized corridors have lower crash rates compared to unsignalized corridors (Hosseinian & Mirzahossein, 2024). Another study by researchers found that signalized corridors tend to have shorter travel times. However, despite the number of existing studies, there is limited analysis of the variability between the two types of corridors (Estrada et al., 2016). Many previous studies have focused on one aspect only, either in terms of safety or efficiency, without considering other factors that might influence the results.

The urgency of this research lies in the need to better understand the differences and challenges faced by road users in Lahore. With the increasing number of vehicles and population, it is important to evaluate the effectiveness of the existing traffic system and look for more sustainable solutions. This research is expected to provide new insights that can inform better transportation policies, as well as provide recommendations that are more focused in the local context. A better understanding of these challenges is also important for formulating more effective strategies to address congestion and improve road safety.

The uniqueness of this research lies in the comparative approach used to explore the variability between signalized and unsignalized corridors, and their effect on traffic safety and efficiency. By combining data from multiple sources, the research aims to provide a more comprehensive picture of the challenges faced by road users in Lahore. This approach will not only enrich the existing literature, but also provide empirical data that can be used to formulate more effective policies. In a broader context, the results from this study can serve as a model for other cities facing similar issues.

The main objective of this study is to compare the variability of traffic flow between signalized and unsignalized corridors, and to identify the challenges faced by road users. The research also aims to explore solutions that can reduce congestion and improve safety in both types of corridors. By focusing on thorough data collection and analysis, it is hoped that this research can provide practical recommendations that can be implemented by policy makers and transportation planners.

The results of this study are expected to make a significant contribution to transportation planners and policymakers in designing a more efficient and safer traffic system. This research not only provides the data and analysis needed for decision-making, but can also provide guidance on more sustainable policies in managing traffic flow. In addition, this research can serve as a reference for further studies related to the development of sustainable transportation infrastructure in urban areas.

## RESEARCH METHOD

Additional details on the data collection and analysis techniques required for transparency follow in the Research Methods section. The research was conducted through data collection from various sources, including online databases, academic journals, and other sources of scientific information. To ensure that all relevant studies on signaled and unsignaled corridors were included, appropriate keywords and search terms were used. After collecting a large number of potential studies, the next step was to screen the articles to determine their relevance. This involves reading the abstract and keywords of each study to decide if the study meets the inclusion criteria. Studies that did not meet the criteria would be

excluded, while relevant ones would be analyzed further. Data was extracted from each study and then analyzed to look for patterns and trends, as well as compare and contrast results from different studies. Various analysis techniques were used to thoroughly understand the implications of the findings, thus increasing transparency in the research process.

## RESULTS AND DISCUSSION

### What are Signalized and Non-Signalized Corridors?

#### Signalized Corridors

Several road users, primarily motorists, bikers, and pedestrians represent signalized intersections. Multiple user forms belong to each road user category. For example, passenger cars, commercial vehicles, buses, and motorcycles are motorists. Bikers include bikers of varying ages and abilities for leisure and commuting. Both age ranges are included (children, adults, elderly). Some pedestrians can also suffer impairment of memory, mobility, or vision.

On the basic level, the right-of-way between streams of road users is signalized intersections. These crossroads thus serve many functions: they permit motorists to join new roads and change paths; they are crossroads of cycle routes, and they provide primary links to and from pedestrian activity centers. Signalized intersections are mostly located along the major roads that may include carriers and other heavy vehicles and contribute to commercial activities.

#### Non-Signalized Corridors

A crossing without signs is identified as the grade junction between two or more public roads where the right of way is not protected by a road sign for motorists, bicyclists, and pedestrians. Non-signalized crossings are classified in a variety of ways, such as by form of traffic control, type of area i.e. urban, suburban, rural) and several approach legs. The researchers stated that non-signalized intersection works for the driver without positive signs or power. It depends on the driver taking the right chance to go down the main lane.

### Advantages/Disadvantages of Signalized and Non-Signalized Corridors

#### Advantages of Signalized Corridors

Minimize delaying – Minimize stoppage – Minimize stoppage for cars – Minimize time wasted – optimize big green time on the street– Maximize pedestrian service – Minimize seriousness/accident.

#### Disadvantages of Signalized Corridors

While many consumers are educated that the number of angle collisions at a cross-section is limited by traffic signals, few realize that other forms of crashes can also increase. For example, other types of accidents, particularly rear-end crashes, were well known to generally increase as a signal is added. Traffic signals have been a magic bullet or a cure-all to any intersectional traffic issues. Incorrect or unsafe signal installation (by MMUTCD) will result in the following factors:

1. It could be caused by undue delay. In contrast with non-signalized intersections, even the best-planned and operated signals typically increase the delay leading to substantial loss of fuel and higher engine costs.
2. Signs are promoted to disobedient. Delays in unjustified traffic signals can lead to a significant lack of compliance with signals and other traffic control devices.
3. To discourage such signals, the use of less suitable routes may be promoted.
4. Unjustified signals or areas where the sound engineering study was not the basis for the installation will dramatically increase the accident frequency.

**Advantages of Non-Signalized Corridors**

1. It provides the road user with uninterrupted, convenient, easy access, and less car fuel costs, including flyovers and underpasses with the presence of grade separate cross-roads. Reducing disturbances and the drawbacks faced by motorists and other road users during driving. Improvement of environmental conditions with fewer congestion opportunities, leading to increased pollution by fuel emissions.
2. Cost of less time
3. Less wait, traffic queues, congestion, and traffic jams
4. Comply for a certain time with potential traffic requirements
5. Many traffic guides suggest that the higher speeds lower decision times

**Disadvantages of Non-Signalized Corridors**

At anon-signalized intersection, there are several issues. Problems may be directly linked to a particular intersection, happen along a stretch of the road, or arise as a structural issue. The following problems are typical at unsigned intersections discussed in the Guide for the Improvement of the unsignalized Intersection (UIIG).

1. The intersection or regulatory traffic control systems have insufficient visibility.
2. Insufficient sight gap intersection.
3. Insufficient instructions for drivers.
4. In or near the intersection excessive intersectional conflicts occur.
5. Vehicle conflicts with non-engine drivers.
6. Low output in service.
7. Misjudgment of traffic loopholes.
8. Speeding.
9. Failure to comply with traffic control equipment intersection.

**Performance Measure**

A specified method of evaluating ability and quality of service through performance measures is available to each facility category. Such steps indicate a plant's running conditions as reflected by the collection of roadway, traffic, and monitoring conditions. The performance measures used for the basic level of service are the service measures. An analytical procedure that allows capacity or levels of service to be determined at intersections is, therefore, an important tool for designers, operating staff, and policymakers. The flow and distribution of traffic, the geometric and the signaling system are elements that influence the level of service at theintersections.

The following advantages could also be reached if some of the objectives are achieved: reducing the congestion at the signaled crossing particularly during peak hours, reducing the cost of transport to the public, improving road network efficiency, increasing security, reducing road maintenance costs, improving traffic flows and operations; and the reduction and conservation of air pollution.

**Travel Time**

Time is gaining traction as the performance and service measure in certain types of installations, especially in the sense of reliability. Travel time is practically equal to speed (it is simply the reciprocal). Like pace, however, traveling time alone is not enough for a long service measure. It should also be eligible by some unit distance.

**Time Delayed**
Time-delayed is characterized as the percentage of the time of travel that vehicles on the given segment of the road must travel at speeds slower than their speed because of the inability to pass or control the traffic during any prescribed period. A good performance metric for interrupted-flow facilities is percent delayed.

**Traffic Congestion**
As an individual is harmed by persistently high decibels, the congestion and bottling of traffic constitute a significant threat to the safe lifestyle of road users. Solving traffic congestion issues must keep this significant traffic congestion aspect in mind, which induces delays in transport and thus imposes considerable costs on society. As a result of this phenomenon, almost 1% of EU GDP is estimated to lose each year. The extension of the road network is one way of moderating congestion but often is not possible due to the presence of buildings in an urban area.

**Traffic Flow**
In general, structures are planned to generate green waves along highway routes, and there is a range of techniques for optimization to achieve this strategy. Since vehicular traffic flow through a signal intersection network is a dynamic and balanced structure, it has been extensively studied using microscopic simulation methods from the perspective of statistical mechanics. The average delay or the number of stops is the indicator of success in most optimization techniques.

**Time Consumption**
Minimizing vehicle delays along the roads may lead to longer reverse-flow wait times and pedestrian crossings; priority may be given to public transport (skipping a step, for instance), reducing private transit performance; optimization of flow can impact on driver's safety and pedestrian. The optimization of signal timing is therefore seen as a multifunctional problem.

**Noise and Air Pollutants**
Air pollution presents a major danger to road users as well as to the people who make up their habitat. Transport leads to environmental contamination, which is a serious health concern and is prevalent worldwide in our nations(World Bank Report). Noise is closely linked to the transport system and bottlenecks development. In these clashes, road users are irritated by the inhibitions they put on their vehicles to pressure the horns with great pleasure.

The explanation for arguing that emissions of (air pollutants) are decreased is that automobiles are congested at low speeds and accelerations, which contribute to incomplete combustion and additional NOx, CO, etc. emissions. Whilst there is commonly recognized the potential for green waves to mitigate travel delays, the side effects of both noise and air pollution on vehicle emissions are much less evident.

**Fuel Consumption**
The basic measure is that the carspendingend static time at busy intersections will minimize fuel consumption. The methods of signal synchronization and the traffic control plans guarantee that these delays are cut to the degree that they contribute substantially to the reduction of pollution amounts.

**Traffic Delayed**
The deceleration and acceleration processes at the intersection leading to vehicle delays. Delay is primarily grouped into two components at the signaled intersection, i.e. delay due to declaration & acceleration and time limitation (Ma et al., 2022). The researchers found that the stopped delay is related to rouge-phase duration and intersection saturations.

**Accidents**

Collision and traffic disruptions in urban areas play a key role in intersections (Aslani et al., 2017). For example, Franke et al.et al. stated "over 33% of accidents causing injuries occur at urban crossings. More than 40% of the traffic accidents recorded to occur at intersections in the United States and Europe even.

**A case study of Washington DC**

A single- and two-lane roundabout analysis was conducted by (Wang, Ong, 2013) to compare all-way stop control, a bid-way stop control, and traffic signal control. Their research also established guidelines for the preferred form of intersection, according to volume, the division of requirements among the four approaches, and the distribution of the turning motions of an approach. In evaluating intersections, they applied the following efficiency measures: vehicle stops and delays, fuel consumption, and pollution. For validating the model of software called INTEGRATION, they use field data from two established circular points, a single-lane roundabout, and a two-lane cycling circle. Results from field data show that the single-hop roundabout is less delayed, but the one-way stop control is the chosen intersection for the environmental effects (ChoChowdhury, 2016). The research also carried out a sensitivity study to determine how different levels of demand and the demand distribution of a single-lane roundabout influenced these parameters compared to a two-phase intersection controlled by signal and a two-lane roundabout compared to a four-phase signaled intersection. Based on these findings, the roundabouts are more efficient for high- and right-wing demand, and less effective for the high demand for left-wing turns than two-phase signal control (Remme et al., 2022). They also concluded that the two-lane roundabouts are more efficient for all the demand levels tested and for all the distribution of turning movements tested.

**A Case Study of Florida**

Kaisar, Edara, Rodriguez-Seda, and Chery [2004] compared the regular four-leg intersection designs to four non-traditional intersection designs, a Controlled Flow Intersection (CFI), a signalized parallel flow intersection (PFI), and a non-signalized roundabout. They have used AIMSUN and VISSIM microsimulation tools for the design of each crossing. Demand ranged from low to high volumes, from 1,000 to 6,000 vehicles per hour squared, but the intersections were balanced from each direction (Sharma et al., 2014). Average delays and the number of stops were determined by performance in this analysis. The roundabout had the lowest average delay at low volumes for traffic volume of 6, although at medium to high traffic volumes the CFI was experiencing the lowest average delay.

**A Case Study of Australia**

The analysis performed by researchers compared the output of an isolated single-lane roundabout to signalized and un-signalized intersections using the microsimulation program, VISSIM (LeBas, 2015). The study also measured the maximum capacity of a one-lane roundabout and the impact on the capacity of the single-lane roundabout of the least perceived spacing times. The efficiency measurements to test the various types of intersection controls included delay in stopping time, average travel speed, upstream and downstream traffic, and the average length of the queue. Every alternative
intersection used balanced approach traffic volumes, passenger vehicles alone, the identical composition of traffic, turnover, and pedestrian volumes. The findings from this study show that the one-lane roundabout exceeds the two-way, regulated intersection of the yield, and all signaling intersections tested (Zhou et al., 2021).

**A Case Study of USA**

An evaluation of the energy and environmental impacts of isolated roundabouts and the two-way stop signs and signaled intersections was carried out by (P. Fernandes et al., 2017). A survey, entitled "Energy and environmental assessment of high-speed roundabouts" was analyzed and compared. In addition to the microscopic energy and emission models to calculate fuel consumption and emission levels, INTEGRATION and VISSIM were used to simulate traffic. The basic demand distribution was a four-leg crossing of high-speed mainline approaches and low-speed roads. They analyzed the various traffic controls at different traffic requirements. If the traffic demand was 50 percent or less than the initial traffic demand, vehicle delay and length of a queue decreased (Li et al., 2018). When demand grew past 50% of the initial traffic demand, it was more efficiently possible to reduce the delay than the roundabout by the signaled intersection. These findings indicate that isolated roads are better suited for roads of limited volume. Results from this analysis have also shown, relative to regulated and signaled intersections, that roundabouts appear to increase fuel consumption and pollution.

## CONCLUSION

This study presents the argument that signalized crossings contribute significantly to traffic collisions, accounting for 25% of total vehicle collisions and 8% of fatal incidents, while non-signalized intersections account for 22% of total vehicles involved and 20% of fatal collisions (NHTSA, 2012). Traffic signals, as electrically controlled traffic control devices, allow road users to manage their journeys by designating right-of-way to various approaches and movements. These signals are essential for road operations and safety, facilitating shared road space by separating competing movements and improving both mobility and safety. Key considerations for installing traffic signals include optimizing travel delays, reducing crash frequency and severity, prioritizing road user movements (like pedestrians and left turns), and accommodating increased traffic volumes at new intersections. Effective installation and operation of traffic signals can mitigate collision severity; however, poorly placed or unnecessary signals can hinder traffic flow, safety, and mobility. Balancing the dual goals of mobility and safety is crucial, as one may need to be compromised to enhance the other. The efficiency of traffic signals is increasingly vital for agencies aiming to meet rising travel demands while maintaining safety. When updating signaled intersections, prioritizing crash reduction is essential, as emphasized by the Federal Highway Administration (FHWA). Conversely, non-signalized roads introduce geometric delays that are often less noticeable to users, as these roads allow for smoother traffic flow without complete stops. Non-signalized corridors typically experience lower vehicle delays than their signalized counterparts, particularly during peak hours, resulting in greater fuel savings, reduced greenhouse gas emissions, and less vehicular noise. Ultimately, optimized signal timing can lead to reduced delays, increased intersection capacity, improved level of service (LOS), and enhanced overall traffic efficiency.

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