EVALUATION OF MOVEMENT PRIORITY AT UNSINGNALIZED INTERSECTION

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ABSTRACT

The major goal of this study was to use a gap acceptance study to evaluate the performance of un-signalized crossings. Unsignalized intersections, particularly in urban and suburban regions, have a significant role in determining the capacity of the road network. A badly functioning un-signalized junction may have an impact on the operation of a signalized network or an Intelligent Transport System. The stop rule, also known as the two-way stop-controlled intersection, was used to govern the T-junction in this study (TWSC). The stop-controlled approaches to a TWSC junction are referred to as minor road approaches. The crucial gap is one of the most important factors impacting the capacity and performance of an un-signalized junction. The Highway Capacity Manual identifies critical deficiencies. As a result, the crucial gap is the difference between each intersection depending on the design of the road, the number of lanes, and the surrounding environment. Although important gaps cannot be assessed in the field, data on approved and rejected gaps can be gathered and examined. A video camera and several pieces of equipment were used to collect data on gaps. The essential gaps were determined using Raff's approach. The crucial gap was separated into three areas in this study: RT from a major route, RT from a minor road, and LT from a small road. The essential gap might be anything between 2 and 7 seconds long. The critical gap value was calculated manually from field observations by HCM. Field observations are more accurate representations of actual field conditions. As a result, this study may be used to assess the performance of a TWSC intersection in terms of queue and service level. This research may be pursued in the future to enhance the input parameter values and develop the analytic technique for four-leg intersections and roundabouts in both urban and suburban settings as well as rural settings. The raff's technique is used to determine important gaps in this study, which is based on approved and rejected gaps. Calculation models M3 definition model and updated definition model are developed from Raff's concept of the critical gap. The M3 definition model is simple and valid, however the improved Raff's models fully adhere to the definition critical gap and have a larger applicability area. We utilized Raff's models for the investigation of critical gap increase and gap acceptance in this study since we wanted more precise results.

Keyword: - *Unsignalized Intersections, TWSC Junction, Raff's Approach, Critical Gap, 3-Arm Intersection, 4-Arm Intersection*

1.INTRODUCTION

1.1 General

Because India is the world's second most populous country, the number of vehicles and transportation demands are at an all-time high. As a result, the amount of time spent stuck in traffic has expanded enormously, resulting in road congestion. Un-signalized intersections are a popular form of intersection used to govern traffic flow, particularly in urban areas. We are examining the moment priority in this study, which is defined as when one of the intersecting roads is given definite priority over the other. The secondary road is normally managed by some type of signboard marking to guarantee that priority cars moving on the larger roadway experience minimal delays. The un-signalized intersection has a gap and a critical gap as a result of the vehicles' momentary priority. At peak hours of both three-arm and four-arm un-signalized intersections, gap analysis and critical gap analysis are performed. In this study, the gap analysis is performed on all vehicles, including the truck. The traffic situation in Bengaluru has been done in this manner for the past two years. Where high traffic causes pollution owing to environmental difficulties. This is the Bengaluru traffic situation.

One of the reasons for the drop in accidents, according to the traffic police department, is "improved road-safety awareness, made possible by various training sessions and camps held by police." "However, there has been a consistent drop over the past few years, and we'd like to believe that our efforts, which include increased enforcement of traffic rules, effective night patrolling, and better road and traffic infrastructure, have also contributed," one officer said, acknowledging that the pandemic may have played a role.
The gap acceptance theory, which uses a critical gap as the basic parameter, is commonly used to assess the capacity of un-signalized intersections. There are several ways for calculating the crucial gap for a priority movement. The majority of these solutions were created under uniform traffic situations with tight adherence to priority and lane movement guidelines. The current study shows that when these approaches are applied to heterogeneous traffic settings, where cars with various static and dynamic characteristics occupy the same road area and priority rules are frequently broken, they produce fairly insignificant results. This research introduces a new critical gap estimation method based on the amount of time the junction region is occupied by a priority movement. The occupancy Time technique calculates critical gaps using two parameters: the distribution of acceptable gaps by vehicle type and the distribution of time these vehicles spend in the intersection area. It can address concerns such as the forced entry of minor street vehicles, zigzag movement, and other issues that are prevalent for intersections functioning in a heterogeneous traffic environment.

Because the occupancy time technique integrates the real clearing pattern of the conflict area and the traffic interaction that happens inside this zone, the values obtained by this method were greater than those obtained by other methods for the Indian junction. The approach is then evaluated under homogenous conditions and found to provide results that are extremely close to those obtained using MLM and other critical gap estimating methods. As a result, the technique may be reliably declared to be applicable to both heterogeneous and homogeneous traffic circumstances.

Bangalore's fast expansion raises the cost of life for citizens, particularly in metropolitan regions. Transportation is similarly impacted by development, with an annual rise in vehicle numbers. Road congestion and accidents have increased as a result of the increased number of cars on the road, particularly during peak hours. Slower speeds, longer journey durations, and higher vehicular queuing define traffic congestion on road networks, which happens as demand grows. Intersections are critical parts of the road network because they are where traffic flows from diverse directions converge. At-grade intersections, signalized intersections, un-signalized intersections, and roundabouts are examples of different types of intersections. The study's scope, however, is limited to research of un-signalized intersections. Un-signalized intersections are a popular form of intersection used to govern traffic flow, particularly in metropolitan areas. An inadequately performing un-signalized junction may have an impact on the operation of a traffic signal network or an Intelligent Transport System. There will be various disagreements over vehicle movement in crossings, which will have an impact on traffic safety. At an un - signalized junction, the most frequent technique to handle such disputes is to implement priority controls such as the give way or stop rule. The restrictions are enforced at T-intersections and 4-way intersections. The T-intersection makes up the bulk of un-signalized junctions in Bangalore. The majority of un - signalized 4-way junctions have been converted to traffic signal.

Congestion, line-ups, delays, and accidents are just a few of the issues that arise around the intersection. The gap acceptance technique, which is utilized for un-signalized junctions procedures, is used to assess capacity at un-signalized crossings. For the un-signalized intersection process, the gap acceptance approach was applied in this study. The crucial gap is an important characteristic to consider while analyzing an un-signalized junction. Highway Capacity Manual proposes the essential gap for an un-signalized intersection in Bangalore. As a result, the crucial gap is the difference between each intersection depending on the design of the road, the number of lanes, and the surrounding environment. If an issue such as a delay or a queue always arises at an un-signalized junction, the efficiency of the performance suffers. Because of this, it is required to investigate the junction, assess the traffic networks, and enhance the intersection's performance in order to address the observed issues.

1.1 Traffic Scenario in Bengaluru City

The traffic scenario is defined as a huge traffic environment that contains a variety of driving scenarios. Typically, a significant number of automobiles are examined over a lengthy period. Bengaluru is India's fastest-growing metropolis, resulting in high traffic and congestion in key regions. Bengaluru is also one of the busiest cities in India's top ten cities.

On Tuesday, August 20, 2019, according to polls from 2019 and 2020, the biggest traffic congestion in Bengaluru in 2019 was 103 percent additional travel time. Bengaluru was placed sixth among the top ten cities in terms of traffic congestion. Bengaluru is one of the key engines of economic growth for the whole country, accounting for almost 36 percentiles of the gross state product for the state of Karnataka. In addition, career prospects are more plentiful in Bengaluru than in Karnataka in 2019. Congestion is expected to drop by 20% on average by 2020. During morning and evening rush hours, the average traffic snarl dropped by 35 percentile and 32 percentiles respectively. Bengaluru, according to the poll, is the most congested city in the country, even during the shutdown, when compared to Mumbai, New Delhi, and Pune. Last year, Bengaluru had 147 days of low traffic, with the worst traffic day being January 6th, with an 89 percentile of congestion. At 70%, January 2020 is the most crowded month of the year. Due to lockdown, April was the least crowded month, at 6 percentiles.

Based on gap acceptance studies, this study was done to investigate and evaluate the performance of UN signalized intersections. Bangalore is considered a city since it has a population of more than 1000 people. Examine where the junctions are placed. The crossroads of Dhodabalapura and Vidyanarayanapura is a major road and a minor road. The un-signalized junction u is classified as a two-way stop-controlled un-signalized intersection (TWSC) with a stop rule for traffic control. The stop-controlled approaches to a TWSC junction are referred to as minor road approaches. Vehicle drivers on small roadways must observe two-way stop control to ensure that conflicts are avoided.

The discovered TWSC junction was in Yelahanka Bangalore, which is a commercial, industrial, and educational district. Figure 1.1 depicts this. These frontage activities, when combined, result in a heavy traffic flow.

Figure 1: Study Area (T-Intersection)

Figure 2: Study Area (Four-Intersection)

1.2 Accident Statics in Bangalore

Accidents are a common occurrence in traffic-congested places. Due to the expanding and development of Bengaluru City, at least high traffic in the due to the lack of space for construction off-road vehicles rest to another, an accident happens. It also happens because of the drinking and driving. According to the poll results.

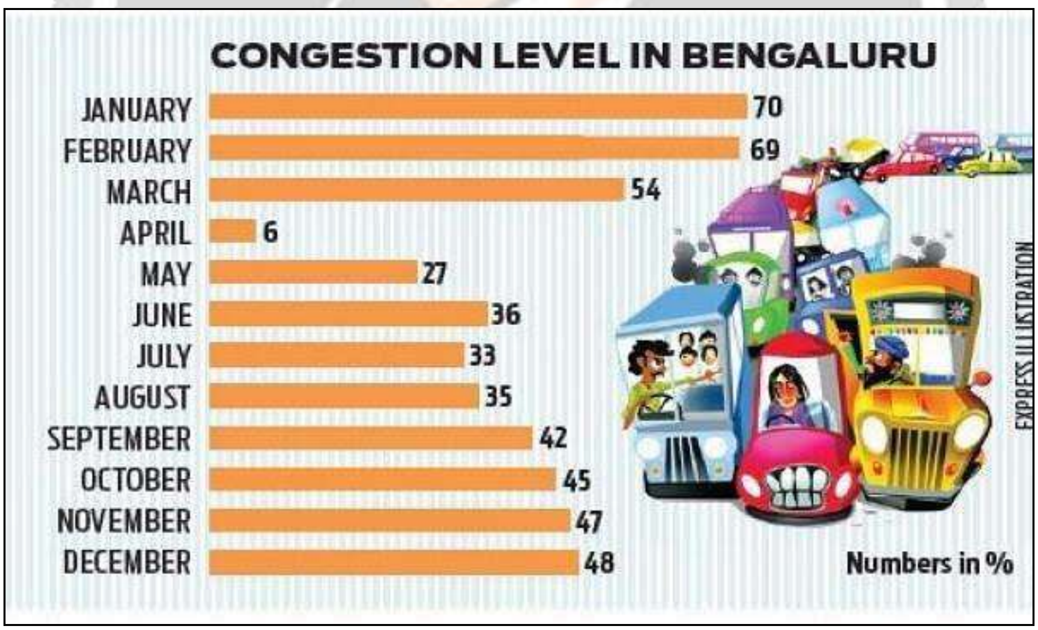
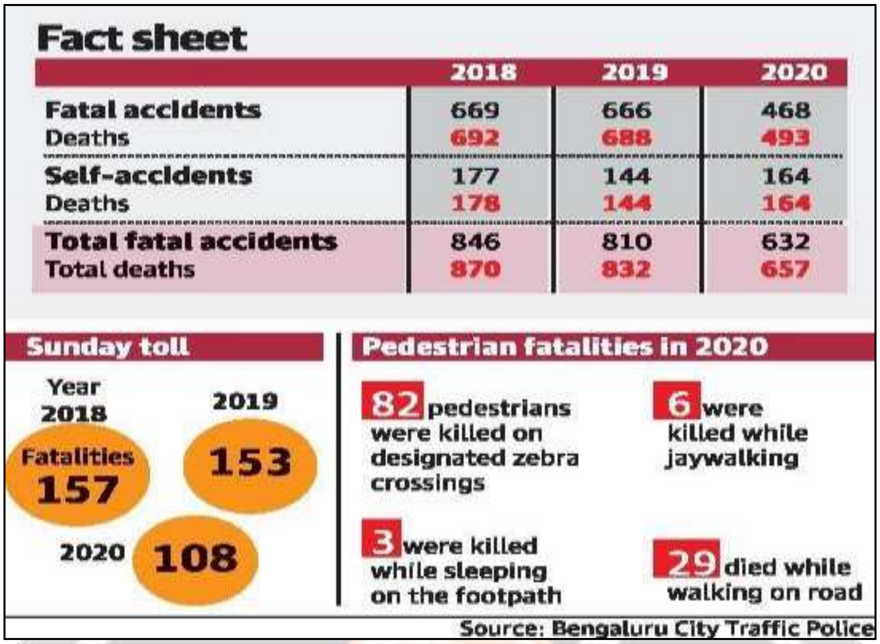


Figure 3: Congestion level in Bangalore


Fact sheet

	2018	2019	2020
Fatal accidents	669	666	468
Deaths	692	688	493
Self-accidents	177	144	164
Deaths	178	144	164
Total fatal accidents	846	810	632
Total deaths	870	832	657

Figure 4: Accident’s fact sheet in Bengaluru

1.3 Importance of Gap Acceptance

One of the most essential aspects of microscopic traffic characteristics is gap acceptance. The gap acceptance hypothesis, which is frequently employed in the study of uncontrolled junctions, is based on the notion of determining the extent to which cars will be able to exploit a gap of a specific size or length. A motorist entering or crossing a traffic lane must assess the spacing between possibly conflicting vehicles before deciding whether or not to cross or enter. The interaction of cars within a single stream of traffic, or the interaction of two different traffic streams, is one of the most critical aspects of traffic operation. When a motorist changes lanes and merges into or crosses a traffic stream, this interaction occurs. The idea of gap acceptance is inherent in the traffic interaction connected with these basic moves.

A gap is the amount of time and space required for a subject vehicle to safely merge between two cars. The minimum space necessary to finish lane shifting safely is known as gap acceptance. As a result, a gap acceptance model can aid in describing how a motorist decides whether or not to accept. The act of a small stream vehicle accepting an accessible gap in order to move Inters. Gap acceptance is a skill that drivers execute on a frequent basis to the point that it is almost instinctive. However, in order to drive safely, you must be able to execute this duty. Not all drivers tolerate gaps in the same way, and even the same driver may react differently in various places and under different circumstances. Data on gap acceptability may be gathered and examined in a variety of methods. The basics of each system, however, are very similar. The best way to collect data on driver’s gap acceptance behavior is through direct field observations.

When traffic is crowded, drivers may opt to be more aggressive and tolerate narrower gaps than typical criteria would predict. As a result, unless more extreme settings are used, it may be difficult to duplicate the current conditions. Setting up video surveillance equipment at the location and then processing the data off-site is now the most popular technique to investigate gap acceptance behavior in the field. Slowly advancing the recording and capturing timestamps of each vehicle passing through the intersection is usually how the data is processed. This is a time-consuming procedure, but the results are generally considered to be accurate.

After collecting and analyzing the gap data, curves reflecting the frequency of gap rejection and acceptance were created. The estimated gap acceptance parameters were implemented in a microsimulation model and compared to observed journey durations, according to Noel Kay (2006). When compared to the default setting, they exhibited a higher degree of fit. At un-signalized junctions, was established gap acceptance is a significant component in evaluating delays, queue lengths, and capacities. Gap acceptance may also be used to estimate the relative risk of an accident at a junction, with smaller gaps implying a higher probability of an accident.

1.4.1 Aim

The main aim of this study is to explain the moment priority of the vehicle at unsignalized intersection gap analysis and the critical gap is an estimation by the Raff method.

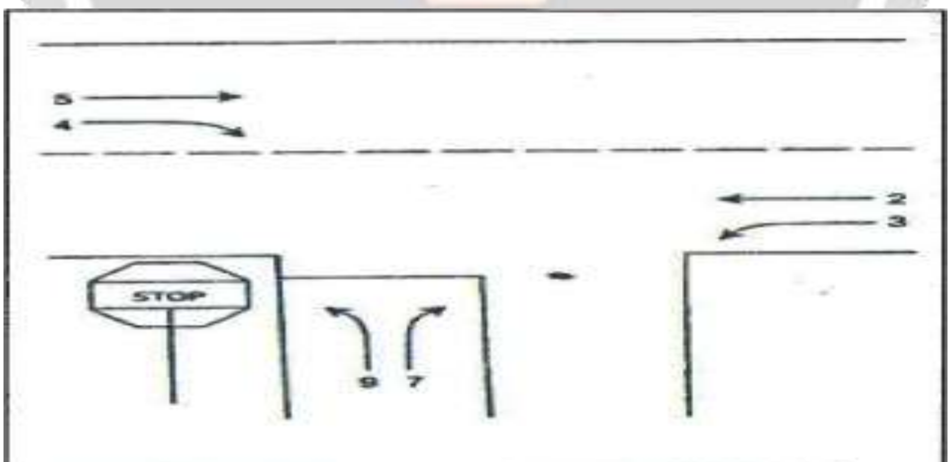
1.4.2 Objectives

- To evaluate the movement priority at a selected unsignalized intersection.
- To study the traffic volume during peak hours in the unsignalized intersections.
- To calculate the conflicting volume of the selected area of unsignalized intersections.
- To determine gap analysis using gap accepted and rejected.
- To find the distribution of gap and critical gap using Raft's method.

1.5 Thesis of Organization

However, in metropolitan areas, most of the two-way stop control at four-leg crossings is converted to signalized junctions. The availability of gaps is an essential criterion in the priority stream. If a right-turning car on the major street and a turning vehicle from Minor Street are both waiting to cross the major stream, the right-turn vehicle on the major street will pick the first available gap of an appropriate size. Minor street-turning traffic must wait for a space to open.

The HCM 2000 specifies a significant number of such right- and left-turning vehicles that might eat up so many of the available gaps that smaller streets would be substantially hampered or impossible to perform safe crossing operations. There is space in the middle of many un-signalized junctions where multiple minor-street cars can be kept between the two directions of traffic flow on the major street, especially in the event of multilane major-street traffic. This storage space within the junction allows minor-street drivers to pass through each of the major-street streams one at a time, potentially increasing capacity (Werner Brilon, 1999).



Rank	Traffic stream
1	2, 3, 5
2	4, 9
3	7

Figure 1: *Traffic Stream at A Two Stop Control intersection*

1.5.1 Conflicting Traffic

Each movement at a two-way stop control junction encounters a unique collection of conflicts, which are determined by the nature of the movement and conflict flow calculation. Figure 2.2 shows an example of an un-signalized T-junction. At the T-junction, there are six distinct sorts of traffic movements. Three layers of competing streams should be considered in the hierarchy of the un-signalized T-junction. It's a combination of Z, Y, and X movement. Because of the competing streams, the movements are unable to pass through the intersection unless the driver grants priority to another movement with a low chance for conflict and a high saturation flow. The first competing stream is a right turn movement from a main road (movement Z), since this movement is from the major stream, which is a priority stream that the minor stream should be aware of and must be given precedence.

The minor stream's left-turn movement is the second conflicting stream. Right to turn movement from the minor stream is the final conflicting stream. The driver must only give way to movement 'A' while turning left from the minor stream, but when turning right from the minor stream, the driver must give way to movements 'A', 'B', and 'Z', which are more problematic. Conflicting maneuvers at un-signalized crossroads, where design and operations are made of a complicated collection of criteria including multiple traffic lanes, traffic volumes, intersection spacing, medians, speed, and turning motions, cause majority of traffic conflicts. Left-turn maneuvers have been blamed for the majority of access-related accidents. Left turn maneuvers from a driveway to a main road at un-signalized crossings cause several challenges and conflict sites (Zhu Jian Lu, 2010).

2. LITERATURE REVIEW

The broad components of this study were reviewed in Chapter 1 starting with the issue definition, objectives, and scope. This chapter conducts literature studies on different processes as well as a discussion of the parameters to better comprehend the study. In section 2.2 of this chapter, the existing literature on un-signalized intersections is reviewed. The concept and significance of the un-signalized junction in highway elements are highlighted in this section. Parameters impacting capacity, such as stream priority and competing traffic, were explored in Sections 2.3. Major parameters that must be addressed in the analysis of the un-signalized junction, such as gap acceptance and critical gap, are covered in sections 2.4 and 2.5. The performance of the TWSC un-signalized junction, which is queued, and the Level of Services were reviewed in Sections 2.6. (LOS).

2.1 Scope of Study

The research location was chosen as a two-way stop-controlled un-signalized crossroads in Yelahenka Bangalore. The most prevalent sort of un-signalized junction, especially in urban and suburban regions, is this one. Furthermore, based on my observations, the un-signalized crossroads is near Bangalore, and it appears that the intersection is confronting a heavy traffic flow because the research location uses space around the un-signalized intersection.

The critical gap is the most important factor determining the capacity and performance of un-signalized junctions. To assess the un-signalized intersection, the parameters must be taken into account. HCM determined the crucial gap at the un-signalized junction (Highway Capacity Manual). Critical gaps, on the other hand, can be created in the field. Critical gaps for each intersection are logically distinct and are situated around the intersection, depending on the geometry of the intersection. A gap acceptance analysis was carried out on the field to evaluate the real value of crucial gaps at the TWSC un-signalized intersection in this study. The essential gaps were determined using Raff's approach. The gap was discovered by field observation.

At first, numerous data collections were undertaken, including geometric layouts of un-signalized intersections, such as multiple lanes, lane width, and others. Other metrics were then monitored, such as the sort of turning motions, traffic volume count movement, and vehicle characteristics. To keep the scope of the study as small as possible, only passenger automobiles were investigated. The data was taken during peak hour, when traffic volume is at its highest, when road accidents, delays, and congestion are common.

2.2 Significance of Study

The research is significant because it examines the performance of a TWSC un-signalized junction at the study location using gap acceptance. The critical gap is a crucial quantity to understand, particularly when analysing un-signalized junctions. The Rafts approach is used to calculate the key gaps of the TWSC un-signalized junction.

The study may then be used to assess if the TWSC un-signalized is efficient or needs to be improved. In traffic, it is a critical component for ensuring a smooth and efficient flow. The importance of junction design is to provide operational efficiency, optimise the intersection's capacity, ensure the safety of road users, and decrease intersection delays. Based on the findings, a new alternative solution to the problem at the intersection may be provided, such as expanding the number of lanes, installing traffic signals, updating the geometrical plan, and others.

2.3 Literature Review

2.3.1 Paper 01

Author name: Xiao jing wang, wan xiang wang
Year: 9 Nov 2014
Title estimation of critical gap based on raff's defined

This study is about estimating critical gap using Raff's definition. In this study, critical gap is an imp parameter that is used to calculate capacity for minor road delays in gap acceptance theory genialised intersections. They calculated critical gap using Raff's method with the help of the highway capacity manual. They acquired a quick overview of all crucial gap estimating approaches in this study. This gap analysis also calculated the critical gap in this study, which was based on the assumption of independence between minor stream vehicle arrival times and major stream vehicle arrival times. This publication examines the comparison of various critical gap methodologies as well as the verification of new models using simulations of Edward theatre.

2.3.2 Paper 02

Author: hassh jigishbhai amin Akhilesh Kumar mourya
Year: - Jul - SEP 2015
Tittle: - A Review of critical gap estimation approaches at uncontrolled intersection in case of heterogeneous traffic conditions.

They mostly discussed critical gap, gap acceptance, uncontrolled junction, and mixed traffic clearing behaviour in this study. A study of gap acceptance is presented in this publication. Driver behaviour at uncontrolled intersections and critical gap prediction approaches such as Raff's green shield method, the lag method, and Harder's method, among others. The current research was undertaken with the goal of beginning research on uncontrolled intersections in India. This study provides a comprehensive assessment of previous research on critical gap estimates. They primarily focused on the challenge of exploiting vital gaps on uncontrolled and diverse weak lane discipline traffic that is prevalent in India.

This research focuses on the idea of clearing time and how it relates to real driving behaviour. Because the cumulative distribution curve of clearing time and acceptable gap behave in a contradicting Mannes, the results achieved with this technique are not greatly influenced by traffic volume on important streets. These are some of the most important topics we learned during our research.

2.3.3 Paper 03

Author: Satish Chandra Mithun Mohan Timothy j
Title: estimation of critical gap using intersection occupancy time
Year: December 2014

This study focuses on the critical gap Occupancy time technique for unsignalized intersections with diverse traffic flows. The study of unsignalized junction traffic flow has long piqued the interest of traffic engineers. Critical gap is a more relevant parameter in the gap acceptance process throughout the world due to its complicated operating features. It cannot be directly measured from the field, but it is calculated based on the accepted and rejected gaps.

This research primarily proposes a novel method for estimating crucial gaps that can be used to both homogeneous and heterogeneous traffic conditions.

The distinction between homogeneous and heterogeneous traffic conditions is explained here. The major goal of this research is to provide a critical gap estimate approach that can be used universally to both traffic conditions. The alternative technique yields crucial gaps that are suitably large and similar to those reported in HCM2010. This method is similar to the occupation time method, which measures the time between a vehicle's entry and full exit from an intersection conflict area. This technique outperforms others since it takes into account the real charging pattern off the conflict zone.

3.METHODOLOGY

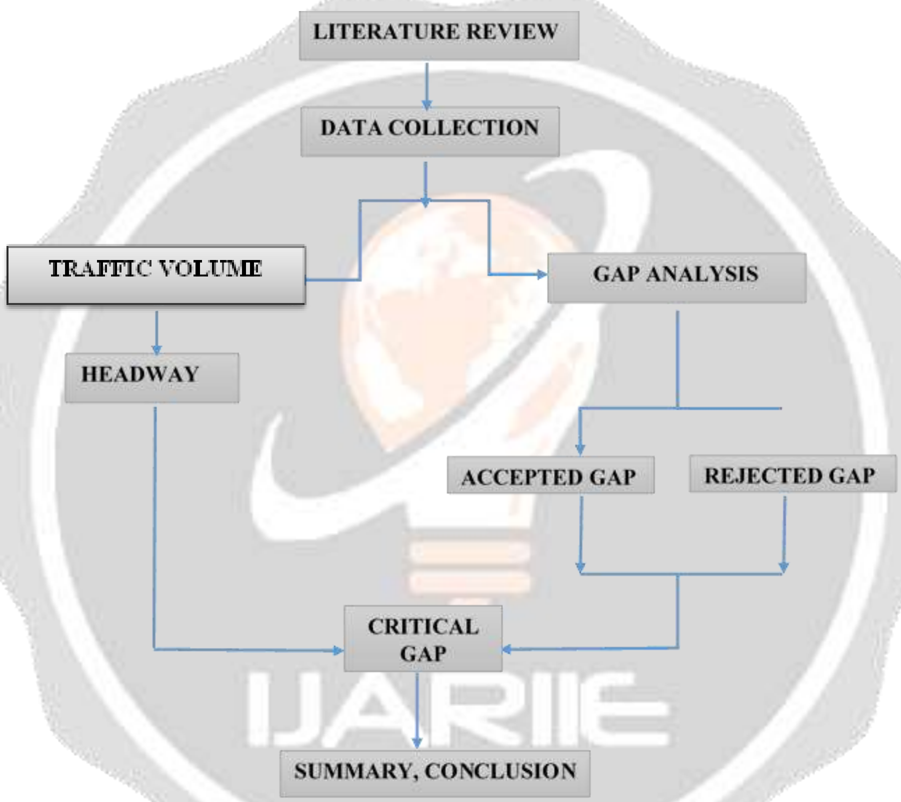


Figure 6: Flow Diagram

3.1.1 Literature review

To complete the assignment, we looked through 18 articles. This research looked at ways to determine each vehicle's moment priority at an unsignalized crossing. Many characteristics, such as critical gap, gap acceptability, and so on, were impacted in the capacity estimate for each vehicle. This study focuses on gap analysis and critical gap determination using Ruff's approach, which is quite accurate. We use Ruff's method to discover the critical gap. In this study, a gap analysis is carried out to calculate the crucial gap. The total time spent by the vehicle in each interval of time is 1 minute, and each vehicle is touched for 1 minute. This comprehensive investigation was carried out to determine the essential gap. Each vehicle's current priority, as well as approved and rejected vehicle gaps. This is the study's comprehensive literature review.

3.1.2 Data collection

In this project, data collecting is an important approach. Data may be gathered for gap analysis and critical gap assessment. When data isn't directly obtained from the field. A survey on video graphics has been completed. The four-arm junction and three-arm intersection were placed in the region of NES to Doddaballapur road to investigate driver gap acceptance behavior. The four-arm intersection is the MS Palya intersection, and the three-arm intersection is the NES to Doddaballapur road.

The junction was discovered at the plane terminal, giving each movement ample visual distance. For data gathering, the video recording technology was modified. Here, data is collected based on which vehicles have been accepted and which have been refused. Accepted vehicle refers to a vehicle that goes quickly without passing another vehicle. When a car comes to a complete stop and leaves a space for another vehicle to pass, this is referred to as a rejected gap. For an hour, the survey is conducted at 1-minute intervals. A video graphics survey in the field is used to gather the total approved vehicle and the rejected vehicle.

3.1.3 Gap analysis

The crucial gap is determined via gap analysis, which is an essential metric. One of the most essential aspects of microscopic features is gap acceptance. The gap acceptance theory is a concept that is often used in the study of uncontrolled junctions. It is based on determining the extent to which cars will be able to exploit a gap of a specific size and length. A gap is the amount of time and space required for a subject vehicle to safely merge between two cars. Gap acceptance is the final step in completing lane switching safely. As a result, the gap acceptance model may be used to describe how to decide whether to accept or reject a driver's car. Gap analysis was mostly done here with a focus on gap acceptance and gap repentance. Except for inaccessible get to man curves, gap acceptance is processed by miner's stream vehicles.

Where it is said that the driver is aware. If you're entering a traffic stream, you'll need to assess the space between possibly conflicting vehicles and split it. It's up to you whether you want to cross or enter. The junction of cars with a single stream of traffic or the intersection of two to separate traffic streams is one of the most critical parts of traffic operation. When a car merges into the traffic stream, they come to this intersection. When a motorist switches lenses and merges into the traffic stream, an intersection occurs. The traffic intersection connected with these basic man curves is inherently in the traffic intersection This is a small description of the gap acceptance.

The gap acceptance idea has an impact on gap repentance. Drivers must accept or reject available gaps at unsignalized junctions. Gap acceptance has a specific set-off condition that may be employed in the analysis because it is a yes or no decision. The driver's gap acceptance behaviour is shown below, which can be used to anticipate whether the gap will be accepted or rejected. This includes the incoming car's speed as well as the distance between it and the subjective vehicle. These are three crucial characteristics of acceptance models.

3.1.4 Accepted gap

When the major stream's headway is more than the crucial gap and the headway, the vehicle can enter the junction. When the headway is less than the crucial gap and the headway, the vehicle cannot enter the junction. As a result, the gap analysis is completed.

Counteracted, so the total accepted coefficient is equal to the accumulative probability off headway if T is larger than a critical gap.

Second circumstances:

The second circumstance is the relations between tc and ^tc. Tc: is the normal distribution that can be estimated by the average value. Tc^: estimation of critical gap.

In the second scenario, the critical gap distribution is demonstrated to be independent of the address distribution. Tc=tc is illustrated in these cases, where the average critical gap is equal to raff's critical gap. Raff's identification of the essential gap was thus completed. Main curves of small stream vehicles that have been accepted and those that have been denied. It is possible to simulate the distribution of acceptable and rejected headway. The proportion may be estimated using two scenarios: total accepted coefficient and total rejected coefficient.

First circumstances:

The number of rejected gaps greater than the crucial gap was equal to the number of acceptable gaps less than the critical gap, according to Raff. The fraction of anticipated gaps bigger than the critical gap is equal to the fraction of accepted gaps smaller than the critical gap, according to Raff's idea of the critical gap. N is a fixed number. The total number of gaps is denoted by N. Using two proportions, several alternative strategies for determining the essential gap at unsignalized have been developed. In this situation, Raff's approach is used to estimate the critical gap. Raff's method is viewed as a critical gap at the junction of rejected and acceptable gap values. This approach is frequently utilized in many nations. It's difficult to measure critical gaps directly, however they may usually be approximated using tolerable gaps. Gaps were also turned down. Here, the critical gap is calculated using Raff's technique.

3.1.5 Critical gap

One of the most essential elements in determining capacity is the critical gap. Cars pouring along major highways get precedence to pass through a signalized junction with two traffic enforcement vehicles. Vehicles streaming on secondary routes must wait until the big stream has a sufficient space. The essential gap is the minimum major stream headwear during which a typical minor stream vehicle can make a man curves critical gap is a judgement they should make to decide if a tiny stream vehicle can join the major stream, i.e. accepted gap and rejected gap.

3.1.6 Raff’s method

The accepted and rejected gaps are used in Raff's method, with the essential gap "L" being the size lag, Also, the number of acceptable lags shorter than l must equal the number of rejected lags larger than l. The important gap is found by intersecting the number of accepted and rejected gap curves. The critical gap value is heavily influenced by the flow velocity of the major road, which has a significant impact on Raff's technique, also known as the threshold method. Because of its simplicity and usefulness, the approach is frequently employed in many nations.

3.1.7 Assumption

The miner's stream vehicles and one of the big stream vehicles' arrival times are independent under the following exceptional condition. When minor stream cars arrive before the intersection, all major stream headway samples should have the same distribution shape as prior stochastic samples. As a consequence, the weekend replicates the headway distribution in the primary stream using letter samples. These address samples may be split into acceptable and rejected headway because all served hat samples are related.

3.1.8 Headway analysis

The critical headway parameter and the gap acceptance theory self, where headway is defined as a specific vehicle and a specific moment at an intersection and represents the shortest time interval in the priorities stream that a minor stream driver can travel without crossing and entering the major stream conflict zone.

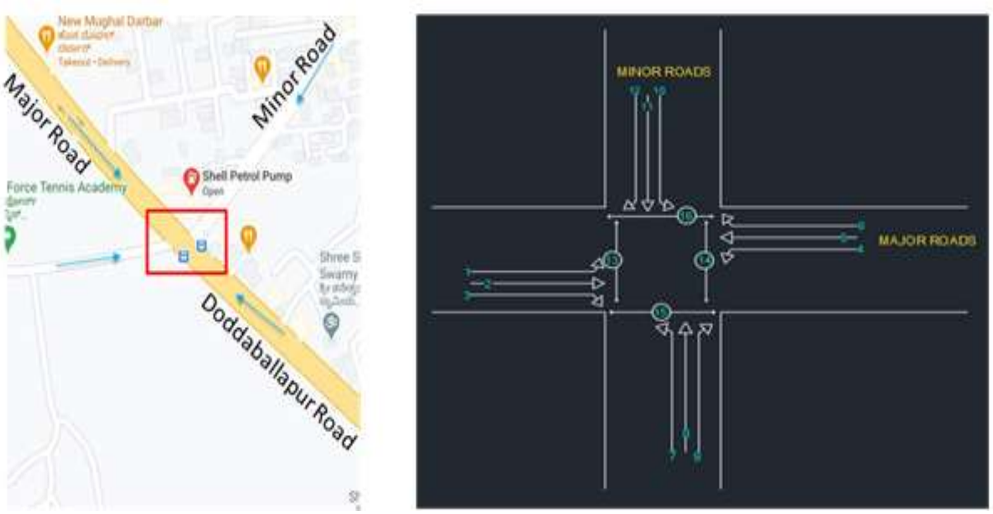


Figure 2: Four-Leg Intersection (Left Side Google Maps, Right Side AutoCAD)

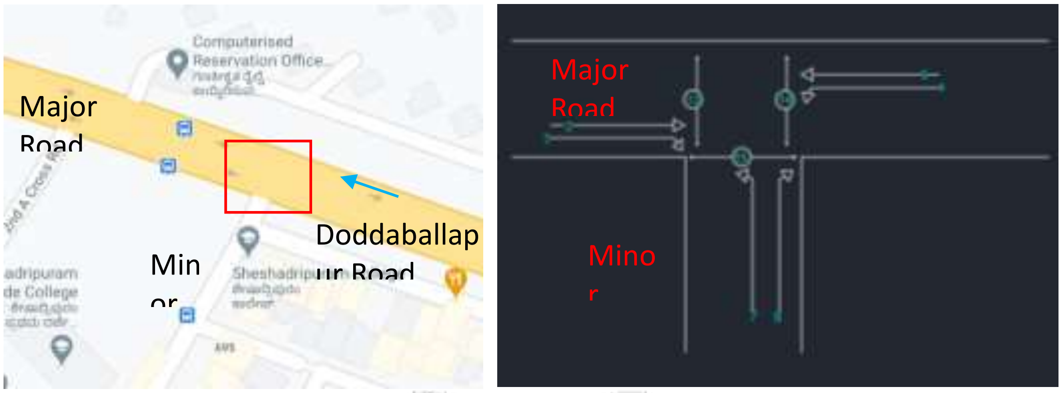


Figure 8: T-Intersection (Left Side Google Maps, Right Side AutoCAD)

3.2.1 Data Collection and Extraction

I have selected Four-Leg Intersection, T-Intersection.

- A video graphic survey was conducted to collect data. The video was recorded between the hours of 10:00 a.m. and 12:00 p.m. The video camera was set up in such a way that it could record all of the vehicles' movements. Two-wheelers, auto-rickshaws, and four-wheelers were the only types of transportation accessible at certain crossroads. At the smaller approaches to the crossroads, cycle-rickshaws and big trucks were rarely seen.
- Data will be collected in a video survey and used to calculate all the vehicle movements in Major Street to Minor Street.
- I have calculated each vehicle movement in 1-minute intervals.
- If the single minor street approach is regulated by a stop sign, the TWSC junction. Three-leg junctions are a type of uncontrolled intersection control where two of the three approaches are controlled by stop signs.

3.2.2 Flows at TWSC Intersections

- TWSC intersections assign right-of-way to conflicting traffic streams based on the hierarchy below.
- At a TWSC junction, the primary street through and right-turning movements get the highest precedence. Figures 01 and 01 depict these motions. 2 at 2, 3, 5, 6, 15, and 16. 1 at 2, 3, 5, 6, 15, and 16.
- Vehicles turning left from a main street onto a small street must yield to conflicting Major Street through and right-turning vehicles only. All other competing movements are subordinated to these big street-level left-turning motions. This rank's moves are 1, 4, 13, 14, 9, and 12.
- All conflicting major Street through, right-turning, and left-turning actions are given priority over minor Street through vehicles. This rank's motions are 8 and 11.
- Turning left on a minor street All competing main Street through, right-turning, and left-turning vehicles, as well as all Minor Street through and right-turning vehicles, are given the right-of-way. On this level, the motions are 7 and 10.
- Since there are so many different motor movements to account for at uncontrolled crossings, the traffic flow procedure is challenging. The majority of these movements collide with opposing traffic volumes. As a result of these disputes, capacity is reduced, delays are increased, and the risk of traffic accidents increases.
- Consider the four-legged junction seen in Figures 01 and 01.1. There are four conflicts while competing through movements, however there are eight conflicts when competing through right turns and movements. Right turns and merging traffic have four conflicts, whereas left turns and merging traffic have four conflicts.
- When all four approaches are taken into consideration, the number of conflicts caused by pedestrians will be eight. About four confrontations result from diverging traffic. As a result, there are around 32 distinct sorts of conflicts at a typical four-legged crossroads.
- Different sorts of junctions produce different forms of conflicts. The goal of junction control is to settle these issues at the intersection so that both automotive and pedestrian traffic may pass safely and efficiently. The following movements are used to determine conflict in four-legged intersections.

Major Street: left turns to look for gaps in opposing through movements, opposing right turns, and pedestrians crossing the minor street's far side.

Minor street: right turns merge into the rightmost lane of the major roadway, which requires through and right-turning cars to follow the pedestrian route depicted on each right turn from the minor street. All main Street Vehicular Flows are created by movements from the smaller cress.
Minor Street: Left Turns deal with two pedestrian flows as well as conflicting Minor Street through and right-turn motions.

3.2.3 T-intersection and four arm intersections

- The most basic type of junction is a T intersection, in which most routes meet at a straight angle. They're not as complicated as a crossroads.
- T-intersections work well in light and medium traffic, but they can be difficult to get out of when turning right in high traffic.
- The four-arm intersection usually involves a crossing over of two streets.
- In areas where there are blocks and in some other cases, the crossing street are perpendicular to each other.

3.3 Traffic volume count

3.3.1 3-Arm Intersection

Time Interval	Volume Count (No's)
8:00-9:00AM	3496

3.3.2 4-Arm Intersection

Time Interval	Volume Count (No's)
8:00-9:00AM	5283

3.4 Gap Analysis

One of the most essential aspects of microscopic traffic characteristics is gap acceptance. The gap acceptance theory is a concept that is often used in the study of uncontrolled junctions. It is based on the notion of determining the extent to which cars will be able to exploit a gap of a specific size or length. A motorist entering or crossing a traffic lane must assess the spacing between possibly conflicting vehicles before deciding whether or not to cross or enter. The interaction of cars within a single stream of traffic, or the interaction of two different traffic streams, is one of the most critical aspects of traffic operation. When a motorist changes lanes and merges into or crosses a traffic stream, this interaction occurs. The idea of gap acceptance is inherent in the traffic interaction connected with these fundamental moves.

A gap is the amount of time and space required for a subject vehicle to safely merge between two cars. Gap acceptance refers to the least amount of distance required to complete lane shifting safely. As a result, a gap acceptance model can help describe how a driver determines whether to accept a gap. The mechanism by which a tiny stream vehicle accepts a gap to move through is referred to as gap acceptance.

3.5 Gap Analysis Raff's Method

The size lag is the critical lag if the number of approved shorter lags matches the number of rejected longer lags (Raff and Hart). Drew proposed a similar idea, except this time for gaps rather than delays. As a consequence, the important gap may be estimated by adding the number of acceptable and rejected gap curves together.

Raff's technique can be represented in a number of ways. Consider the following example: What is the cumulative probability of an acceptable gap in the primary stream, and what is the cumulative chance of a rejected gap? The threshold approach is another name for Raff's methodology. The critical gap value is heavily influenced by the flow rate of major roadways. Because of its simplicity and usefulness, the approach is frequently employed in many nations.

4. HEADWAY ANALYSIS

The concept of level of service in highway traffic flow describes variations in flow characteristics that may be studied using vehicle headways. Time headways are the intervals between subsequent autos passing by a certain place on the road. Because the velocity of flow is inversely proportional to the interim headway. Headways have long been thought considered as the oddball elements of traffic flow. The time headway achieves its smallest value when the traffic flow reaches its highest value. Individual values of time headway fluctuate substantially if time headways are monitored across time. The magnitude of these variances is mostly determined by the highway and traffic conditions.

On a country highway with low traffic. Vehicles are free to overtake at any time. From zero between passing cars to greater headways between widely separated vehicles, a range of headways will be seen. When flow conditions on more highly used roadways are observed, there are fewer possibilities to overtake and fewer cars that are more widely separated. When there are no overtaking chances, relatively short headways are unavailable, especially in densely travelled areas. As they follow each other down the highway, all cars maintain a consistent headway.

The method of measuring headways may be divided into two categories. They may be measured using a system that tracks the arrival of cars at a certain location. Alternatively, headways can be captured using an aerial snapshot that captures the distribution of headways between subsequent cars at a single point in time.

The time headway distribution is obtained using the first approach, while the space headway distribution is produced using the second method. The time headway distribution has been extensively explored and published because to its simplicity of observation. The time headway distribution is obtained using the first approach, while the space headway distribution is produced using the second method. The time headway distribution has been extensively explored and published because to its simplicity of observation.

When cars arrive at a certain place on the roadway is mentioned. The number of cars coming in a given time interval might be described by the distribution. The time gap between subsequent vehicle arrivals. The counting distribution is the first, while the gap distribution is the second.

The most striking aspect of vehicular traffic has been noted as the significant diversity in all sorts of headway that may be monitored. As a result, statistical approaches and probability theory have been used to create theoretical distributions to reflect observed headway distributions in attempts to comprehend them.

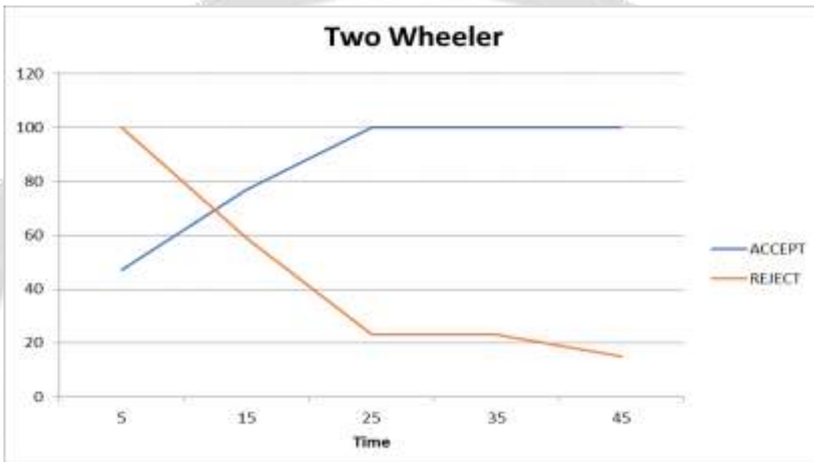
The link between counting and the gap distribution was examined by Haight Whistler and Mosherl, however it is generally the gap distribution that is studied. For the examination of gap distributions, a shorter duration of observation is required than for the investigation of counting distributions. In the examination of junction capacity, minor road vehicles exploit gaps in the major road flow to access the major road, and the gap distribution is important once again.

Kinzer and Adams created the negative exponential distribution as a suitable match for the cumulative gap distribution, which was one of the first automobile traffic flow headway distributions. Adams demonstrated the validity of negative exponential distributions by observing traffic movement in London. When this distribution reflects the cumulative headway distribution, arrivals occur at random, and the counting distribution may be characterized by the Poisson distribution. This type of traffic can be found in regions where there are a lot of overtaking opportunities and poor volume/capacity ratios.

5. GAP ANALYSIS

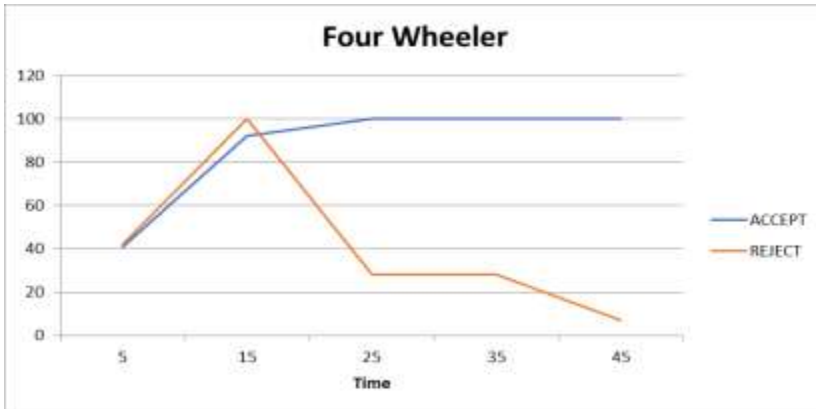
5.1 Critical Gap

5.1.1 Three-Arm Intersection

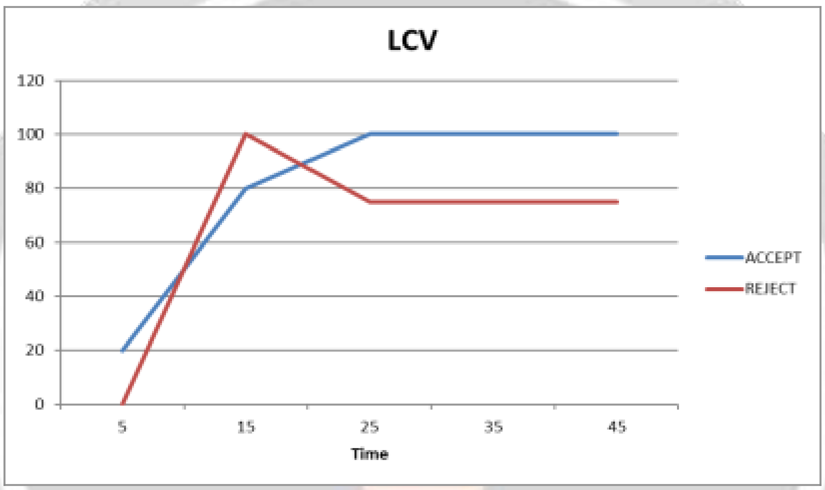


Graph 1: Two-Wheeler (Three-Arm)

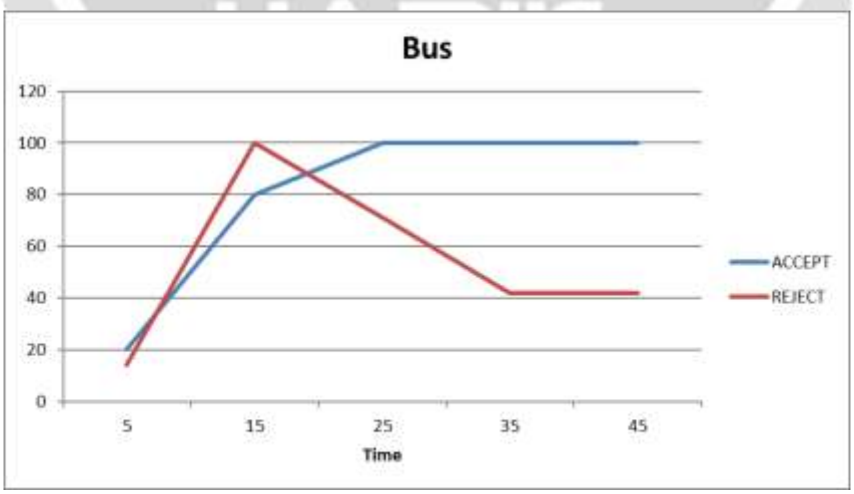
Graph 2: Three-Wheeler (Three-Arm)



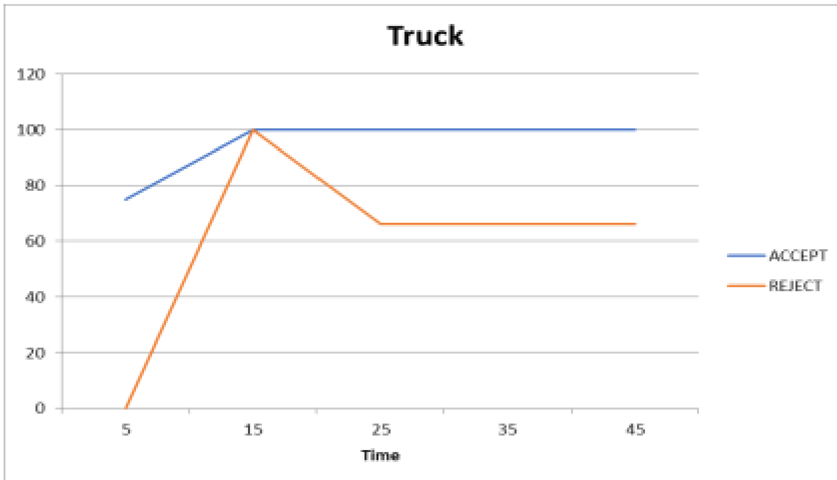
Graph 3: Four-Wheeler (Three-Arm)



Graph 4: LCV (Three-Arm)



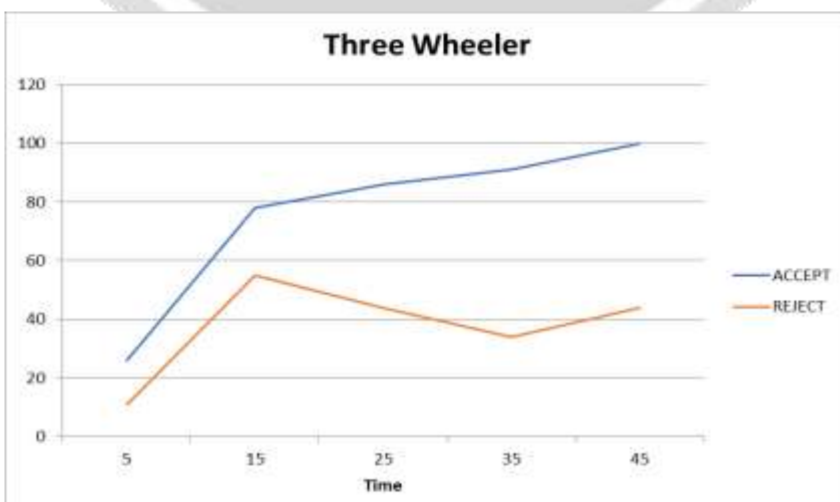
Graph 5: Bus (Three-Arm)



Graph 6: Truck (Three-Arm)

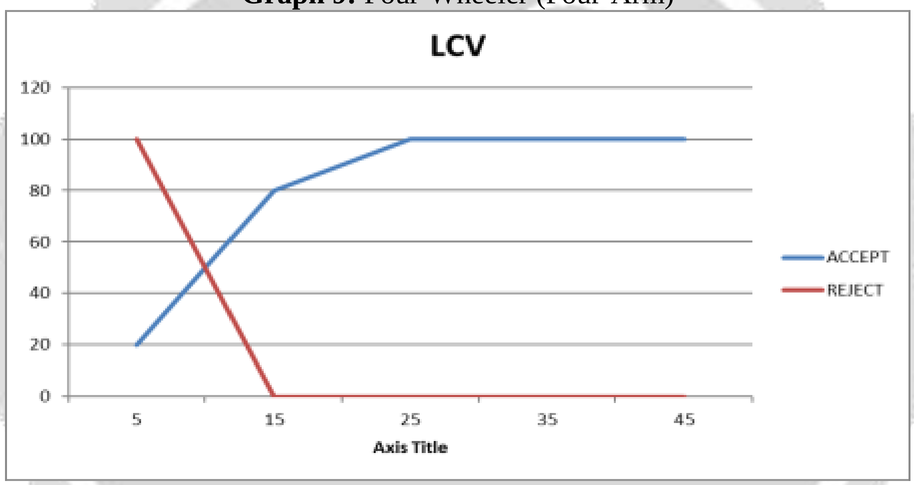
5.1.2 Four-Arm Intersection

Graph 7: Two-Wheeler (Four-Arm)

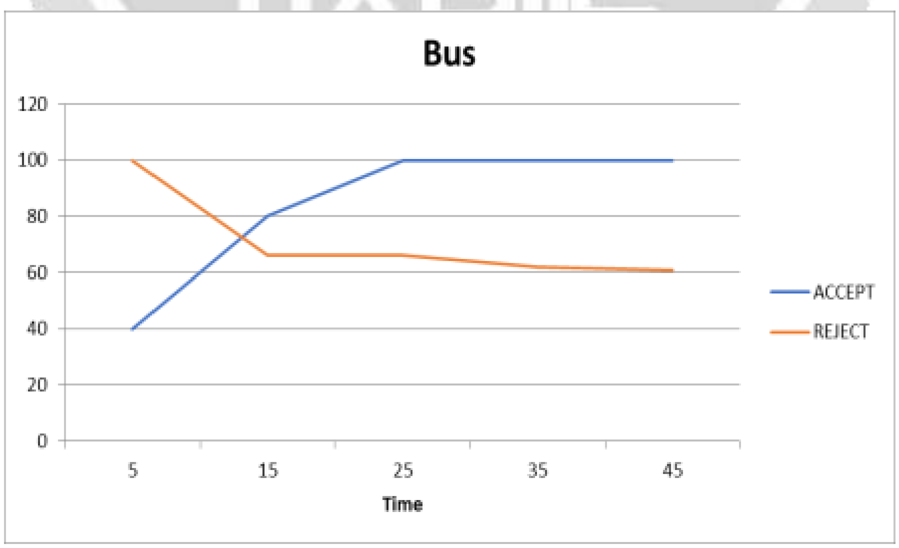


Graph 8: Three-Wheeler (Four-Arm)

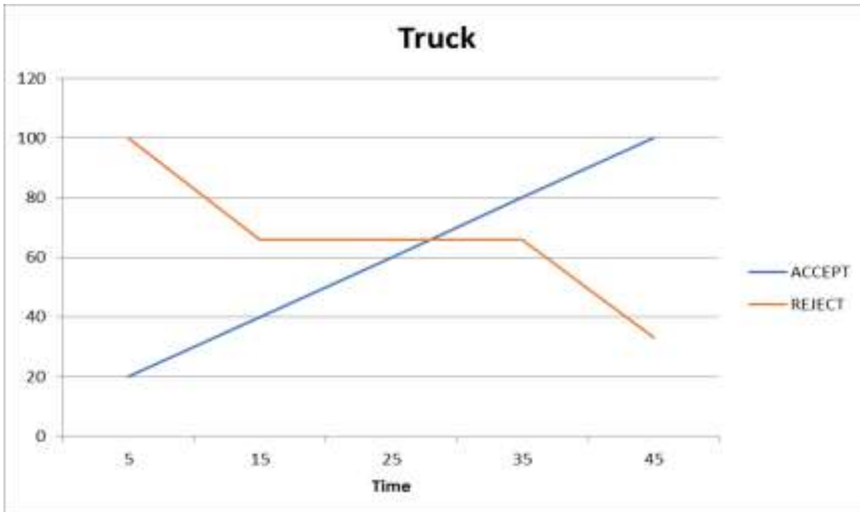
Graph 9: Four-Wheeler (Four-Arm)



Graph 10: LCV (Four-Arm)



Graph 11: Bus (Four-Arm)



Graph 12: Truck (Four-Arm)

6. RESULTS

- The interval between one vehicle to another vehicle was found to be 0-2 seconds.
- Number of vehicles moving in a 1-hour duration at a 3-arm intersection was found to be 3496 for a minimum traffic flow.
- Number of vehicles moving in a 1-hour duration at a 4-arm intersection was found to be 5283 for a minimum traffic flow.
- Using Raft's method, we found out that the critical gap follows the average flow at 3 and 4 arm intersections.
- Distribution of gaps for (2, 3, 4) wheelers, LCV, min bus, bus, the truck has unpredictable gaps where each interval observed in seconds varies.
- We have observed that rejected gaps are high in number than accepted gaps in critical gaps which were found to be 2-7 seconds.

7. CONCLUSION

- I have observed that the flow of vehicles has being increasing gradually day by day due to the expansion of Bangalore and major transportation demands.
- Shortly traffic flow in this intersection will have long vehicle jams, accidents, and other major occurrences.
- consequently, I recommend at minimum a traffic signal (TWSC) to provide a better-controlled flow of traffic or expansion of lanes from 1 to 2.
- I recommend the speed limit to be max of 60 Kmph.
- Heavy load vehicles must not travel in peak hours but can take advantage of the road in the early mornings and late evenings as non-commercial vehicle traffic will be less.
- On max we can build infrastructure such as flyover on the metro to reduce the traffic flow.
- By providing controlled or zero traffic flow we can decrease the amount of carbon produced by vehicles and time to travel.

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