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"Suggesive Measure Travel Time And Congestion Under Heterogeneous Traffic Conditions"

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DECLARATION

1. I certify that the thesis report entitled **SUGGESIVE MEASURE TRAVEL TIME AND CONGESTION UNDER HETEROGENEOUS TRAFFIC CONDITIONS** submitted by me to RIMT UNIVERSITY, Mandi Gobindgarh, Punjab for the award of the degree of **Master of Technology in Highway and Transportation Engineering** under the supervision of **Prof. Manish Kumar** is original work. The contents of this thesis, in full or in parts, have not been submitted to this or any other Institute or University for the award of any degree or diploma.

2. I further certify that wherever any database or the work of some other author has been used, the same has been properly acknowledged.

CERTIFICATE

This is to certify that the thesis report entitled **SUGGESIVE MEASURE TRAVEL TIME AND CONGESTION UNDER HETEROGENEOUS TRAFFIC CONDITIONS** submitted by **Munazil Mushtaq Khanday,** roll no.: **19-M-CE-11019** of Civil Engineering department, to the RIMT UNIVERSITY, Mandi Gobindgarh, Punjab for the award of the degree of Master Of Technology in Highway and Transportation is a bonafide record of research work carried out by him under my supervision. The contents of this thesis, in full or in parts, have not been submitted to this or any other Institute or University for the award of any degree or diploma.

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ABSTRACT

Movement in urban areas effectively effects both well-being and traffic conditions. More the congested activity, greater the rate of auto-movement will have more regrettable impacts. The impacts can be decreased by movement diminishment, or by moving from autos and bicycles to alternate methods of transport with less negative effects. For this venture, the range for the study which i have taken is Phagwara, Jalandhar. The purpose of the study is to control traffic jams on roads due to increase in number of vehicles and saving time of people at intersections. Travel time data is vital segment of numerous smart transportation frameworks (ITS) applications. As of late, the quantity of vehicles in India has been expanded enormously, prompting extreme movement blockage and pollution in an urban range, generally within peak periods. If we mitigate the congestion, another things will also decrease

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like pollution will be less and reduction in accident rate due to less delay to the road users. An attractive system to manage such issues is to move more individuals from personal vehicles to open transport by giving better administration and less travel time. In this circumstance, propelled open transportation frameworks (APTS) are a standout amongst the most essential ITS applications, which can completely add to the movement circumstance in India. But this is not possible in every city because India is developing country and has weak economy. Our point is to work out the traveler auto unit PCU for various categories of vehicles under non-homogeneous movement conditions. From the study we perceived that traffic volume was increasing ominously with mixed traffic conditions on the roadway consisting of Six-Lane Two-way traffic. The relation between volume and speed represents a third and fourth degree curve.

I. INTRODUCTION- CHAPTER 1

1.1 Background of The Study

Travel time information is an essential component of many intelligent transportation systems (ITS) applications. Belonging to a period of time not long ago, the number of vehicles in India has increased in a very great amount, leading to highly developed traffic congestion and pollution in urban areas, particularly during peak periods. A useful strategy is to deal with such issues or shift more people from personal vehicles to public transport by providing better service, anxiety, freedom from effort and so on. In this circumstances, advanced public transportation systems (APTS) are one of the extremely important ITS applications, which can extensively improve the traffic situation in India. One such application will be to give precise or particular data about transport entries to travelers, prompting or cause diminished holding up times at transport stops. This needs a constant information buildup strategy, a speedy and dependable forecast system to find out the certain normal travel time in light of ongoing information and educating the travelers with respect to the same. The extent of this study is to utilize worldwide situating framework information gathered from open transportation employing or make use of urban roadway in the city of Jalandhar, India and to anticipate travel time under heterogeneous movement conditions utilizing a calculation in light of the Kalman sifting system. The execution of the proposed calculation is observed to be promising and anticipated that would be profitable in the improvement of APTS in India. The work exhibited here is one of the first earnest and industrious at ongoing fleeting forecast of travel time for ITS applications in Indian movement conditions.

1.2 Need for The Study

Traffic activity in urban areas or a specific town has negative or undesirable consequences for wellbeing and nature. The more swarmed or congested the movement and the greater the extent of car activity, the more terrible or substandard these impacts appear to be. The impacts can be decreased by activity of traffic lessening, or by moving from autos to different methods of transport with less negative effects, for example, open or public transport. Some of measures taken so as to lessen auto movement are regularly detested and their execution met with battle. Nowadays, they can be triumphant or won a battle both as far as city of general supposition and natural or biological impacts. These days various urban communities are considering the execution of key strategy measures and the blockage charging. London has turned into a "worldwide model or sample". In spite of the fact that not exceptionally famous among drivers, clog charging has the imminent or potential to speak to such various or different hobbies as established financial analysts that support a client pay show, a person's standard occupation or exchange or organizations that experience the ill effects of lessened simple entry or availability, ecological gatherings that need smaller or decreased air contamination, and open equity social change or activists, that need upgrades or venture up in broad daylight transport. Furthermore, since London is perceived as a world city and a precursor in urban modernization or change, any technique effectively actualized there has incredible metaphorical or typical worth.

1.3 Importance of Study

The development in urban activity clog has been perceived as a difficult issue in all vast metropolitan ranges in the nation, with critical impact on the economy, travel behavior, land use and a reason for inconvenience for a huge number of drivers. Despite the fact that movement clog is not a new problem in urban regions, it has been reached out to rural ranges sooner than anticipated. Schrank and Lomax (1997) evaluated that the yearly cost of blockage is 50 urban regions in 1994 surpassed $53 billion. They additionally evaluated that 90 percent of aggregate blockage costs in major urban zones are credited to travel delay, with the other 10 percent ascribed to fuel cost. The decrease in urban portable object coming about because of movement blockage has turned into a noteworthy worry to the transportation and business group and to the general population as a rule or governing conduct. Different discovery

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frameworks have been introduced in urban zones as a method for checking movement blockage with a specific end goal to help drivers in settling on better travel choices. Furthermore, the forecast of future activity conditions has turned into a basic part for some Smart or Intelligent Transportation system or Framework (ITS) applications, for example, Advanced Traffic Management systems or Frameworks (ATMS) and Advanced Traveler Information systems or Frameworks (ATIS). Among the numerous issues that require consideration in clog administration system is the requirement for logical techniques and in addition activity reproduce systems to consider carefully the impact of blockage and, besides, to be used in evaluating elective blockage mitigating procedures or strategies. A key issue in using these techniques is a comprehension of assumptions of the hypothesis and confinements of these systems all together that they are used inside of their area of use.

1.4 Objective of The Study

The objective of this study is to develop an architecture for an area traffic control system suitable for heterogeneous traffic conditions.

- Critically evaluate the system architectures of the popular ATCS, which is Advanced Technology Consulting Service or systems.
- Suggest a system architectures best suited for heterogeneous traffic conditions.
- Study the major traffic components of the system specifically the vehicle progression models and saturation flow models with the help of field data.
- Controlling the traffic jams on roads due to increase in the number of vehicles.
- Saving the time of the people at the intersections.

The area for the study which I have taken is PHAGWARA, JALANDHAR.

1.5 Description of Study Area

The area for the study which I have taken is PHAGWARA, JALANDHAR. The study area shown in the map, is one of the famous village as more number of NRI's belong to that village. Phagwara is a developing city as more number of vehicles are registered in the area.

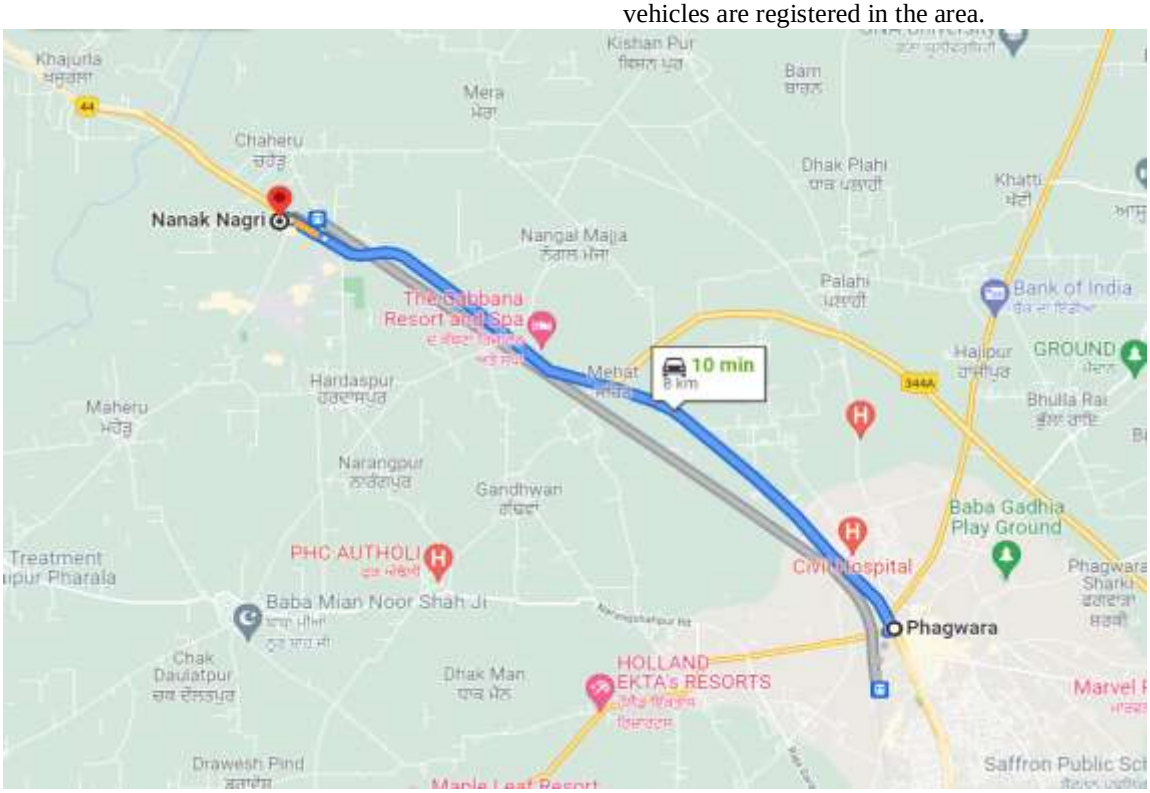

Fig. 1.1: Location of Study Points on Jalandhar Map.

From 1995-2007 the increase in number of vehicles registered has reached more than 54% (Source: District Transport Office, Jalandhar). PHAGWARA is a town and has been done lately it got to be municipal corporation in KAPURTHALA region or district in North India, inside the focal piece of PUNJAB. The city is universally perceived on the grounds that a lot of NRI (Non-

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Occupant Indian) community fits in with this town. Previously PHAGWARA was united with KAPURTHALA region it was a piece of JALANDHAR area. PHAGWARA lies on DELHI-AMRITSAR roadway NH-1 and is additionally served by the rail connection in the middle of DELHI and AMRITSAR. It is situated between the two major urban areas of LUDHIANA and JALANDHAR. PHAGWARA is 76 miles far from CHANDIGARH and 220 miles or 355 km from DELHI. PHAGWARA railroad station is an intersection, with rail and street connections to different urban communities too. Most significant rails bring to a standstill here, e.g., the Shatabdi Express. PHAGWARA is likewise well-known for Haveli a family eatery with two meal corridors and RANGLA PUNJAB a town themed eatery and outing spot.

PHAGWARA is situated at 31.13^0N 75.47^0E. It has a normal rise of 234 meters or 767 feet. According to google information of 2011 registration PHAGWARA town mass had a population of 117,954, out of which guys were 62,171 and females were 55,783. The literacy rate was 87.43%. Starting 2001 India census, PHAGWARA had a public of 95,627. Guys constitute 54% of the populace and feminines 46%. PHAGWARA has a normal education tempo of 82%, higher than the national normal or average of 59.6%: male proficiency or literacy is 81%, and female proficiency is 74%. In the town of PHAGWARA, 11% of the populace is under 6 years old. Scheduled Caste populace in PHAGWARA is more than 49.15%.

PHAGWARA was manufactured by SHAH JEHAN as a business sector town. After some time, a few individuals of PHAGWARA began cultivating and PHAGWARA tackled a rural character. PHAGWARA, which now is just secured by the region encompassing Sukhchainianna Gurdwaara. Where a few individuals keep on cultivating the earth. It turned out to be a piece of the Ahluwalia Sikh Tradition of KAPURTHALA. The 6th Sikh Master, Shri Master Hargobind Sahib Ji went to this spot in 1635 in the wake of winning the clash of Kartarpuur and Pallahi. PHAGU, an incredible fan of Master Ji used to live here. At the point when PHAGU came to realize that Master Ji had come subsequent to battling against Mughals and imagined that Mughals may be tailing or following him, he was concerned and did not serve Master Ji. Master Ji said," PHAGU DA WARA, Bahroon Mithaa Androon Kharaa". Consequently, PHAGWARA got its name from "PHAGU-DA-WARA". Narur is the popular and huge town in PHAGWARA. JAMA MASJID was constructed through then Maharaj KAPURTHALA. Its primary entrance way is confronting towards east in Mohhalla Atisshbazan and extra west side entrance way is on Gaushaala street.

1.6 Approach and Methodology

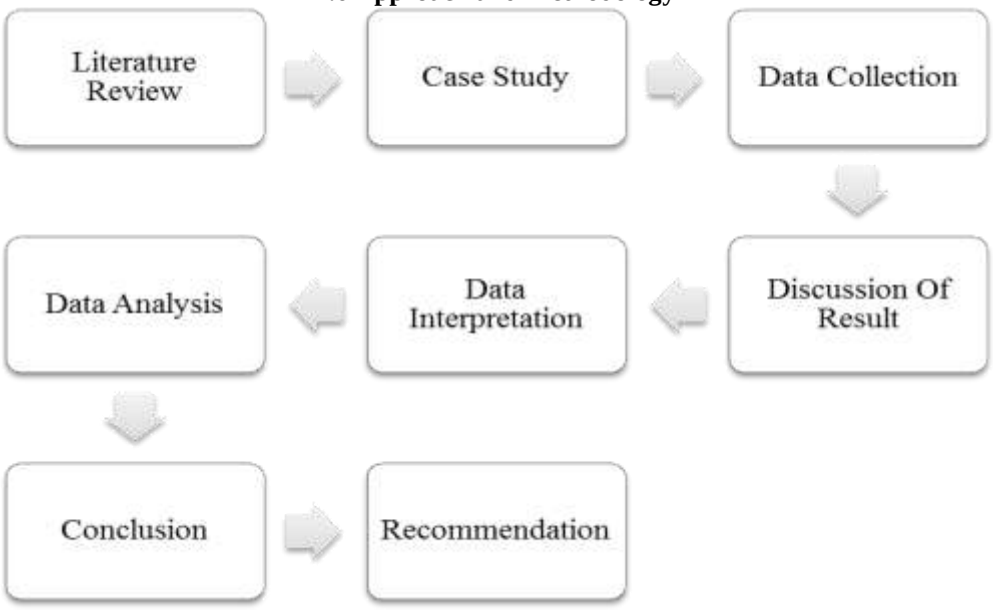

Fig. 1.2: Flow Chart for Approach and Methodology.

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1.7 Study Synthesis

- Chapter one contains introduction.
- Chapter two contains review of literature.
- Chapter three contains methodology.
- Chapter four contains data collection and analysis
- Chapter five contains discussion on results and to find the conclusion.
- Chapter six contains recommendation of result.

II. LITERATURE REVIEW- CHAPTER 2

Travel clogging is one of the most important fear of present life and numerous methods have been developed by numerous researchers to downbeat effects of mitigate jamming. Jamming pricing is a technique which is being second-hand by many countries and there are an amount of information showing that it can profitably manage traffic jamming when it is used successfully. This episode reviews existing hypothetical studies as well as authentic-world implementations of the idea of jamming pricing. Literature dealing with the value of travel time due to the muscular relationship with jamming pricing is also reviewed in this episode.

The major traffic features in these rising countries are combination of non-motorized vehicles and motorised vehicles on street, that builds the task of analysis or scrutiny much supplementary complex, due to the presence of heterogeneous or mixed traffic. That forms the source for the want of equivalent commuter car units.

Gupta, 1986 the combination of non-motorised-vehicles and motorized vehicles makes severe decline of the speed, and even causes traffic overcrowdings.

Stropher, 2004 the presence of bottlenecks is bound to lessen the speed of the vehicles and may also result in needless delays in the case of high traffic concentration. It was to be reported that the capacity of a two-lane street can go down by 28% when the lane width altered from 3.7 to 2.75 m.

Khaled, 2006 it was also found out that, the change of a shoulder to a bonus travel lane that could be likely or expected to boost the average speed of a two-lane highway by about 5% for volumes beyond 150 vehicles per hour. One more option is to provide significance to public transport vehicles by giving main concern or priority to buses, which can significantly trim downs the use of private vehicles.

2.1 Impacts of Traffic Congestion on Travel Time

Increased travel times and the uncertainty brought about by jamming impacts the efficiency of logistics processs. Weisbrod et al., 2001 direct and indirect costs related with jamming have been broadly calculated and reported. Most of the studies have been focused on commuter's price of travel time, delivery services price or value of time and marketplace access costs, production costs, and manual labor production costs. On the other hand, the modeling and learning of the specific impacts of urban jamming on commercial vehicle tours have received slight awareness. The need of studies is mostly explained by lack of disaggregated and complete commercial motor vehicle data, which due to privacy or competitive reasons, is luxurious to collect or impossible at the desired level of detail. This research studies the impact of jamming on commercial vehicle tours in an urban area. It contributes to the understanding of the impacts of jamming on commercial vehicle tours. The specific contributions of this research are threefold:

- It analytical approximations and empirical data to study and describe the impact of jamming on tour characteristics.
- It discusses congestion costs from a carrier's perspective.
- It uses a new and spontaneous classification of urban distribution tours according to their efficiency and weakness to jamming. Empirical or real-world disaggregated tour data is also analyzed to validate analytical insights of the model.

2.2 Impact of Congestion on Duration controlled Tours

To make possible the study of overcrowding impacts, tours are to be broken down into three belongings:

- The increase in average travel time.
- The increase in the travel time irregularity, and
- The communication effect between a simultaneous raise in average travel time and variability. Basically, the latter and the most complicated case is usually the most appropriate. However, uncomplicated cases are to be analyzed initially for the sake of production efficiency.

2.3 Impact On Prices.

Arnott, R, and Small, K.A., 1994 obstruction pricing is defined as, charging motorists during peak hours to give them

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confidence to either control their travel times or to use an alternative route which are not obstructed at climax or peak hours. The assumption behind the street pricing suggests that, in order to achieve social best possible, a tax needs to be charged which must be equivalent to the difference between social subsidiary costs which include external costs that street users require on each other on a jam-packed road and personal or private average costs of users like travel delays, fuel, maintenance etc.

Morrison, 1986 explained the theory of best tolls used in overcrowding pricing by making use of the speed-flow curve. According to his economical reason, commuters do not think about how much delay they use to impose on other travelers and commuters only pay attention to how long it takes them to travel. As seen in Figure 2.1, the demand equilibrium where individual costs are considered is at Q_0, whereas when the social best conditions are considered equilibrium occurs at Q*. The difference means that each vehicle joining the system causes a hindrance or delay on each other vehicle which is not to be taken into account in private costs and therefore more vehicles are to be present in the organization as it should be at the communities most favorable conditions. The idea or thought of charging the related cost difference from each vehicle enables shifting the demand from Q_0 to Q* and operating or in the system at its best.

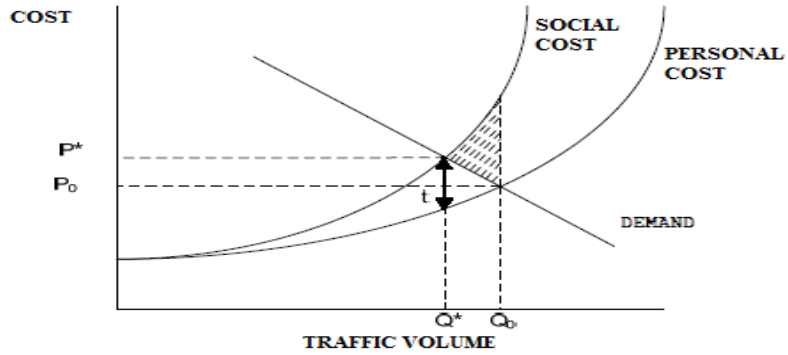

Fig. 2.1: Economics of Overcrowding Pricing (Morrison, 1986)

2.4 Value of Time

Value of time, in other words, the change in amount of the user's willingness to pay for a unit change in travel time, is also one of the topics that have to be taken into account in determining toll rates. Value of travel time is one of the important factors for determining user's route and time departure choices. Depending on the value that commuters set for their travel time, they make the decision to use a tolled road and reduce their travel time or to use a free alternative road and spend more time in traffic because of delays and travelling longer distances.

It is also important to distinguish user groups in traffic when considering value of travel times. Commuter value of time basically depends on travel time savings, therefore their income, route choice and departure time choice are basically the three determining factors.

Ozbay et al., 2008 presented an analytical model for value of travel time investigating the relationship between departure/arrival time, travel time and income.

For commercial vehicles, on the other hand, value of travel time is not solely dependent on the same parameters identified to be important for commuters. Since commercial are also a part of a business activity, they have several other criteria to consider for their departure time and route choices. Most of the commercial vehicles are working as carriers, meaning they have receivers and suppliers, therefore costumer needs to come into play in their travel choices. They have to make profit therefore any kind of costs related to their trips (e.g. fuel, toll, delay penalties) not only affect their time savings (which is the case for commuters) but also affects their overall budget.

2.4.1 Commuter Value of Time

Several "value of travel time" studies were conducted for passenger trips in different regions of the world. Discrete choice models (e.g., binary logit, mixed logit, multinomial logit, and nested logit) based on traveler survey data are commonly used in estimating commuters' value of times (Small and Rosen, 1981: Laurent, 1998; Hensher, 1996; Algers et al., 1998; Calfee and Winston, 1998; Ghosh, 2000; Sullivan, 2000; Small and Sullivan, 2001; Hultkrantz and Mortazavi, 2001; Brownstone et al., 2003; Cirillo and Axhausen,

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2006). In these models, utility models include variables which were selected via trial-and-error method. It is important to determine user's willingness to pay to figure out their behavior, such as route or mode choice, in a network where tolled roads take place.

Blayac et. al., 2001 proposed the idea of relaxing the constancy of marginal utilities and derived analytical functions to relate VOTT (value of travel time), time, price, income level and departure/arrival time restrictions. Following the same idea, Ozbay et. al., 2008 improved the functions by adding departure time choices and used nested logit model to estimate value of travel time of New Jersey Turnpike users under the presence of a time-of-day pricing.

Table 2.1 gives a summary of the major commuter value of time studies for different facilities, the models they use and the value of time they obtain for the passengers.

Table 2.1: Major commuter value of time studies for different facilities

Study	Region	Model	VOT
Laurent (1995)	Marseilles, France	RP, Binary Logit	$12 /hr
Hensher (1996)	Australia	SP, Heteroscedastic Logit	$6.34-$10.2 / hr
Algers et.al. (1998)	Sweden	SP, Mixed Logit	$7.96/hr
Calfee et al. (1998)	Michigan	SP, Multinomial Logit	$4/hr
Ghosh (2000)	I-15 San Diego	RP, Conditional Logit	$22 /hr
Sullivan (2000)	SR 91, California	RP, Multinomial Logit	$8-$16 /hr
Small et al. (2001)	SR 91, California	RP, Multinomial Logit	$13-$16
Hultkrantz et al. (2001)	Sweden	SP, Probit	$6.43 /hr
Browstone et.al. (2003)	I-15, San Diego	RP, Conditional Logit	$30 /hr
Steimetz et. al. (2005)	I-15, San Diego	RP, Conditional Logit	$45-$30 /hr
Ozbay et al. (2008)	NJTPK, New Jersey	SP, Nested Logit	$15-$20 /hr

2.4.2 Commercial Value of Time

Although there are many studies done for commuter value of time for commercial vehicles there is a limited amount of research available.

Haning and McFarland, 1963 one of the first studies for the evaluation of the value of travel time for commercial vehicles was published by Their analysis showed that commercial vehicle value of time should be greater than passenger car value of time even if no cargo or good is being carried.

Kawamura, 1999 defined a commercial vehicle value of travel time with using two different methods; first switching point analysis and second a random coefficient logit model. In his study, he analyzed the stated preference by conducting a survey on 77 trucking companies. Switching point analysis is a straightforward method in which the estimation of value of time based on the level of trade-off where the user chooses to switch from the cost option to free option. For example, a traveler states that he/she would pay a toll for a given amount of time savings up to $10, then for all tolls above $10 he/she chooses the alternative road without a toll then the switching point for this individual is $10 and this would be the estimate of his/her value of time. In the second method, he fitted seven models by dividing the data into groups, by company ownership status and distance traveled. He first tried to estimate a logit model but the results are not suitable to generalize for every company therefore he fitted a random coefficient logit model that allows him to define different value of times for different types of companies. His findings showed that value of time of commercial vehicles

has a mean of 23.4/hr and a standard deviation of $32/hr. At conclusion, he noted that the limited sample size bounds the study at a level that for further analysis a larger sample size is needed.

Smalkoski and Levinson, 2003 conducted a study for value of time determination for commercial vehicle operators in Minnesota. They fit a two-bit model to the data they obtained from the adapted stated preference survey. 50 companies were interviewed and they found a VOT of $49.42/hr.

Most of the value of time estimation studies are done based on stated preference user surveys. In these surveys, there are questions to get an idea about the traveler choice behavior under different circumstances.

Vilain and Wolfram, 2001 conducted a survey for truckers in New York region and their study indicate that the response of truckers to congestion charges would be relatively modest.

Holguin-Veras et al., 2005 states that as a result of their trucker survey 61.6% of commercial vehicles travel at the time they do because of customer requirements. This is an important finding showing that most of the truckers do not have schedule flexibility. In addition to stated preference, revealed preference analysis also gives an idea about possible trucker behavior.

2.5 Impact of Traffic Congestion on Road Accidents

Traffic clogging and street mishaps are two significant externalities formed by means of road consumers. Greater than before travel time caused by traffic overcrowding requires public costs to highway users, mutually in the terms of economic loss and besides the reduced value of existence of life and the mobility. The expenditure of road traffic mishaps to folks, asserts or property, and civilization in common have too been more significant. Traffic jamming and mishaps together compel a burden to the society, and as such it is very significant to diminish their influences. An ultimate solution possible to decrease them at the same time but this may not be feasible. However, given that it is considered that there may be an opposite connection or relationship sandwiched between traffic overcrowding and highway safety.

Shefer and Rietveld, 1997 imagine that in a smaller amount jam-packed street network system, the average or regular speed of traffic would probably be usually high, which is expected to effect in more severe injuries or fatalities.

Alternatively, in a crowded highway network, traffic would be time-consuming and may cause a smaller amount of fatalities and serious amount of injuries. This may be greater before traffic jamming may guide to additional accidents due to bigger traffic volume; though, these accidents may be less brutal. This suggests that the whole external price or cost of accidents perhaps be less in an overcrowded circumstances or situations relative to an uncongested condition. This poses a possible problem or dilemma for transport guidelines makers because it would come into view that traffic jamming can progress highway safety; on the other hand, traffic clogging reduces mobility which consequently declines economic efficiency or productivity. It is, thus, important to understand that the association stuck between traffic jamming and highway safety so that useful policies can be implemented to manage both jamming and highway safety. There are hardly any studies in this region or area and the studies which exists have a tendency to use a logical approach and a weak substitute for traffic jamming. As such, more strong empirical support, and a specific jamming measurement, are essential.

Shefer, 1994 wished-for the hypothesis that there is a converse connection or relationship among overcrowding and highway fatalities, where volume over capacity proportion (Volume/Capacity) was used as a substitute to measure or evaluate the level of jamming.

Shefer and Rietveld, 1997 an additional study, was inspected the relation between jamming along with safety or protection on highways. They use a parallel theory and give experimental proof by comparing fatality rates throughout the day finding that for the period of or during peak hours the fatality rate is clearly lesser than other times of the day. Due to data unavailability they were to be examined a planned model by using the simulated dataset rather than authentic or real-world data. These studies were used traffic density as a simple proxy for overcrowding, which may not represent overcrowding characteristics or uniqueness appropriately.

Boarnet et al., 1998 overcrowding and traffic density are not an alike concepts and it is uncertain how the overcrowding level develops with respect to the density. It was recommended that the V/C value superior than 0.77 is viewed as crowded. It is likely that overcrowding increases are not proportional to density increases.

III. METHODOLOGY -CHAPTER 3

3.1 Equipments Used and Procedure of the Study

For **VOLUME** data collection, we have adopted manual method using camera. The materials which we used in this study was Camera

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with extra battery backup device and a camera stand, because volume of study was done for 12 hours in a day. After the data was recorded through camera, it was further analyzed manually by naked eye. We have calculated the total volume and total passenger car unit (PCU) for all type of vehicles which were travelling on the particular highway NH-1 between Phagwara and Nanak Nagri. The data was collected 12x7 (12hours for a week) during daytime only. For particular vehicles one by one total volume and PCU has been calculated and graphs and pie-charts were to be generated. Graphs for Time vs Total PCU and the pie chart for type of vehicles vs total PCU, which gives the total PCU composition for all types of vehicles were generated.

We have followed a particular code for guidelines of capacity IRC: 106-1990 The Indian Road Congress and Khanna S.K and Justo C.E.G for Highway Engineering.

Figure 3.1 Photos on NH-1 between Nanak Nagri and Phagwara for volume count.

Volume data has been collected and analyzed for a week between Nanak Nagri to Phagwara. It has been observed that the Level of Service was almost same for both non - weekend days and weekend days.

For the **SPEED** data, the materials used in this is tape, stop watch, pen and notebook. Here we have taken a stretch of 60m with the help of tape and note down the time for all vehicles passing through the stretch and we have found the speed

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based on time and distance taken. And from that speed we have found the percentiles from the noted data.

For the speed study analysis same stretch was taken using Spot Speed Study method to find the speed data of vehicles and based on that we have found the speed percentiles (i.e.: 50^{th} ,85^{th} and 98^{th}). Using percentile analysis data, we have found the percentile speed for each type of vehicle.

Speed is an important parameter in transportation because it relates to safety, time, comfort, convenience and economics. Spot speed studies are used to determine the speed distribution of a traffic stream at a specific location. The data gathered in spot speed studies are used to determine vehicle speed percentiles, which are useful in making many speed-related decisions. Spot speed data have a number of safety applications. This study includes spot speeds, journey speeds and running speeds.

- **Running speed:** It is the average speed maintained over a particular course while the vehicle is moving and is found by dividing the length of the course by the time duration the vehicle was in motion.
- **Journey speed:** It is the effective speed of the vehicle on a journey between two points and is the distance between the two points divided by the total time taken for the vehicle to complete the journey including any stopped time. If the journey speed is less than running speed, it indicates that the journey follows a stop-go condition with enforced acceleration and deceleration. The spot speed here may vary from zero to some maximum in excess of the running speed. Uniformity between journey and running speeds denotes comfortable travel conditions.
- **Time mean speed:** It is defined as the average speed of all the vehicles passing a point on a highway over some specified time period. Space mean speed is defined as the average speed of all the vehicles occupying a given section of a highway over some specified time period.

Applications of Spot speed data which are as:

➢ Determining existing traffic operations and evaluation of traffic control devices
- Evaluating and determining proper speed limits.
- Determining the 50th and 85th speed percentiles.
- Evaluating and determining proper advisory speeds.
- Establishing the limits of no-passing zones.
- Determining the proper placements of traffic control signs and markings.
- Setting appropriate traffic signal timing.

➢ Establishing roadway design elements
- Evaluating and determining proper intersection sight distance.
- Evaluating and determining proper passing sight distance.
- Evaluating and determining proper stopping sight distance.

➢ Assessing roadway safety questions
- Evaluating and verifying speeding problems.
- Assessing speed as a contributor to vehicle crashes.
- Investigating input from the public or other officials.

➢ Monitoring traffic speed trends by systematic ongoing speed studies

IV. DATA COLLECTION AND ANALYSIS -CHAPTER 4

Here is the volume data for a complete week i: e; 12X7, data collected at a particular day individually at particular time for all the vehicles present on the carriageways under PHAGWARA city.

The volume count was done on a stretch between NANAK NAGRI and PHAGWARA at a common stretch for all seven days. The data was collected using camera and was further counted manually.

The direction of traffic is from NANK NAGRI to PHAGWARA.

The other direction of traffic is from PHAGWARA to NANAK NAGRI.

The data was collected generally for 12 hours everyday in a week. And based on that very data graphs and pie charts were plotted to determine the peak flow of traffic.

Another data collection was about speed, which I have done through spot speed analysis by stop watch method. In this speed data I have taken a stretch of 60m measure with the help of tape along with another fellow.

❖ Two observers were stationed at the two end of the stretch each having a stopwatch.
❖ A sample of 10 (cars, 2 wheelers and 3 wheelers) were examined and a sample of 10 (buses and trucks) were examined.
❖ Running time of the vehicles was noted in an observation sheet.
❖ This data was later analysed using the Excel programme by finding out the individual speeds in m/s and kmph.

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- Later this data was plotted in the form of histograms showing Speed versus Percentage Frequency of vehicles.
- Also the cumulative frequency curves were plotted to determine the various percentile speeds.

4.1-A Volume Study Data.

4.1 Direction of Traffic: NANAK NAGRI to PHAGWARA.

Table 4.1: Hourly Classified Traffic Volume for Traffic going towards PHAGWARA.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT NAGRI to PHAGWARA					**DAY**: MONDAY		DIRECTION OF TRAFFIC: NANAK		
DURATION: 7:00AM-7:00PM					**WEATHER**: SUNNY			**DATE**:13-09-2021	
COUNT HOUR	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6	CLASS 7	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	3 WHEELER	CARS - JEEPS	LCV	BUSES/TRUCKS				
					2 AXLE	3 AXLE	m AXLE		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM-08:00AM	86	62	180	56	12	4	20	420	515.3
08:00AM-09:00AM	436	220	570	82	18	12	96	1434	1701.8
09:00AM-10:00AM	336	180	612	76	21	13	116	1354	1694.4
10:00AM-11:00AM	321	162	686	32	14	11	125	1351	1678.45
11:00AM-12:00PM	316	154	622	28	11	8	136	1275	1616
12:00PM-01:00PM	352	104	726	36	16	10	160	1404	1803.2
01:00PM-02:00PM	348	114	722	49	23	8	162	1426	1848.4
02:00PM-03:00PM	372	102	556	48	42	13	166	1299	1770.6
O3:00PM-04:00PM	306	120	586	56	45	15	168	1296	1805.9
04:00PM-05:00PM	390	106	675	92	52	11	165	1491	1990
05:00PM-06:00PM	412	112	736	146	19	9	178	1612	2090.8
06:00PM-07:00PM	465	92	822	132	12	10	189	1722	2193.45
07:00PM-08:00PM	430	102	742	116	11	9	192	1602	2081.3
T OTAL VOLUME	4570	1630	8235	949	296	133	1873	17686	22789.6
TOTAL PCU	3427.5	1956	8235	1328.6	888	399	6555.5	22789.6	

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Fig 4.1 : Variation of classified total PCU with time.

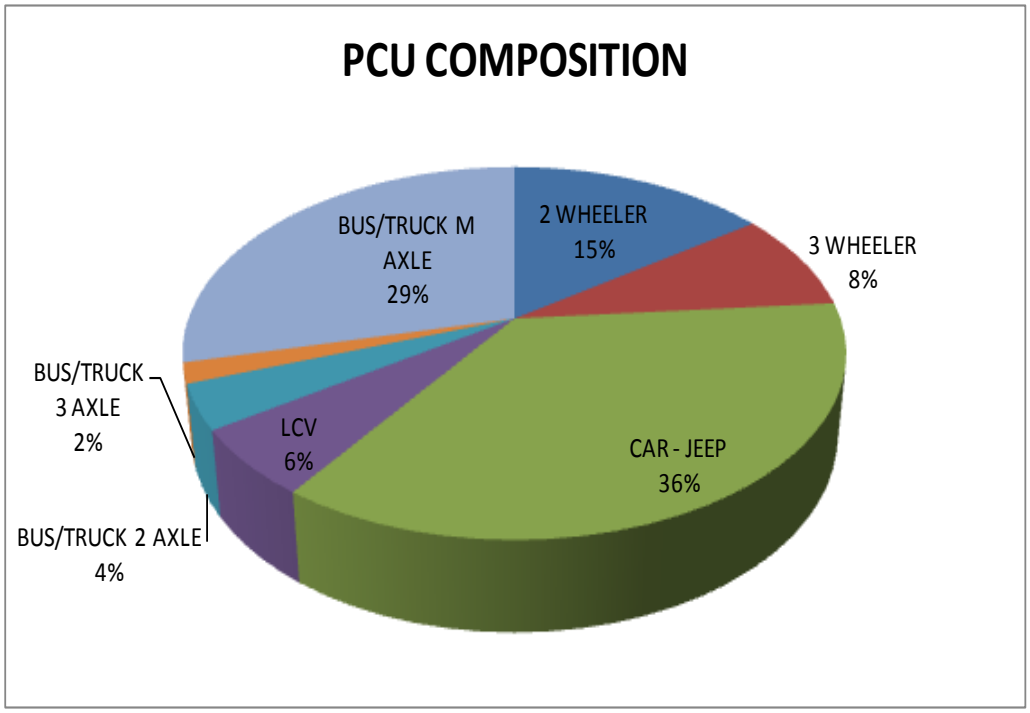

Fig. 4.2: Pie Chart showing Traffic Composition for Entire Day

4.2 Direction of Traffic: PHAGWARA to NANAK NAGRI.

Table 4.2: Hourly Classified Traffic Volume for Traffic going towards NANAK NAGRI.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT **DAY:** WEDNESDAY DIRECTION OF TRAFFIC: PHAGWARA to NANAK NAGRI									
DURATION: 7:00AM-7:00PM **WEATHER:** SUNNY **DATE:**22-09-2021									
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM - 08:00AM	64	60	62	18	22	3	13	242	327.7
08:00AM - 09:00AM	218	186	266	29	46	7	39	791	988.8
09:00AM - 10:00AM	312	220	398	46	52	5	98	1131	1474.4
10:00AM - 11:00AM	290	206	449	54	55	9	112	1175	1573.3
11:00AM	298	196	542	62	50	8	158	1314	1814.

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-12:00PM									5
12:00PM-01:00PM	342	187	586	80	52	8	162	1417	1925.9
01:00PM-02:00PM	334	155	686	88	54	12	176	1505	2059.7
02:00PM-03:00PM	364	156	654	72	62	13	189	1510	2101.5
O3:00PM-04:00PM	372	142	622	78	50	15	162	1441	1942.6
04:00PM-05:00PM	336	139	742	89	52	16	158	1532	2042.4
05:00PM-06:00PM	348	132	898	90	48	10	219	1745	2383.9
06:00PM-07:00PM	376	131	846	84	44	11	209	1701	2299.3
07:00PM-08:00PM	208	162	406	60	21	9	72	938	1182.4
T OTAL VOLUME	3862	2072	7157	850	608	126	1767	16442	22116.4
TOTAL PCU	2896.5	2486.4	7157	1190	1824	378	6184.5	22116.4	

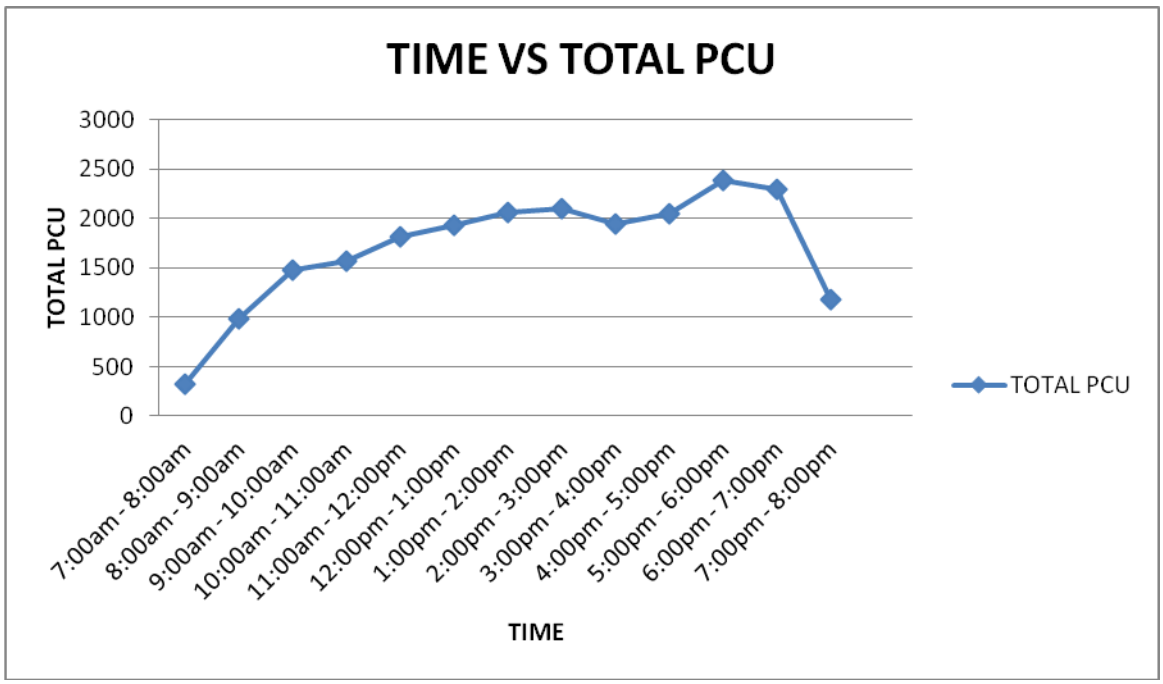

Fig. 4.3: Variation of Classified Total PCU with Time

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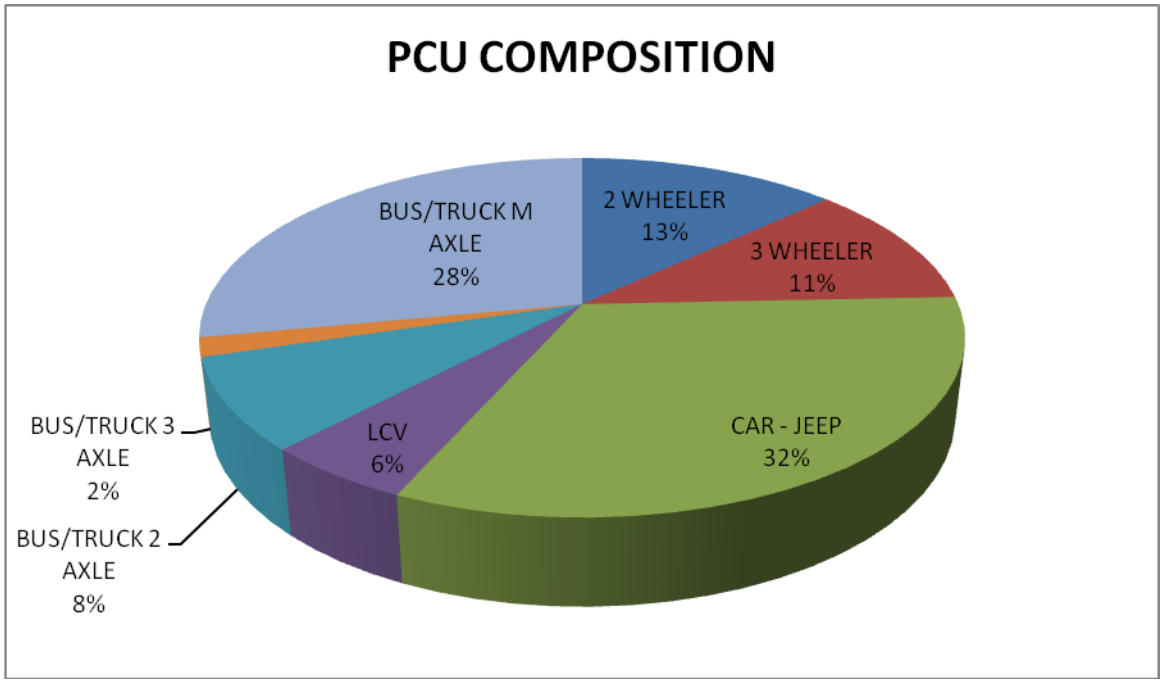

Fig. 4.4: Pie Chart showing Traffic Composition for Entire Day

4.3 Direction of Traffic: NANAK NAGRI to PHAGWARA.

Table 4.3: Hourly Classified Traffic Volume for Traffic going towards PHAGWARA.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT NANAK NAGRI to PHAGWARA			**DAY: TUESDAY**			**DIRECTION OF TRAFFIC:**			
DURATION: 7:00AM-7:00PM 14-09-2021			**WEATHER: SUNNY**			**DATE:**			
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM - 08:00AM	78	66	220	56	12	4	25	461	571.6
08:00AM - 09:00AM	428	220	560	82	16	10	97	1413	1677.3
09:00AM - 10:00AM	342	190	620	75	21	12	111	1371	1697
10:00AM - 11:00AM	290	154	660	35	14	11	125	1289	1623.8
11:00AM -12:00PM	312	159	655	26	11	8	124	1295	1607.2

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12:00PM-01:00PM	341	104	735	36	16	10	160	1402	1803.95
01:00PM-02:00PM	354	114	730	52	23	8	162	1443	1865.1
02:00PM-03:00PM	365	102	560	48	42	13	166	1296	1769.35
O3:00PM-04:00PM	309	120	594	59	43	14	174	1313	1832.35
04:00PM-05:00PM	390	128	680	92	52	11	165	1518	2021.4
05:00PM-06:00PM	412	112	740	146	19	9	179	1617	2098.3
06:00PM-07:00PM	462	102	788	132	10	10	168	1672	2089.7
07:00PM-08:00PM	445	117	738	119	11	9	189	1628	2100.25
T OTAL VOLUME	4528	1688	8280	958	290	129	1845	17718	22757.3
TOTAL PCU	3396	2025.6	8280	1341.2	870	387	6457.5	22757.3	

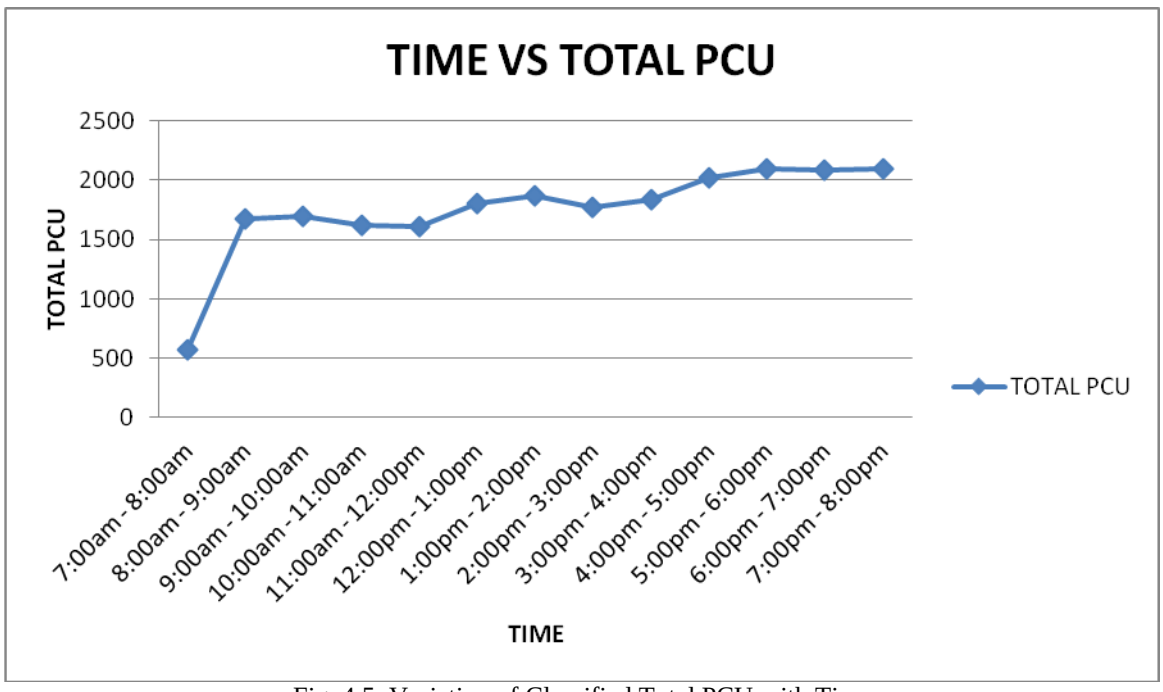

Fig. 4.5: Variation of Classified Total PCU with Time

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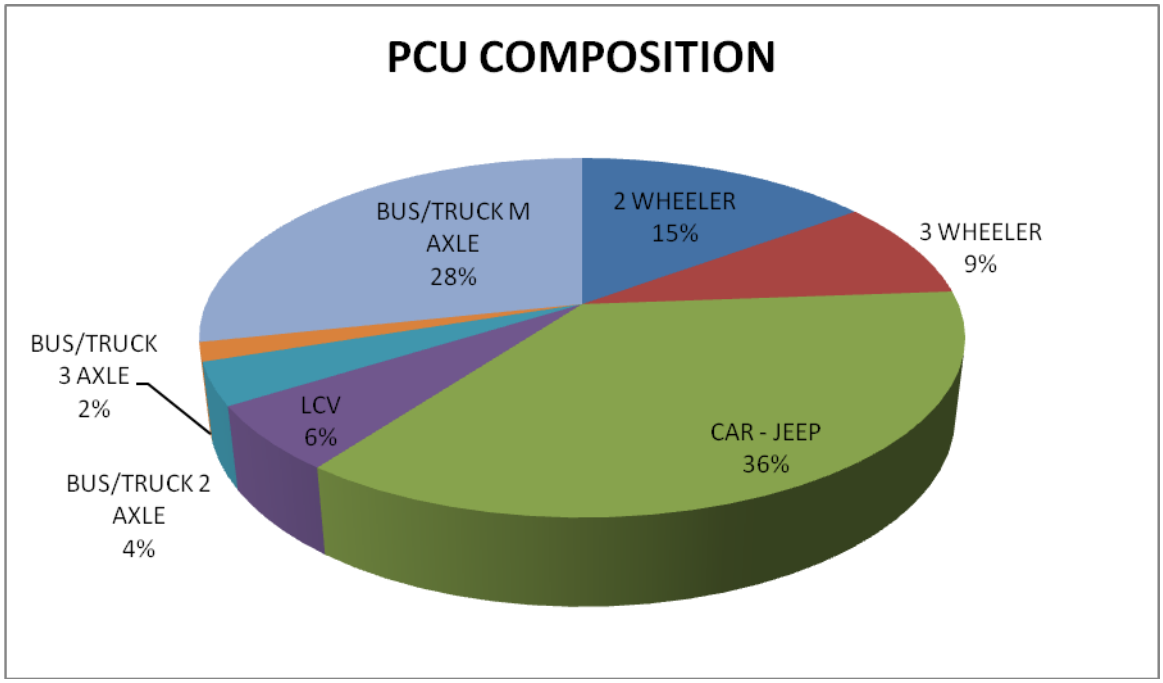

Fig. 4.6: Pie Chart showing Traffic Composition for Entire Day.

4.4 Direction of Traffic: PHAGWARA to NANAK NAGRI.

Table 4.4: Hourly Classified Traffic Volume for Traffic going towards NANAK NAGRI.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT PHAGWARA to NANAK NAGRI			**DAY: THURSDAY**			DIRECTION OF TRAFFIC:			
DURATION: 7:00AM-7:00PM			**WEATHER: SUNNY**					**DATE: 23-09-2021**	
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM - 08:00AM	68	63	71	19	24	9	21	275	396.7
08:00AM - 09:00AM	225	174	270	27	43	8	41	788	981.85
09:00AM - 10:00AM	315	218	402	42	49	11	92	1129	1460.65
10:00AM - 11:00AM	296	212	445	52	52	10	116	1183	1586.2
11:00AM	292	198	552	60	50	8	158	1318	1819.6

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-12:00PM									
12:00PM -01:00PM	332	192	590	79	51	9	164	1417	1934
01:00PM -02:00PM	339	156	688	87	54	13	173	1510	2057.75
02:00PM -03:00PM	375	145	667	74	62	11	182	1516	2081.85
O3:00PM-04:00PM	372	140	623	76	50	15	158	1434	1924.4
04:00PM -05:00PM	339	132	756	89	51	17	165	1549	2074.75
05:00PM -06:00PM	352	135	902	90	46	10	219	1754	2388.5
06:00PM -07:00PM	380	138	856	86	41	11	189	1701	2244.5
07:00PM -08:00PM	242	136	556	65	25	9	73	1106	1349.2
T OTAL VOLUME	3927	2039	7378	846	598	141	1751	16680	22299.95
TOTAL PCU	2945.25	2446.8	7378	1184.4	1794	423	6128.5	22299.95	

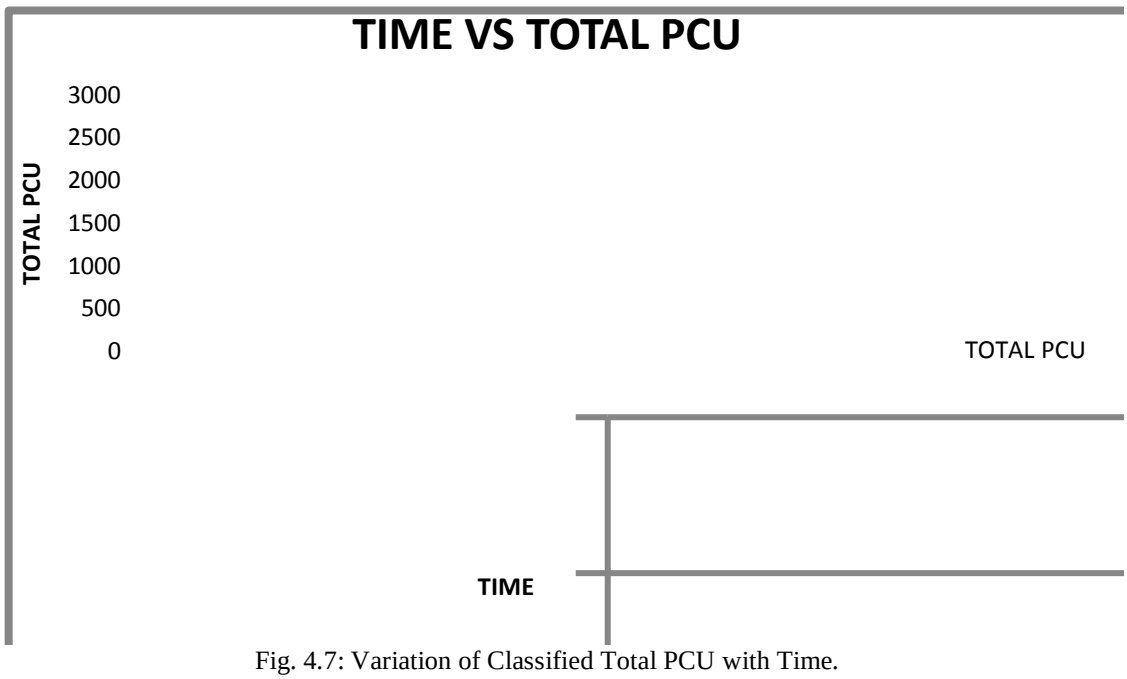

Fig. 4.7: Variation of Classified Total PCU with Time.

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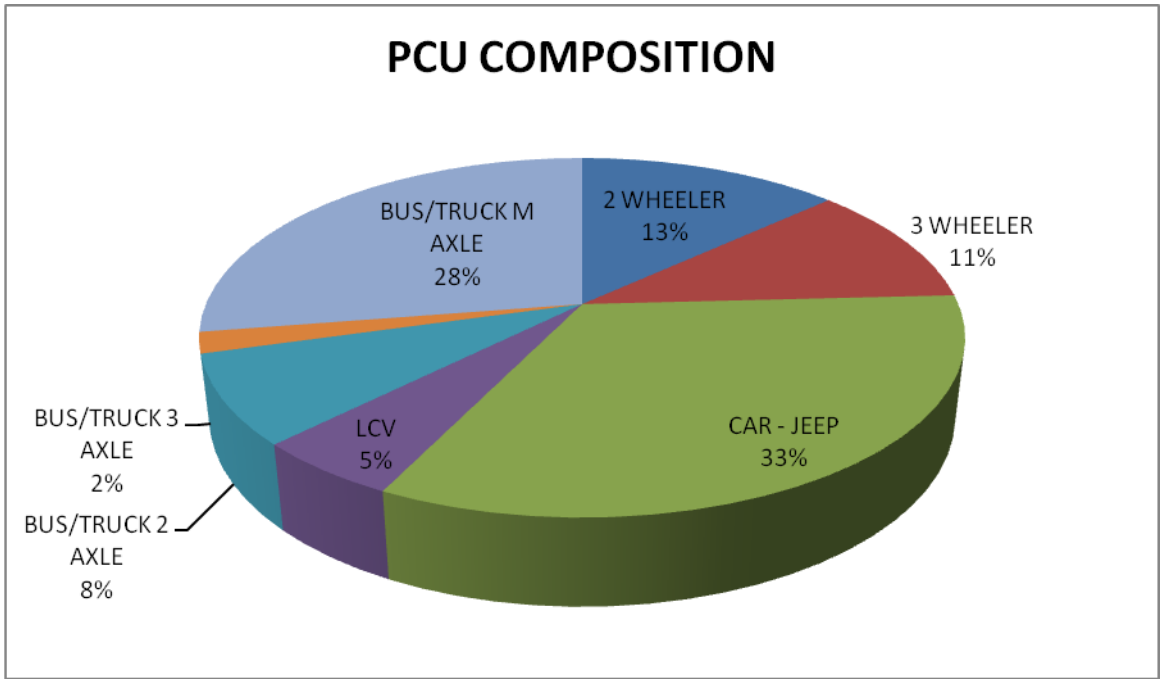

Fig. 4.8: Pie Chart showing Traffic Composition for Entire Day.

4.5 Direction of Traffic: NANAK NAGRI to PHAGWARA.

Table 4.5: Hourly Classified Traffic Volume for Traffic going towards PHAGWARA.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT **DAY: WEDNESDAY** DIRECTION OF TRAFFIC: NANAK NAGRI to PHAGWARA									
DURATION: 7:00AM-7:00PM **WEATHER: SUNNY** **DATE: 15-09-2021**									
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM - 08:00AM	82	96	223	62	15	7	29	514	654
08:00AM - 09:00AM	418	221	557	86	18	10	98	1408	1683.1
09:00AM - 10:00AM	346	196	618	78	21	13	112	1384	1715.9
10:00AM - 11:00AM	296	158	656	32	14	11	122	1289	1614.4

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11:00AM - 12:00PM	311	157	667	25	22	9	126	1317	1657.65
12:00PM - 01:00PM	341	128	745	39	16	10	153	1432	1822.45
01:00PM - 02:00PM	352	119	756	52	23	8	160	1470	1888.6
02:00PM - 03:00PM	363	123	569	55	45	13	166	1334	1820.85
O3:00PM- 04:00PM	322	116	622	64	49	11	169	1353	1863.8
04:00PM - 05:00PM	395	126	695	96	56	10	165	1543	2052.35
05:00PM - 06:00PM	399	118	742	135	29	8	179	1610	2109.35
06:00PM - 07:00PM	456	122	786	122	14	15	159	1674	2088.7
07:00PM - 08:00PM	452	125	742	116	19	9	175	1638	2089.9
T OTAL VOLUME	4533	1805	8378	962	341	134	1813	17966	23061.05
TOTAL PCU	3399.75	2166	8378	1346.8	1023	402	6345.5	23061.05	

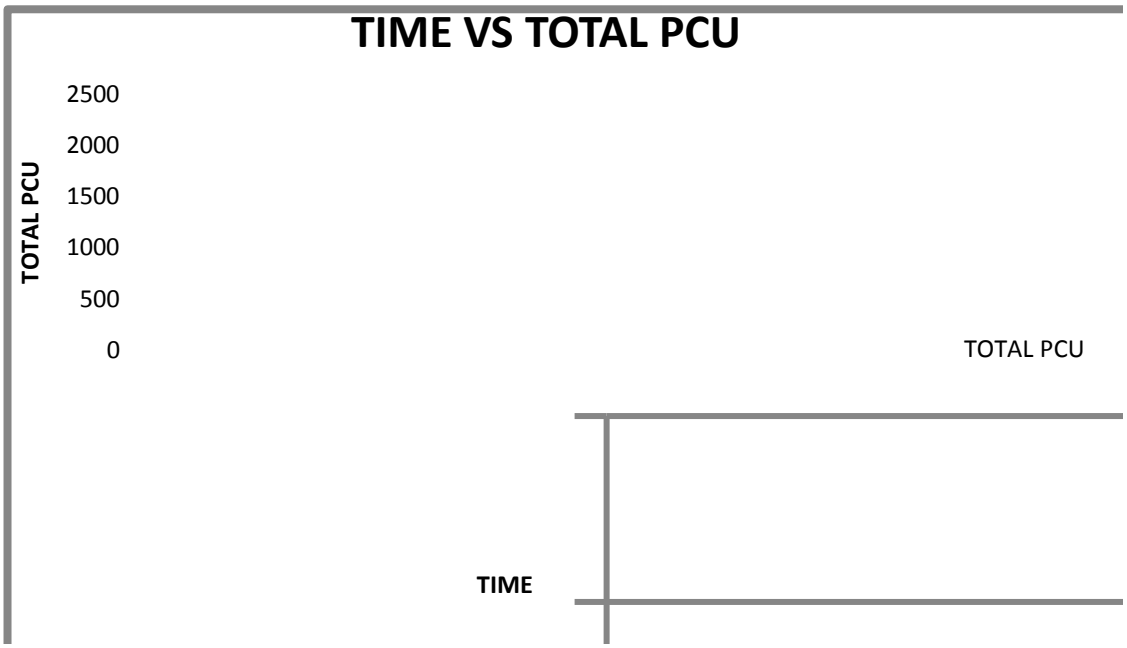

Fig. 4.9: Variation of Classified Total PCU with Time

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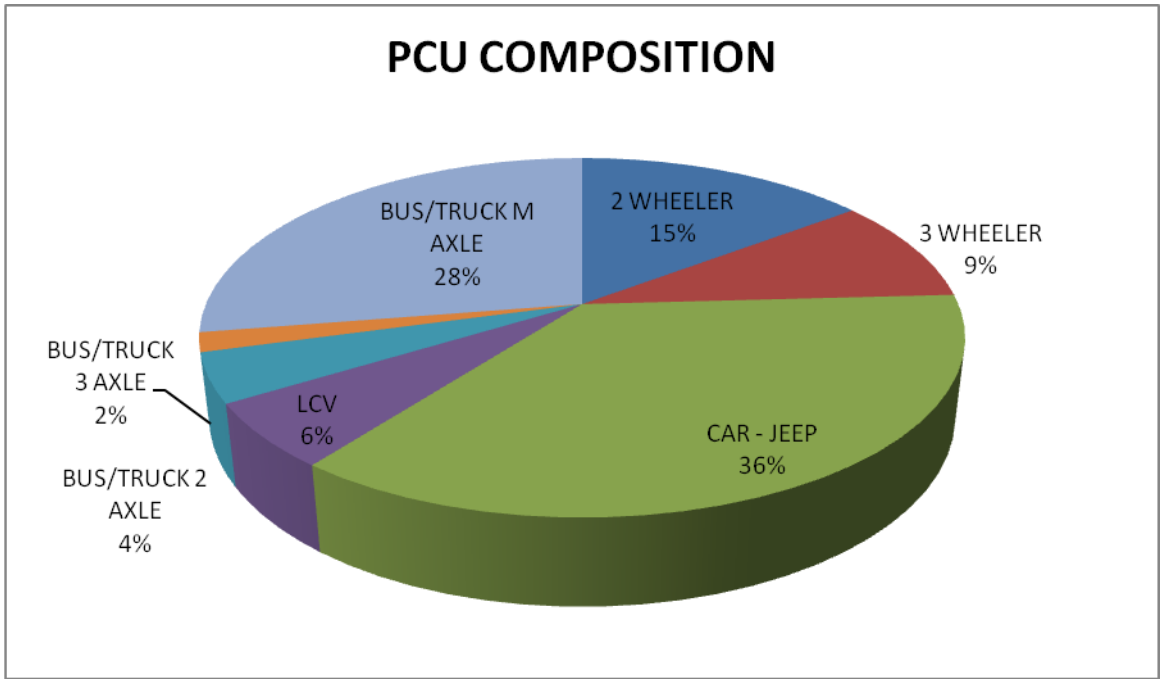

Fig. 4.10: Pie Chart showing Traffic Composition for Entire Day.

4.6 Direction of Traffic: PHAGWARA to NANAK NAGRI.

Table 4.6: Hourly Classified Traffic Volume for Traffic going towards NANAK NAGRI.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT **DAY: FRIDAY** DIRECTION OF TRAFFIC: PHAGWARA to NANAK NAGRI									
DURATION: 7:00AM-7:00PM **WEATHER: SUNNY** **DATE: 24-09-2021**									
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM - 08:00AM	92	70	88	24	22	14	21	331	456.1
08:00AM - 09:00AM	242	182	390	32	41	9	41	937	1128.2
09:00AM - 10:00AM	349	228	456	42	46	11	92	1224	1543.15
10:00AM - 11:00AM	326	216	436	52	48	13	102	1193	1552.5
11:00AM -12:00PM	312	149	429	60	50	8	142	1150	1596.8

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12:00PM-01:00PM	302	158	586	76	51	9	154	1336	1827.5
01:00PM-02:00PM	375	185	688	87	49	13	165	1562	2076.55
02:00PM-03:00PM	354	143	667	74	52	15	176	1481	2024.7
O3:00PM-04:00PM	376	138	629	76	50	15	158	1442	1931
04:00PM-05:00PM	388	130	756	89	55	14	165	1597	2112.1
05:00PM-06:00PM	398	134	916	90	48	10	219	1815	2441.8
06:00PM-07:00PM	380	132	866	86	39	11	174	1688	2188.8
07:00PM-08:00PM	340	135	656	84	27	9	84	1335	1592.6
T OTAL VOLUME	4234	2000	7563	872	578	151	1693	17091	22471.8
TOTAL PCU	3175.5	2400	7563	1220.8	1734	453	5925.5	22471.8	

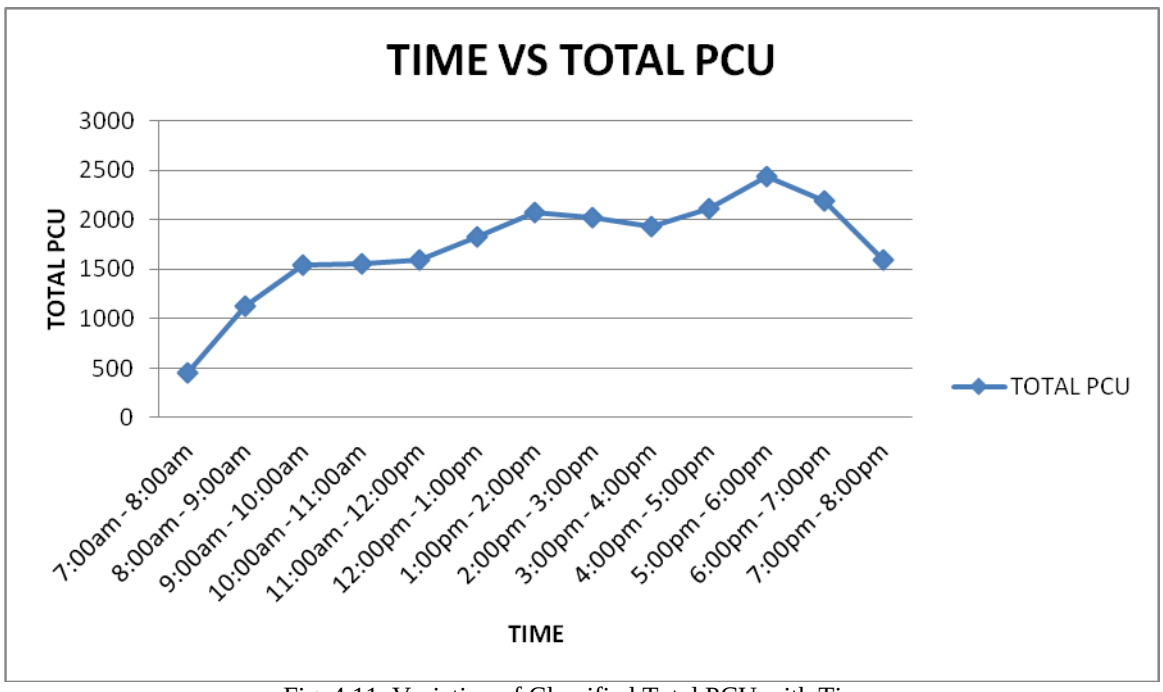

Fig. 4.11: Variation of Classified Total PCU with Time.

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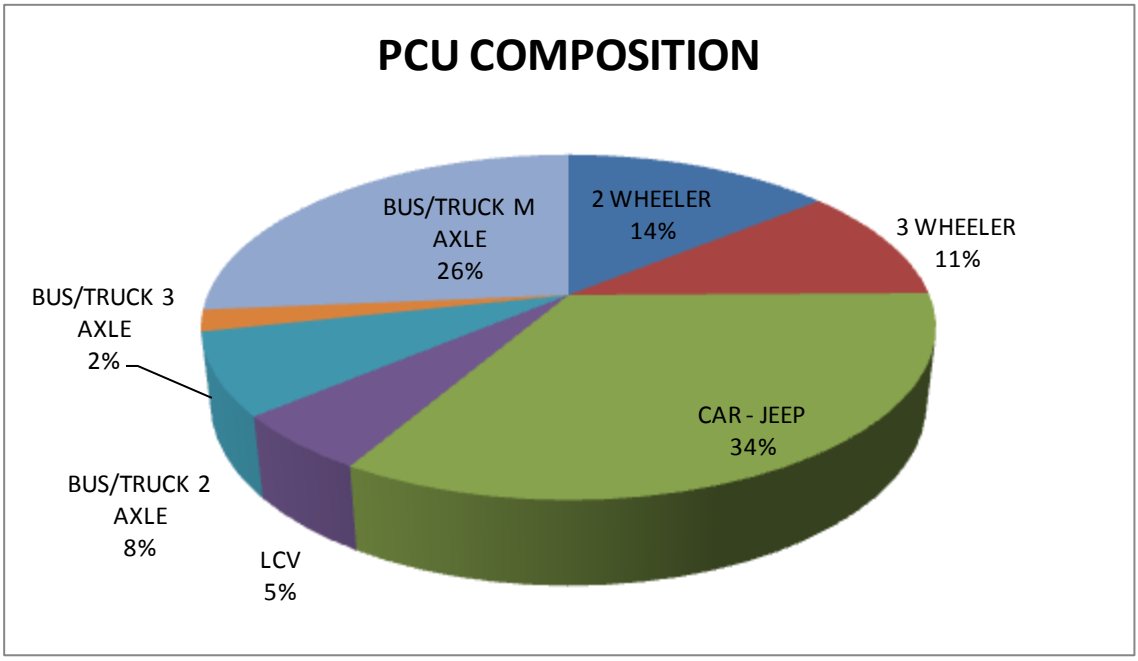

Fig. 4.12: Pie Chart showing Traffic Composition for Entire Day.

4.7 Direction of Traffic: NANAK NAGRI to PHAGWARA.

Table 4.7: Hourly Classified Traffic Volume for Traffic going towards PHAGWARA.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT			**DAY: THURSDAY**		DIRECTION OF TRAFFIC: NANAK NAGRI to PHAGWARA				
DURATION: 7:00AM-7:00PM			**WEATHER: SUNNY**				**DATE: 16-09-2021**		
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM-08:00AM	102	97	220	68	21	8	26	542	686.1
08:00AM-09:00AM	402	211	558	87	18	10	88	1374	1626.5
09:00AM-10:00AM	422	198	625	72	21	13	98	1449	1724.9
10:00AM-11:00AM	315	162	668	43	15	11	126	1340	1677.85
11:00AM-12:00PM	312	157	667	29	21	9	129	1324	1671.5
12:00PM-01:00PM	358	132	738	42	18	15	156	1459	1868.7
01:00PM-02:00PM	352	119	756	48	25	9	158	1467	1885
02:00PM-	365	124	560	56	48	13	168	1334	1831.9

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03:00PM									5
O3:00PM -04:00PM	372	118	580	52	49	12	162	1345	1823.4
04:00PM-05:00PM	425	122	722	65	57	10	165	1566	2056.65
05:00PM-06:00PM	412	119	736	78	32	9	172	1558	2022
06:00PM-07:00PM	452	121	792	109	29	14	156	1673	2103.8
07:00PM-08:00PM	448	136	785	117	22	11	181	1700	2180.5
T OTAL VOLUME	4737	1816	8407	866	376	144	1785	18131	23158.85
TOTAL PCU	3552.75	2179.2	8407	1212.4	1128	432	6247.5	23158.85	

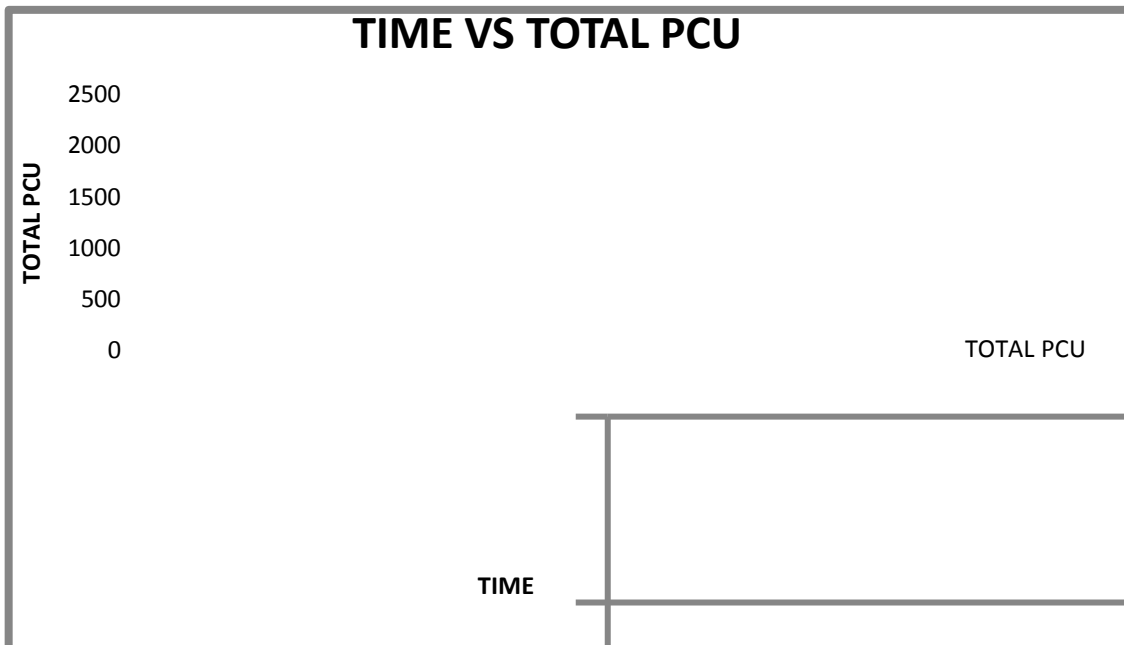

Fig. 4.13: Variation of Classified Total PCU with Time.

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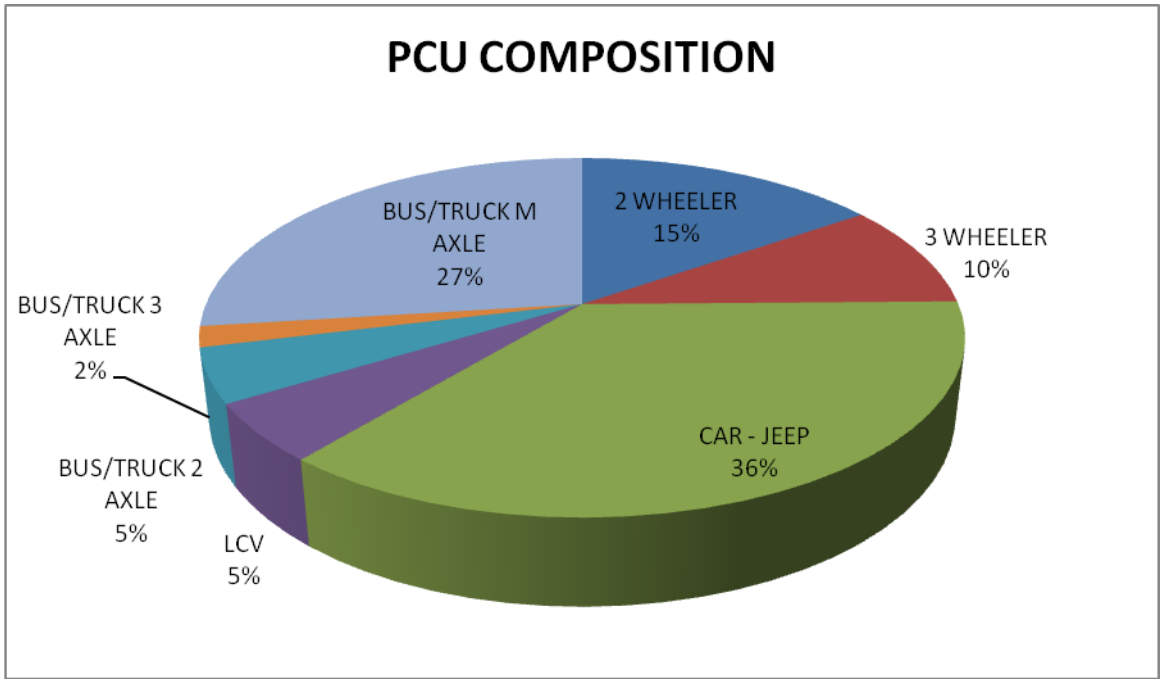

Fig. 4.14: Pie Chart showing Traffic Composition for Entire Day.

4.8 Direction of Traffic: PHAGWARA to NANAK NAGRI.

Table 4.8: Hourly Classified Traffic Volume for Traffic going towards NANAK NAGRI.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT **DAY: SATURDAY** DIRECTION OF TRAFFIC: PHAGWARA **to NANAK NAGRI**									
DURATION: 7:00AM-7:00PM **WEATHER: SUNNY** **DATE: 25-09-2021**									
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM - 08:00AM	96	68	102	28	21	13	25	353	484.3
08:00AM - 09:00AM	236	176	396	30	36	9	38	921	1094.2
09:00AM - 10:00AM	342	218	462	38	43	8	89	1200	1497.8
10:00AM - 11:00AM	354	211	455	46	46	11	96	1219	1545.1
11:00AM	342	132	467	54	48	10	125	1178	1569

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-12:00PM									
12:00PM-01:00PM	309	145	572	67	47	9	142	1291	1736.55
01:00PM-02:00PM	382	184	680	79	45	13	136	1519	1947.9
02:00PM-03:00PM	361	148	692	74	48	14	145	1482	1937.45
O3:00PM-04:00PM	372	139	642	76	50	16	147	1442	1906.7
04:00PM-05:00PM	392	128	767	87	52	13	159	1598	2087.9
05:00PM-06:00PM	402	133	890	92	49	10	192	1768	2328.9
06:00PM-07:00PM	390	129	922	86	44	9	165	1745	2226.2
07:00PM-08:00PM	356	134	880	82	36	11	112	1611	1955.6
T OTAL VOLUME	4334	1945	7927	839	565	146	1571	17327	22317.6
TOTAL PCU	3250.5	2334	7927	1174.6	1695	438	5498.5	22317.6	

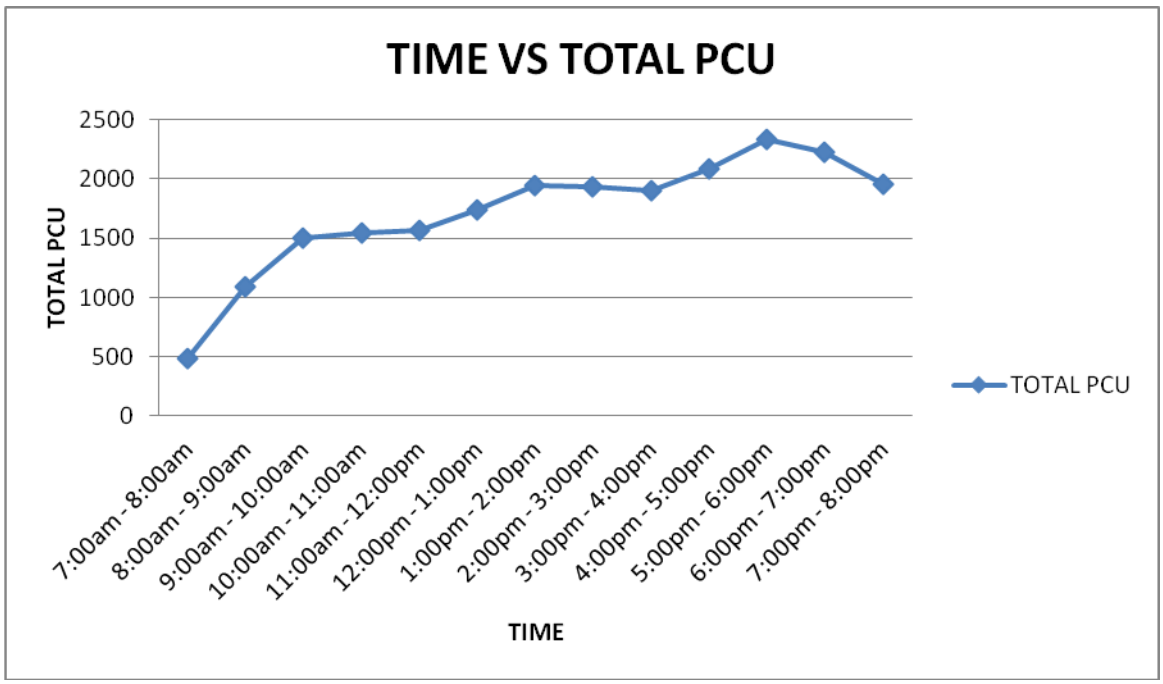

Fig. 4.15: Variation of Classified Total PCU with Time.

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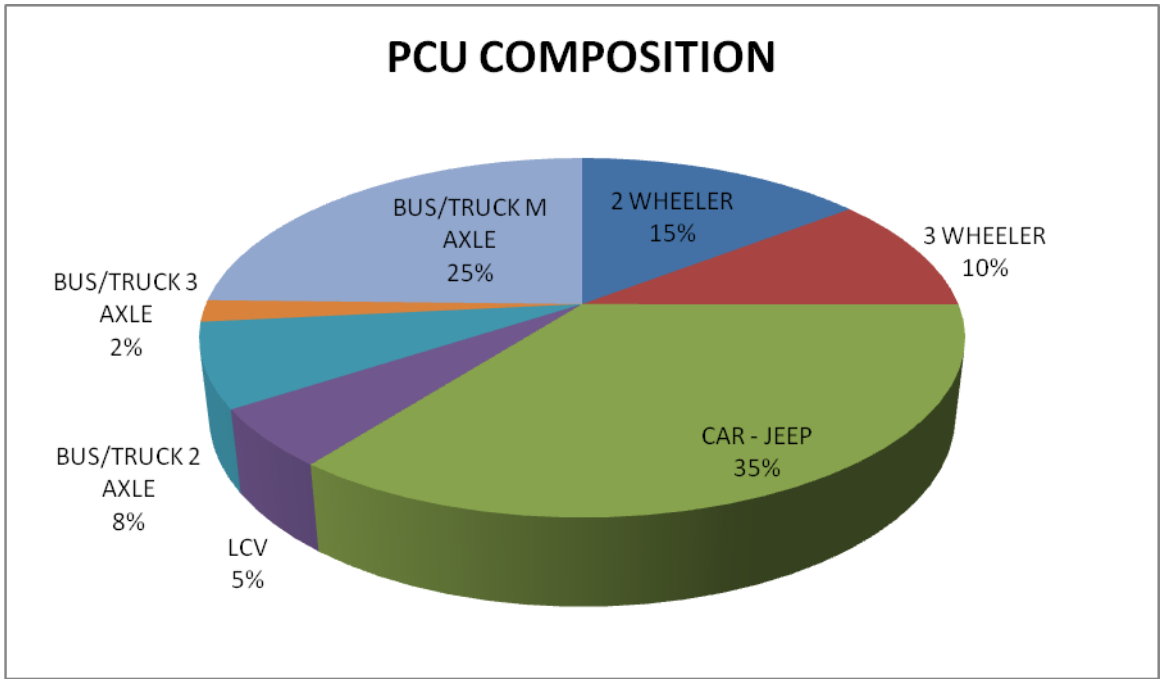

Fig. 4.16: Pie Chart showing Traffic Composition for Entire Day.

4.9 Direction of Traffic: NANAK NAGRI to PHAGWARA.

Table 4.9: Hourly Classified Traffic Volume for Traffic going towards PHAGWARA.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT			**DAY: FRIDAY**		DIRECTION OF TRAFFIC: NANAK NAGRI to PHAGWARA				
DURATION: 7:00AM-7:00PM			**WEATHER: SUNNY**				**DATE: 17-09-2021**		
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM - 08:00AM	122	95	242	72	24	9	22	586	724.3
08:00AM - 09:00AM	396	209	548	88	19	14	82	1356	1605
09:00AM - 10:00AM	432	192	621	71	18	11	91	1436	1680.3
10:00AM - 11:00AM	421	180	679	52	14	12	123	1481	1792.05
11:00AM	390	162	672	35	20	13	124	1416	1740

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-12:00PM									.9
12:00PM -01:00PM	367	136	748	42	19	15	153	1480	1882 .75
01:00PM -02:00PM	356	121	762	41	23	11	148	1462	1851 .6
02:00PM -03:00PM	372	124	560	56	46	13	154	1325	1782 .2
O3:00PM-04:00PM	368	119	592	48	42	9	158	1336	1784
04:00PM -05:00PM	425	122	722	65	57	10	162	1563	2046 .15
05:00PM -06:00PM	422	119	736	72	29	12	178	1568	2042 .1
06:00PM -07:00PM	458	126	797	102	27	14	169	1693	2149
07:00PM -08:00PM	446	135	802	116	18	9	192	1718	2213 .9
T OTAL VOLUME	4975	1840	8481	860	356	152	1756	18420	2329 4.25
TOTAL PCU	3731.25	2208	8481	1204	1068	456	6146	23294 .25	

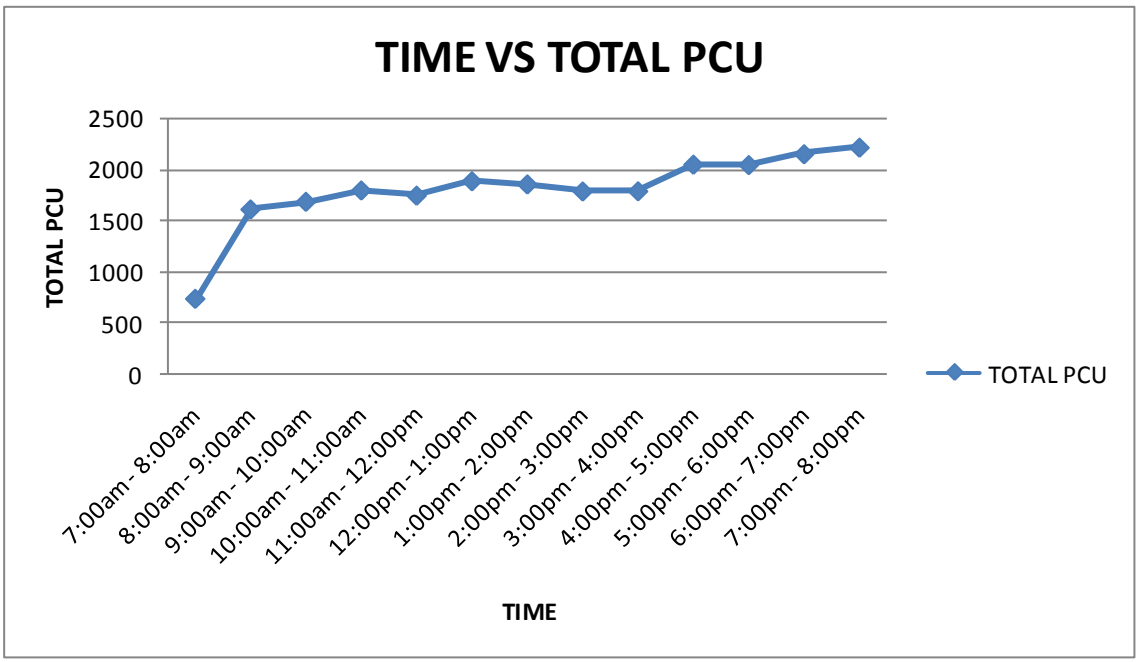

Fig. 4.17: Variation of Classified Total PCU with Time

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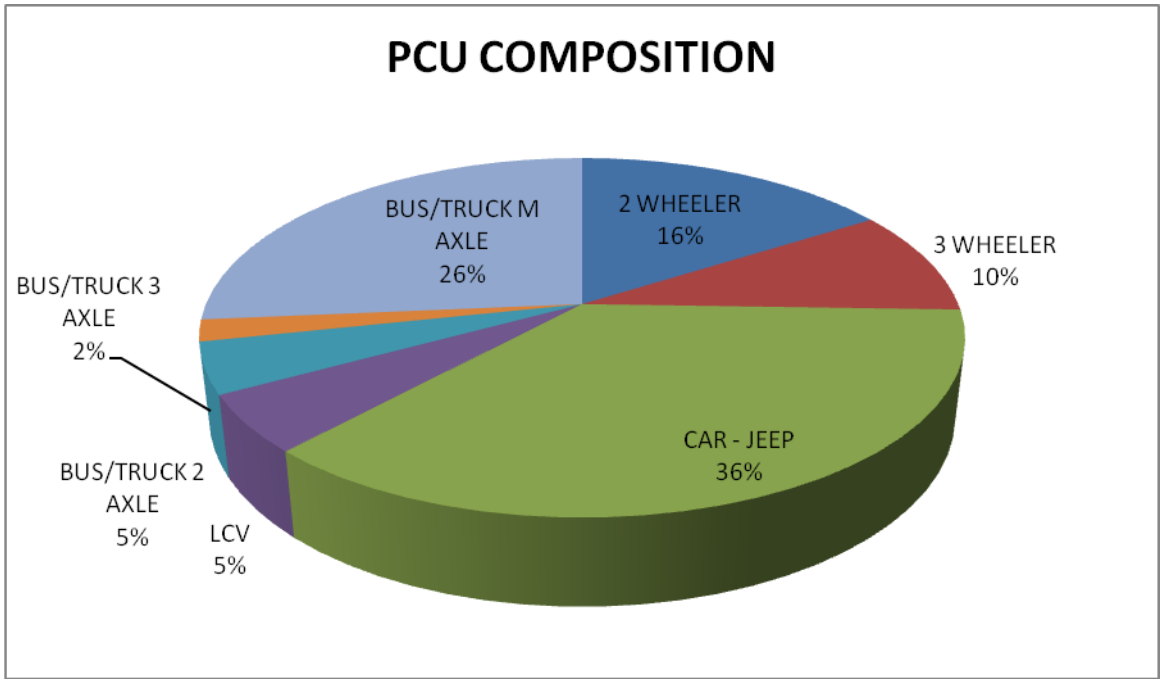

Fig. 4.18: Pie Chart showing Traffic Composition for Entire Day.

4.10 Direction of Traffic: PHAGWARA to NANAK NAGRI.

Table 4.10: Hourly Classified Traffic Volume for Traffic going towards NANAK NAGRI.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT **DAY: SUNDAY** DIRECTION OF TRAFFIC: PHAGWARA to NANAK NAGRI									
DURATION: 7:00AM-7:00PM **WEATHER: SUNNY** **DATE: 26-09-2021**									
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM - 08:00AM	119	98	122	32	22	14	26	433	572.65
08:00AM - 09:00AM	238	186	402	35	32	12	34	939	1103.7
09:00AM - 10:00AM	362	215	476	42	41	9	76	1221	1480.3
10:00AM - 11:00AM	354	188	454	38	43	11	92	1180	1482.3
11:00AM	346	138	448	48	46	10	112	1148	1500.

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-12:00PM									3
12:00PM -01:00PM	321	149	562	65	45	14	132	1288	1711.55
01:00PM -02:00PM	396	178	690	75	42	12	136	1529	1943.6
02:00PM -03:00PM	376	146	695	72	43	14	138	1484	1907
O3:00PM-04:00PM	365	136	656	68	50	15	143	1433	1883.65
04:00PM -05:00PM	412	130	760	78	53	13	156	1602	2078.2
05:00PM -06:00PM	408	133	918	84	49	11	185	1788	2328.7
06:00PM -07:00PM	388	125	890	82	48	9	169	1711	2208.3
07:00PM -08:00PM	362	121	878	78	39	10	122	1610	1977.9
T OTAL VOLUME	4447	1943	7951	797	553	154	1521	17366	22178.15
TOTAL PCU	3335.25	2331.6	7951	1115.8	1659	462	5323.5	22178.15	

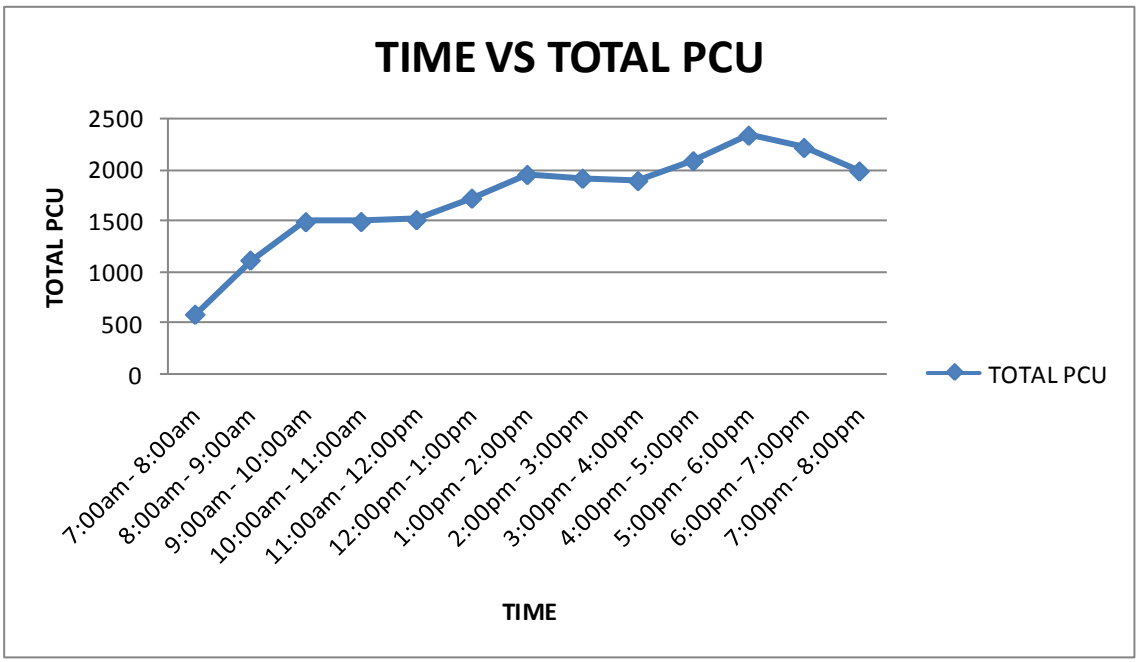

Fig. 4.19: Variation of Classified Total PCU with Time

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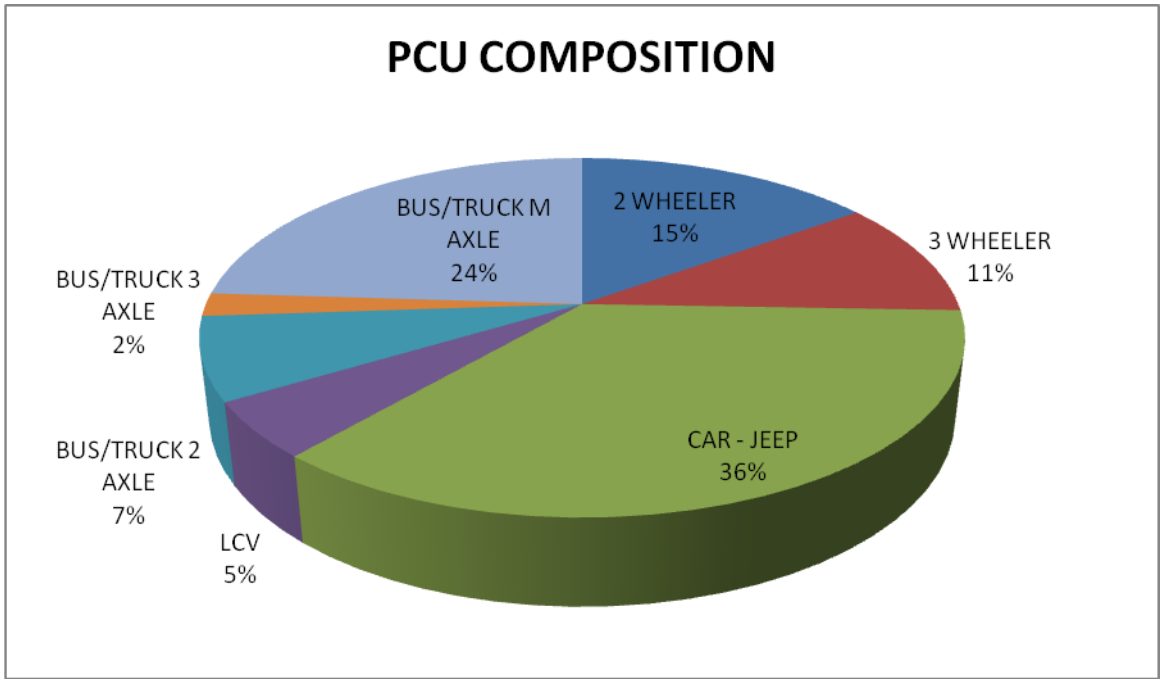

Fig. 4.20: Pie Chart showing Traffic Composition for Entire Day.

4.11 Direction of Traffic: NANAK NAGRI to PHAGWARA.

Table 4.11: Hourly Classified Traffic Volume for Traffic going towards PHAGWARA.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT			**DAY: SATURDAY**		DIRECTION OF TRAFFIC: NANAK NAGRI to PHAGWARA				
DURATION: 7:00AM-7:00PM			**WEATHER: SUNNY**				**DATE: 18-09-2021**		
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM-08:00AM	178	102	310	75	26	10	14	715	827.9
08:00AM-09:00AM	456	205	560	85	19	12	56	1393	1556
09:00AM-10:00AM	462	225	692	72	16	10	68	1545	1725.3
10:00AM-11:00AM	452	196	682	62	13	13	88	1506	1729
11:00AM-12:00PM	412	178	702	36	19	11	112	1470	1757
12:00PM-01:00PM	402	132	742	45	19	14	132	1486	1825.9
01:00PM-02:00PM	422	136	780	39	21	10	128	1536	1855.3

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02:00PM-03:00PM	390	122	772	52	38	9	132	1515	1886.7
O3:00PM-04:00PM	398	121	668	45	45	7	146	1430	1841.7
04:00PM-05:00PM	436	135	752	65	52	8	154	1602	2051
05:00PM-06:00PM	448	145	765	69	32	12	168	1639	2091.6
06:00PM-07:00PM	466	122	825	96	27	13	176	1725	2191.3
07:00PM-08:00PM	502	136	845	109	30	10	198	1830	2350.3
T OTAL VOLUME	5424	1955	9095	850	357	139	1572	19392	23689
TOTAL PCU	4068	2346	9095	1190	1071	417	5502	23689	

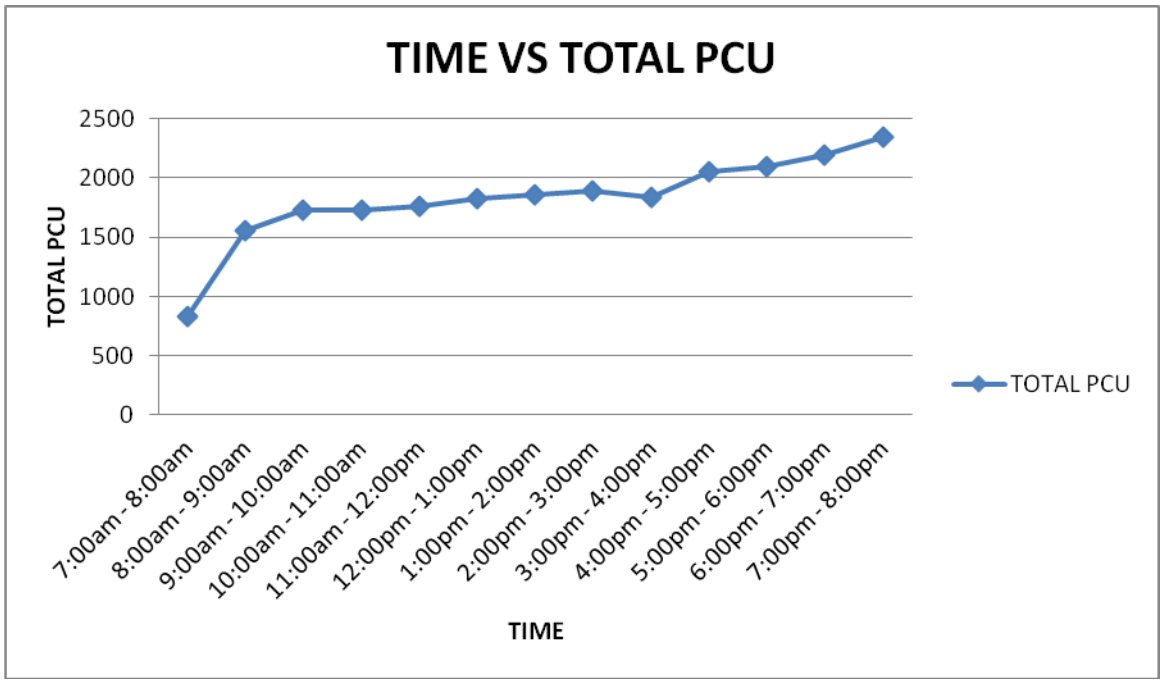

Fig. 4.21: Variation of Classified Total PCU with Time

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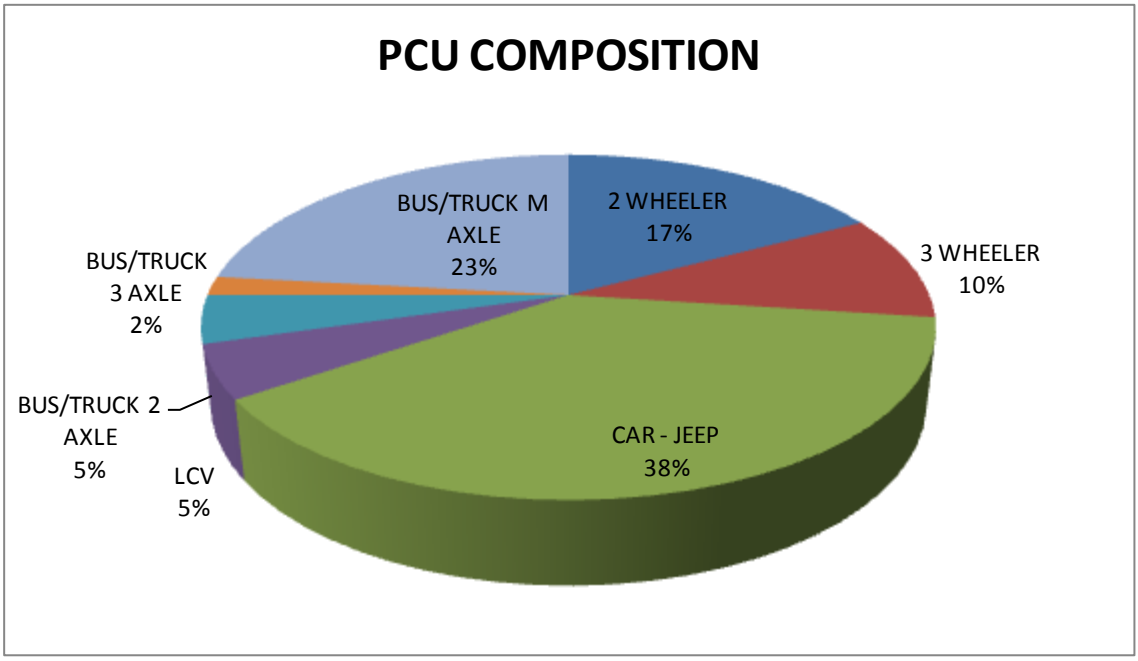

Fig. 4.22: Pie Chart showing Traffic Composition for Entire Day.

4.12 Direction of Traffic: PHAGWARA to NANAK NAGRI.

Table 4.12: Hourly Classified Traffic Volume for Traffic going towards NANAK NAGRI.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT DAY: MONDAY DIRECTION OF TRAFFIC: PHAGWARA to NANAK NAGRI									
DURATION: 7:00AM-7:00PM WEATHER: SUNNY DATE: 27-09-2021									
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS – JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM-08:00AM	119	98	122	32	22	14	26	433	572.65
08:00AM-09:00AM	238	186	402	35	32	12	34	939	1103.7
09:00AM-10:00AM	362	215	476	42	41	9	76	1221	1480.3
10:00AM-11:00AM	354	188	454	38	43	11	92	1180	1482.3
11:00AM-12:00PM	346	138	448	48	46	10	112	1148	1500.3
12:00PM-01:00PM	321	149	562	65	45	14	132	1288	1711.55
01:00PM-02:00PM	396	178	690	75	42	12	136	1529	1943.6

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02:00PM-03:00PM	376	146	695	72	43	14	138	1484	1907
O3:00PM-04:00PM	365	136	656	68	50	15	143	1433	1883.65
04:00PM-05:00PM	412	130	760	78	53	13	156	1602	2078.2
05:00PM-06:00PM	408	133	918	84	49	11	185	1788	2328.7
06:00PM-07:00PM	388	125	890	82	48	9	169	1711	2208.3
07:00PM-08:00PM	362	121	878	78	39	10	122	1610	1977.9
T OTAL VOLUME	4447	1943	7951	797	553	154	1521	17366	22178.15
TOTAL PCU	3335.25	2331.6	7951	1115.8	1659	462	5323.5	22178.15	

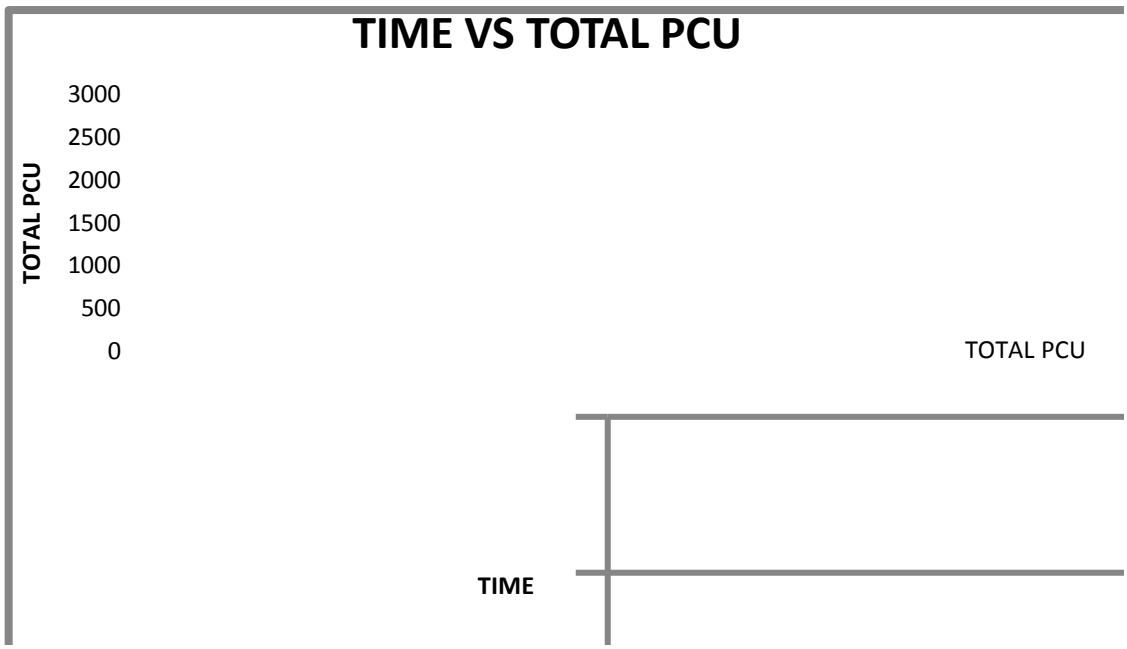

Fig. 4.23: Variation of Classified Total PCU with Time

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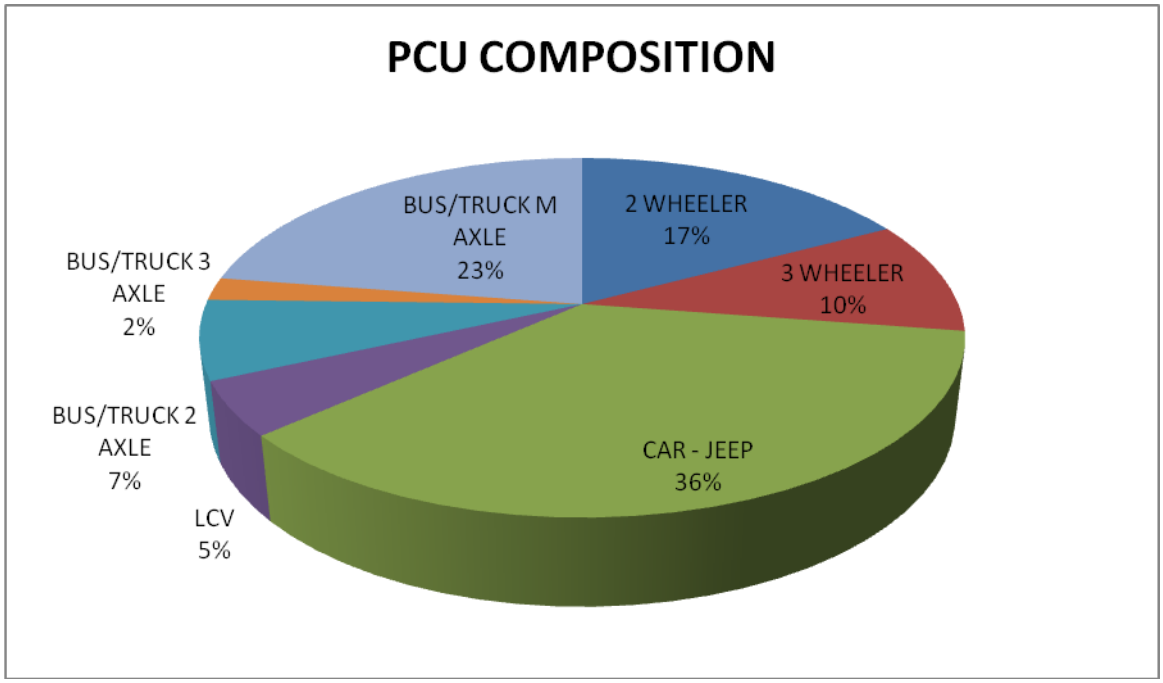

Fig. 4.24: Pie Chart showing Traffic Composition for Entire Day.

4.13 Direction of Traffic: NANAK NAGRI to PHAGWARA.

Table 4.13: Hourly Classified Traffic Volume for Traffic going towards PHAGWARA.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT DAY: SUNDAY DIRECTION OF TRAFFIC: NANAK NAGRI TO PHAGWARA									
DURATION: 7:00AM-7:00PM WEATHER: SUNNY DATE:19-09-2021									
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM-08:00AM	198	128	360	80	23	9	11	809	908.6
08:00AM-09:00AM	465	217	575	74	19	12	52	1414	1562.75
09:00AM-10:00AM	478	220	702	70	15	10	64	1559	1721.5
10:00AM-11:00AM	462	192	698	61	13	13	78	1517	1711.3
11:00AM-12:00PM	452	168	712	32	18	11	98	1491	1727.4
12:00PM-01:00PM	448	128	765	42	19	15	125	1542	1852.9
01:00PM-02:00PM	470	132	792	36	20	12	126	1588	1890.3

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02:00PM-03:00PM	467	120	770	48	28	8	128	1569	1887.45
O3:00PM-04:00PM	460	125	755	42	40	12	142	1576	1961.8
04:00PM-05:00PM	492	184	816	56	46	9	148	1751	2167.2
05:00PM-06:00PM	486	192	802	60	30	11	154	1735	2142.9
06:00PM-07:00PM	468	148	856	92	25	10	168	1767	2206.4
07:00PM-08:00PM	490	141	902	102	27	9	184	1855	2333.5
T OTAL VOLUME	5836	2095	9505	795	323	141	1478	20173	24074
TOTAL PCU	4377	2514	9505	1113	969	423	5173	24074	

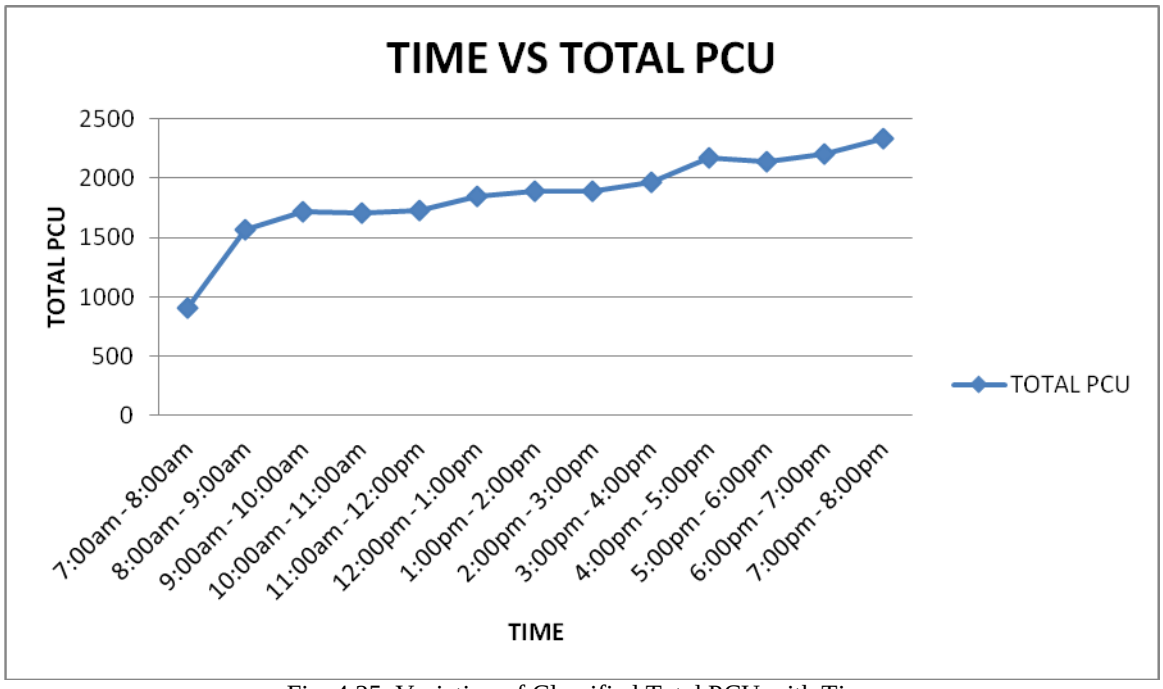

Fig. 4.25: Variation of Classified Total PCU with Time

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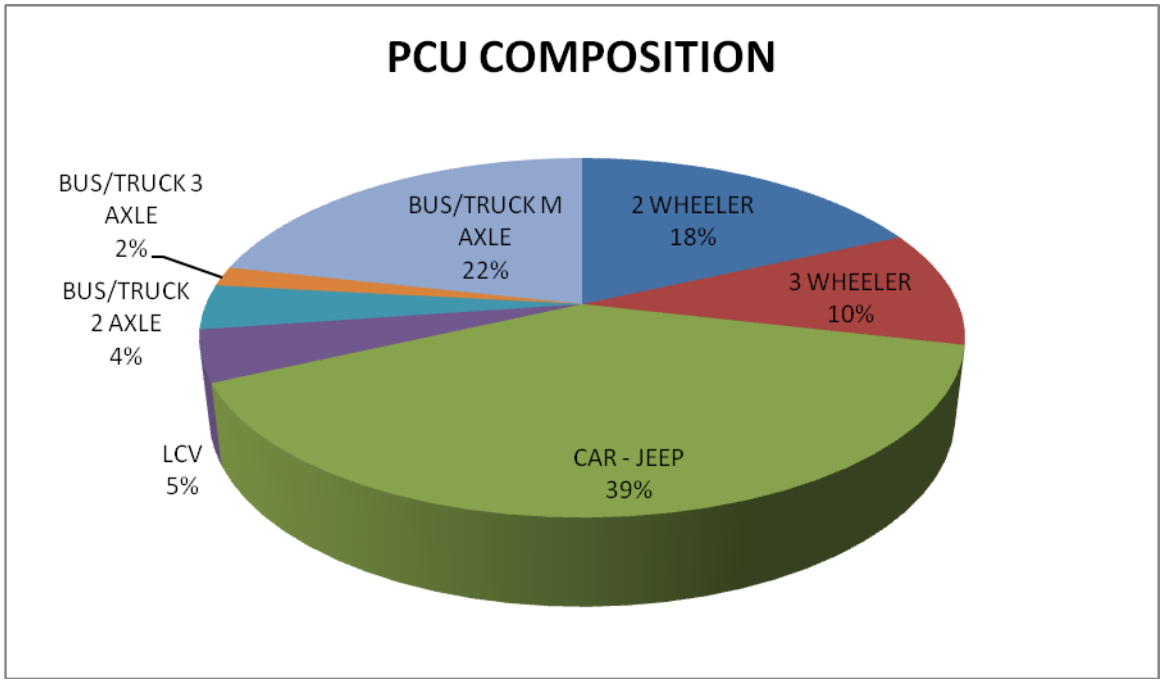

Fig. 4.26: Pie Chart showing Traffic Composition for Entire Day.

4.14 Direction of Traffic: PHAGWARA to NANAK NAGRI.

Table 4.14: Hourly Classified Traffic Volume for Traffic going towards NANAK NAGRI.

TRAFFIC VOLUME OBSERVATION SHEET AT SECTION BETWEEN NANAK NAGRI AND PHAGWARA									
LOCATION: MEHAT DAY: TUESDAY DIRECTION OF TRAFFIC: PHAGWARA to NANAK NAGRI									
DURATION: 7:00AM-7:00PM WEATHER: SUNNY DATE: 28-09-2021									
COUNT HOUR	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**	**CLASS 7**	**TOTAL VOLUME**	**TOTAL PCU**
	2 WHEELER	**3 WHEELER**	**CARS - JEEPS**	**LCV**	**BUSES/TRUCKS**				
					2 AXLE	**3 AXLE**	**m AXLE**		
PCU	**0.75**	**1.2**	**1**	**1.4**	**3**	**3**	**3.5**		
07:00AM-08:00AM	142	108	162	29	18	9	19	487	586.2
08:00AM-09:00AM	340	174	415	30	27	11	28	1025	1132.8
09:00AM-10:00AM	452	200	502	36	36	12	54	1292	1464.4
10:00AM-11:00AM	435	191	490	39	32	14	82	1283	1525.05
11:00AM-12:00PM	370	142	460	45	38	17	100	1172	1485.9
12:00PM-01:00PM	372	136	590	56	42	7	121	1324	1681.1
01:00PM-	425	156	736	68	37	9	119	155	1891.6

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02:00PM								0	5
02:00PM-03:00PM	419	141	700	72	36	12	127	1507	1872.75
03:00PM-04:00PM	412	125	836	65	42	19	128	1627	2017
04:00PM-05:00PM	536	140	929	82	50	14	150	1901	2330.8
05:00PM-06:00PM	552	135	890	78	52	12	168	1887	2355.2
06:00PM-07:00PM	524	117	915	68	48	15	165	1852	2310.1
07:00PM-08:00PM	517	120	918	72	42	9	119	1797	2120.05
T OTAL VOLUME	5496	1885	8543	740	500	160	1380	18704	22773
TOTAL PCU	4122	2262	8543	1036	1500	480	4830	22773	

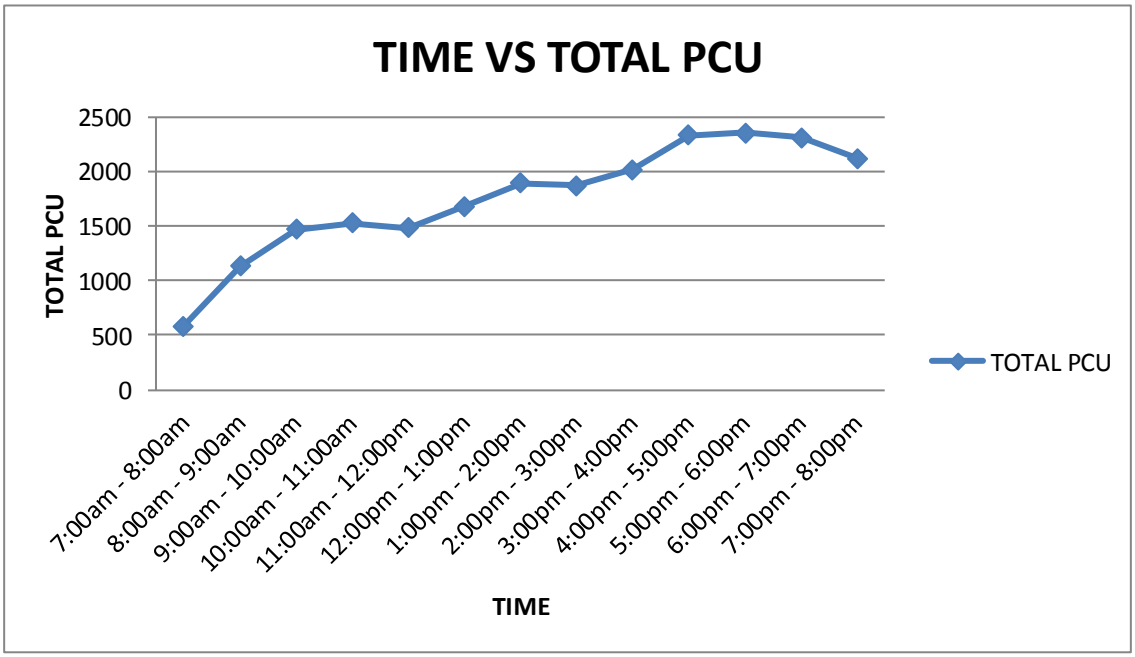

Fig. 4.27: Variation of Classified Total PCU with Time.

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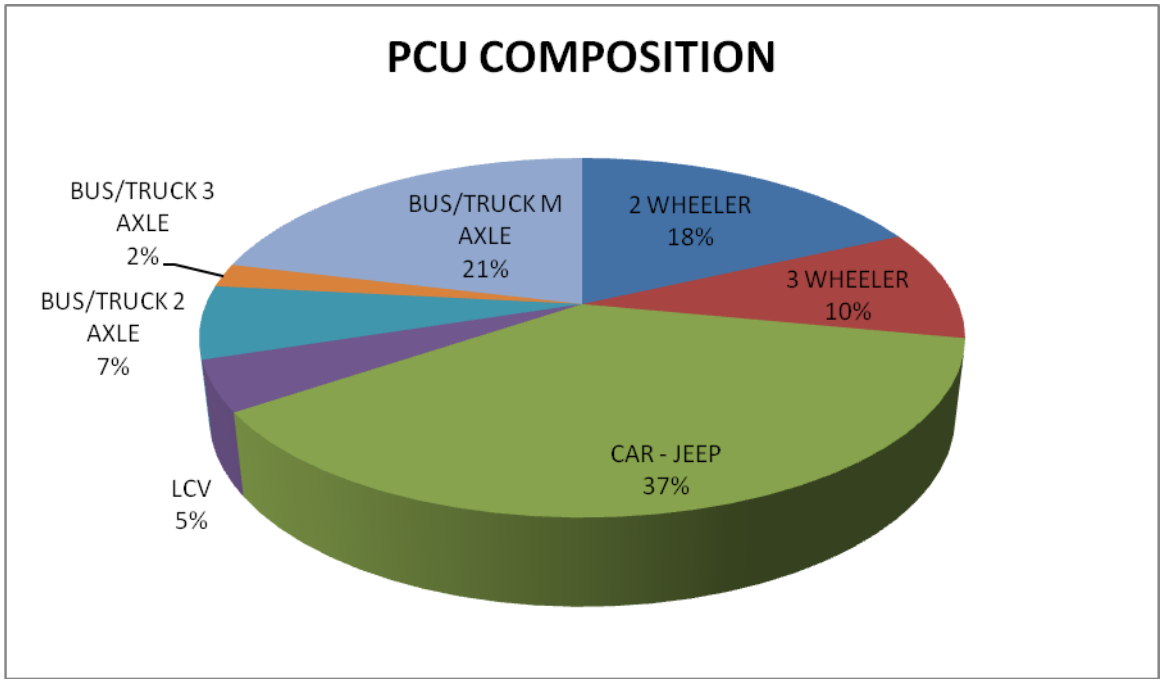

Fig. 4.28: Pie Chart showing Traffic Composition for Entire Day.

Table 4.15: Peak Hour flow for Both Direction of Traffic (Monday)

Location	Direction of Traffic	Period	Total PCU
MEHAT	TOWARDS PHAGWARA	Entire day 12 hours	22789.6
		Morning Peak hour	1701.8
		Evening peak hour	2193.45
	TOWARDS NANAK NAGRI	Entire day 12 hours	22116.4
		Morning Peak hour	1814.5
		Evening peak hour	2383.9

Table 4.16: Level of Service for Both Directions of Traffic (Monday)

Location	Direction	Time	PCU/Hour	Width of Road per Lane (m)	No. of Lanes	Design Service Volume	V/C per Ratio	LOS
	TOWARDS PHAGWARA	Morning Peak Hour	1701.8	3.5	3	3600	.47	B
		Evening Peak Hour	2193.45	3.5	3	3600	.60	C

MEHAT	**TOWARDS NANAK NAGRI**	**Morning Peak Hour**	1814.5	3.5	3	3600	.50	C
		Evening Peak Hour	2383.9	3.5	3	3600	.66	D

Table 4.17: Peak Hour flow for Both Direction of Traffic (Tuesday)

Location	Direction of Traffic	Period	Total PCU
MEHAT	**TOWARDS PHAGWARA**	Entire day 12 hours	22757
		Morning Peak hour	1623.8
		Evening peak hour	2098.3
	TOWARDS NANAK NAGRI	Entire day 12 hours	22299.95
		Morning Peak hour	1819.6
		Evening peak hour	2388.5

Table 4.18: Level of Service for Both Directions of Traffic (Tuesday)

Location	Direction	Time	PCU/Hour	Width of Road per Lane(m)	No. of Lanes	Design Service Volume	V/C per Ratio	LOS
MEHAT	**TOWARDS PHAGWARA**	**Morning Peak Hour**	1623.8	3.5	3	3600	.45	B
		Evening Peak Hour	2098.3	3.5	3	3600	.58	C
	TOWARDS NANAK NAGRI	**Morning Peak Hour**	1819.6	3.5	3	3600	.50	C
		Evening Peak Hour	2388.5	3.5	3	3600	.66	D

Table 4.19: Peak Hour flow for Both Direction of Traffic (Wednesday)

Location	Direction of Traffic	Period	Total PCU
MEHAT	**TOWARDS PHAGWARA**	Entire day 12 hours	23061.05
		Morning Peak hour	1715.9
		Evening peak hour	2109.35
	TOWARDS	Entire day 12 hours	22471.8

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	NANAK NAGRI		
		Morning Peak hour	1596.8
		Evening peak hour	2441.8

Table 4.20: Level of Service for Both Directions of Traffic (Wednesday)

Location	Direction	Time	PCU/Hour	Width of Road per Lane(m)	No. of Lanes	Design Service Volume	V/C per Ratio	LOS
MEHAT	**TOWARDS PHAGWARA**	**Morning Peak Hour**	1715.9	3.5	3	3600	.47	B
		Evening Peak Hour	2109.35	3.5	3	3600	.58	C
	TOWARDS NANAK NAGRI	**Morning Peak Hour**	1596.8	3.5	3	3600	.44	B
		Evening Peak Hour	2441.8	3.5	3	3600	.67	D

Table 4.21: Peak Hour flow for Both Direction of Traffic (Thursday)

Location	Direction of Traffic	Period	Total PCU
MEHAT	**TOWARDS PHAGWARA**	Entire day 12 hours	23158.85
		Morning Peak hour	1677.85
		Evening peak hour	2180.5
	TOWARDS NANAK NAGRI	Entire day 12 hours	22317.6
		Morning Peak hour	1569
		Evening peak hour	2328.9

Table 4.22: Level of Service for Both Directions of Traffic (Thursday)

Location	Direction	Time	PCU/Hour	Width of Road per Lane(m)	No. of Lanes	Design Service Volume	V/C per Ratio	LOS
	TOWARDS PHAGWARA	**Morning Peak Hour**	1677.85	3.5	3	3600	.46	B
		Evening Peak	2180.5	3.5	3	3600	.60	C

MEHAT		**Hour**						
	TOWARDS NANAK NAGRI	**Morning Peak Hour**	1569	3.5	3	3600	.43	B
		Evening Peak Hour	2328.9	3.5	3	3600	.64	D

Table 4.23: Peak Hour flow for Both Direction of Traffic (Friday)

Location	Direction of Traffic	Period	Total PCU
MEHAT	**TOWARDS PHAGWARA**	Entire day 12 hours	23294.25
		Morning Peak hour	1792.05
		Evening peak hour	2213.9
	TOWARDS NANAK NAGRI	Entire day 12 hours	22178.15
		Morning Peak hour	1500.3
		Evening peak hour	2328.7

Table 4.24: Level of Service for Both Directions of Traffic (Friday)

Location	Direction	Time	PCU/Hour	Width of Road per Lane(m)	No. of Lanes	Design Service Volume	V/C per Ratio	LOS
MEHAT	**TOWARDS PHAGWARA**	**Morning Peak Hour**	1792.05	3.5	3	3600	.49	C
		Evening Peak Hour	2213.9	3.5	3	3600	.61	D
	TOWARDS NANAK NAGRI	**Morning Peak Hour**	1500.3	3.5	3	3600	.41	B
		Evening Peak Hour	2328.7	3.5	3	3600	.64	D

Table 4.25: Peak Hour flow for Both Direction of Traffic (Saturday)

Location	Direction of Traffic	Period	Total PCU
	TOWARDS PHAGWARA	Entire day 12 hours	23689
		Morning Peak hour	1757
		Evening peak hour	2350.3

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MEHAT			
	TOWARDS NANAK NAGRI	Entire day 12 hours	22178.15
		Morning Peak hour	1500.3
		Evening peak hour	2328.7

Table 4.26: Level of Service for Both Directions of Traffic (Saturday)

Location	Direction	Time	PCU/Hour	Width of Road per Lane(m)	No. of Lanes	Design Service Volume	V/C per Ratio	LOS
MEHAT	**TOWARDS PHAGWARA**	**Morning Peak Hour**	1757	3.5	3	3600	.48	B
		Evening Peak Hour	2350.3	3.5	3	3600	.65	D
	TOWARDS NANAK NAGRI	**Morning Peak Hour**	1500.3	3.5	3	3600	.41	B
		Evening Peak Hour	2328.7	3.5	3	3600	.64	D

Table 4.27: Peak Hour flow for Both Direction of Traffic (Sunday)

Location	Direction of Traffic	Period	Total PCU
MEHAT	**TOWARDS PHAGWARA**	Entire day 12 hours	24074
		Morning Peak hour	1727.4
		Evening peak hour	2333.5
	TOWARDS NANAK NAGRI	Entire day 12 hours	22773
		Morning Peak hour	1525.05
		Evening peak hour	2355.2

Table 4.28: Level of Service for Both Directions of Traffic (Sunday)

Location	Direction	Time	PCU/Hour	Width of Road per Lane(m)	No. of Lanes	Design Service Volume	V/C per Ratio	LOS
	TOWARDS PHAGWARA	**Morning Peak Hour**	1727.4	3.5	3	3600	.47	B

MEHAT		**Evening Peak Hour**	2333.5	3.5	3	3600	.64	D
	TOWARDS NANAK NAGRI	**Morning Peak Hour**	1525.05	3.5	3	3600	.42	B
		Evening Peak Hour	2355.2	3.5	3	3600	.65	D

4.2-B SPEED STUDIES.

The traffic speed was conducted on between Nanak Nagri and Phagwara road so as to analyse the speed pattern throughout the off peak hour i.e. 11:30 a.m. to 12:30p.m.

- A road stretch of 60 metres was separated using tapes on the mid block section and the study was conducted. Spot speeds were determined by examining the running or travelling time of the various composition of vehicles.
- Two observers were stationed at the two end of the stretch each having a stopwatch.
- A sample of 10 (cars, 2 wheelers and 3 wheelers) were examined and a sample of 10 (buses and trucks) were examined.
- Running time of the vehicles was noted in an observation sheet.
- This data was later analysed using the Excel programme by finding out the individual speeds in m/s and kmph.
- Later this data was plotted in the form of histograms showing Speed versus Percentage Frequency of vehicles.
- Furthermore, the cumulative frequency curves were plotted to determine a variety of percentile speeds.

4.2.1 SPEED STUDY SHEET:

Table 4.29: Speed Data Analysis.

Spot Speed Study							
Date: 01-10-2021. **Start Time: 11:30am** **Name: Munazil Mushtaq Khanday.** **End Time: 12:30pm(Noon)** **Location: NH-1 GT road phagwara.** **Weather: Sunny.**							
TRUCKS				**BUSES**			
Dist.	**Time**	**Speed(m/s)**	**Speed(km/h)**	**Dist.**	**Time**	**Speed(m/s)**	**Speed(km/h)**
60	4.8	12.5	45	60	4	15	54
60	4.5	13.3	48	60	3.2	18.8	67.5
60	4.2	14.3	51.43	60	3.1	19.4	69.68
60	5.3	11.3	40.75	60	3	20	72
60	5.2	11.5	41.54	60	4.2	14.3	51.43
60	5.5	10.9	39.27	60	4.1	14.6	52.68
60	4.1	14.6	52.68	60	3.2	18.8	67.5
60	4	15	54	60	3	20	72
60	4.2	14.3	51.43	60	3	20	72

60	5	12	43.2	60	3.2	18.8	67.5
4 WHEELER				**3 WHEELER**			
Dist.	**Time**	**Speed(m/s)**	**Speed(km/h)**	**Dist.**	**Time**	**Speed(m/s)**	**Speed(km/h)**
60	4	15	54	60	6	10	36
60	5	12	43.2	60	5.5	10.9	39.27
60	5.2	11.5	41.54	60	5.9	10.2	36.61
60	4.6	13	46.96	60	6.2	9.68	34.84
60	2.3	26.1	93.91	60	6.5	9.23	33.23
60	3	20	72	60	6.4	9.38	33.75
60	4	15	54	60	6.7	8.96	32.24
60	5.2	11.5	41.54	60	7	8.57	30.86
60	5.1	11.8	42.35	60	6.2	9.68	34.84
60	5.7	10.5	37.89	60	6.3	9.52	34.29
2 WHEELER							
Dist.	**Time**	**Speed(m/s)**	**Speed(km/h)**	**Dist.**	**Time**	**Speed(m/s)**	**Speed(km/h)**
60	4	15	54	60	3.8	15.8	56.84
60	4.3	14	50.23	60	4.5	13.3	48
60	4.2	14.3	51.43	60	4.3	14	50.23
60	4.1	14.6	52.68	60	4	15	54
60	3.9	15.4	55.38	60	4.6	13	46.96

Table 4.30: Percentile Analysis.

SPEED	**FREQUENCY**	**CUMULATIVE FREQUENCY**	**CUMULATIVE PERCENTAGE**	**SPEED PERCENTILE**	
30-35	0	0	0		
35-40	1	1	10		
40-45	4	5	50	50th	**TRUCKS**
45-50	1	6	60	85th	
50-55	4	10	100	98th	
SPEED	**FREQUENCY**	**CUMULATIVE FREQUENCY**	**CUMULATIVE PERCENTAGE**	**SPEED PERCENTILE**	
50-55	3	3	30		
55-60	0	3	30		**BUSES**
60-65	0	3	30	50th	
65-70	4	7	70	85th	
70-75	3	10	100	98th	
SPEED	**FREQUENCY**	**CUMULATIVE FREQUENCY**	**CUMULATIVE PERCENTAGE**	**SPEED PERCENTILE**	
30-45	5	5	50	50th	
45-60	3	8	80	85th	**4 WHEELER**
60-75	1	9	90		
75-90	0	9	90	98th	
90-105	1	10	100		
SPEED	**FREQUENCY**	**CUMULATIVE FREQUENCY**	**CUMULATIVE PERCENTAGE**	**SPEED PERCENTILE**	
30-32	1	1	10		

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32-34	3	4	40	50th	**3 WHEELER**
34-36	3	7	70	85th	
36-38	2	9	90	98^{th}	
38-40	1	10	100		
SPEED	**FREQUENCY**	**CUMULATIVE FREQUENCY**	**CUMULATIVE PERCENTAGE**	**SPEED PERCENTILE**	
43-46	0	0	0		
46-49	2	2	20		**2 WHEELER**
50-52	3	5	50	50^{th}	
52-55	3	8	80	85^{th}	
55-58	2	10	100	98^{th}	

From the above data the percentile speeds for the vehicles can be interpreted as follows:

TABLE 4.31: PERCENTILE SPEED FOR THE VEHICLES

	SPEEDS(KMPH)				
PERCENTILE	**TRUCKS**	**BUSES**	**4 WHEELERS**	**3 WHEELERS**	**2 WHEELERS**
98^{th}	49.75	69.5	87	37.5	54.5
85^{th}	48	67.5	58	35.5	52.75
50^{th}	40	62.5	30	32.5	49

4.2.2 BAR CHARTS

These charts are used to determine the common speed at which maximum number of frequency of vehicles are moving. These charts for the various modes of travel are as follows:

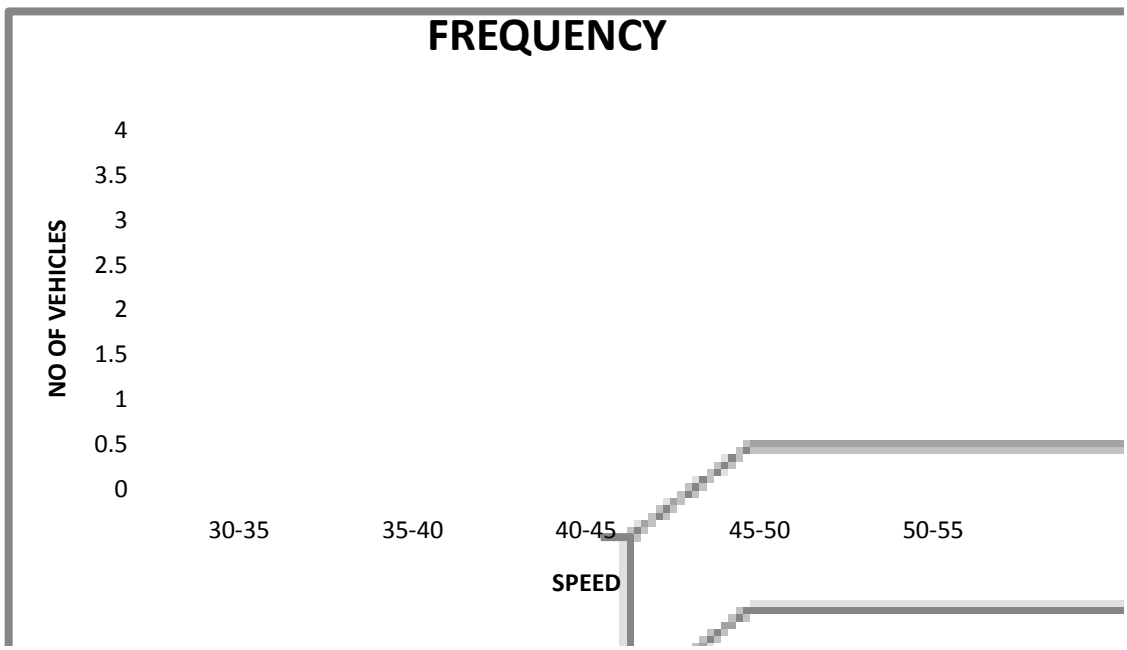

Figure 4.29 Histogram for Trucks.

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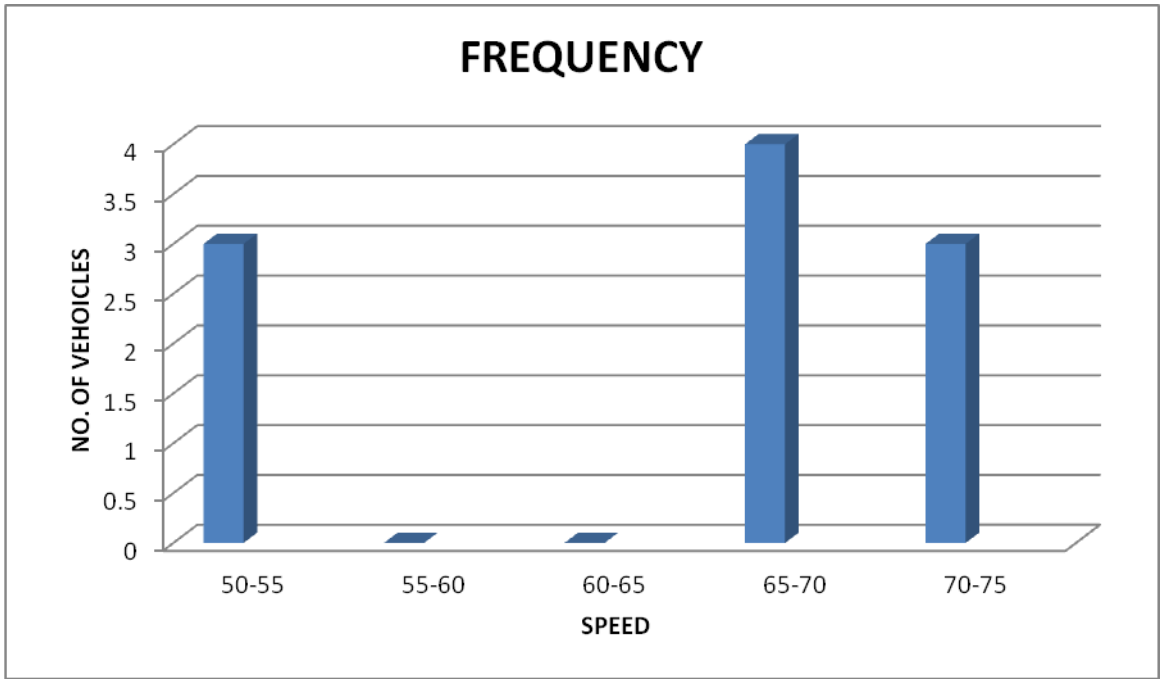

Figure 4.30 Histogram for Buses.

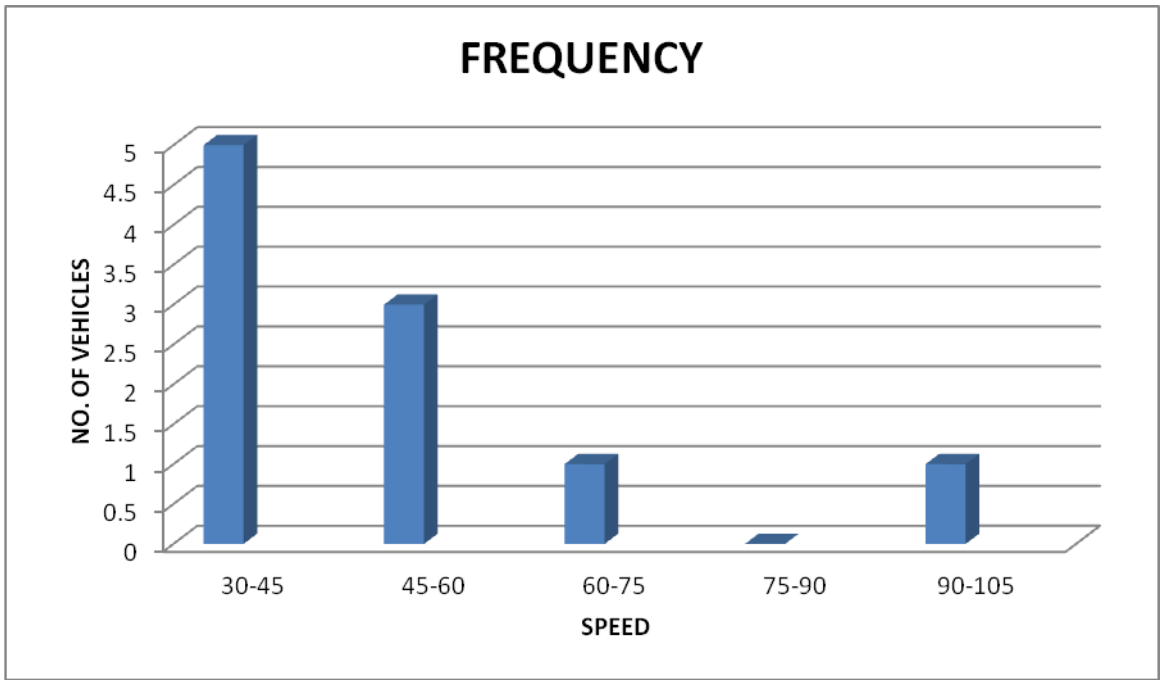

Figure 4.31 Histogram for 4 Wheelers.

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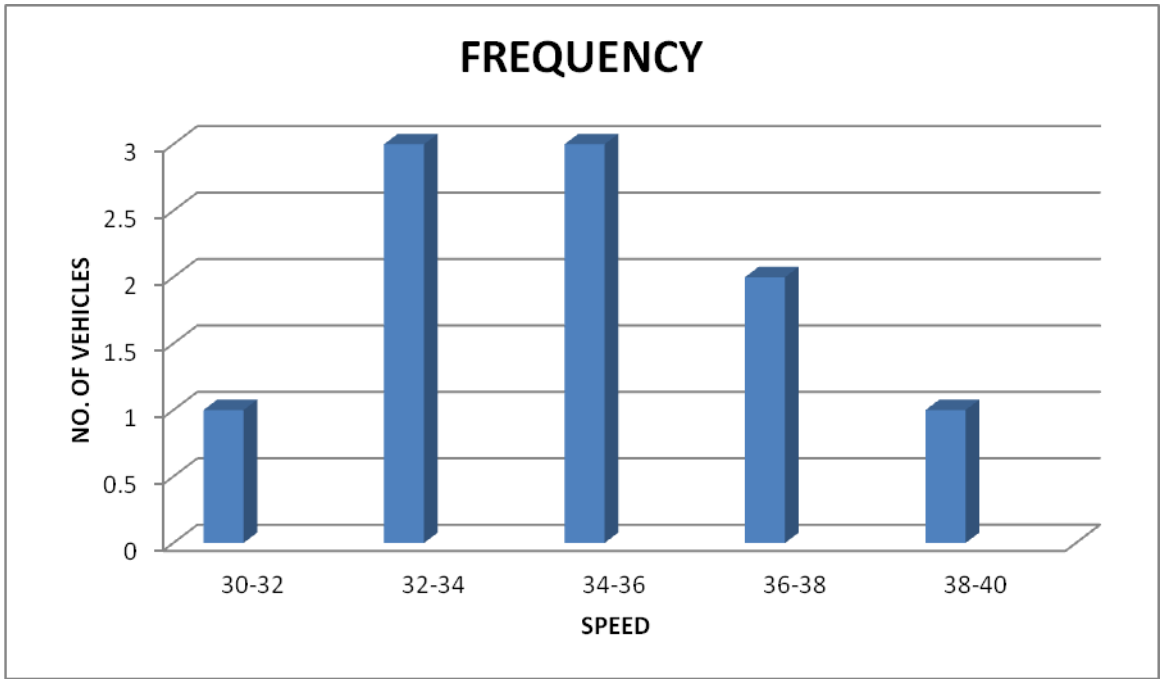

Figure 4.32 Histogram for 3 Wheelers.

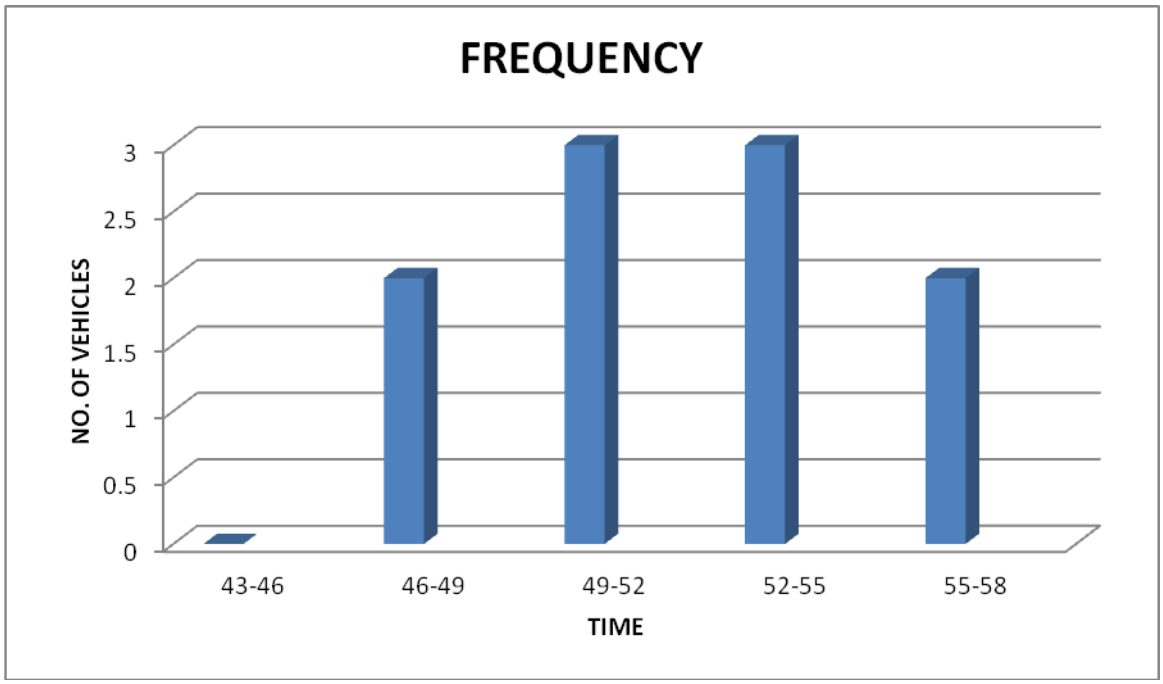

Figure 4.33 Histogram for 2 Wheelers.

Thus from the above charts it can be seen that the speeds of vehicles tend to cluster about the mean value and the frequency drops as the speeds depart from the mean.

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4.2.3 CUMULATIVE FREQUENCIES

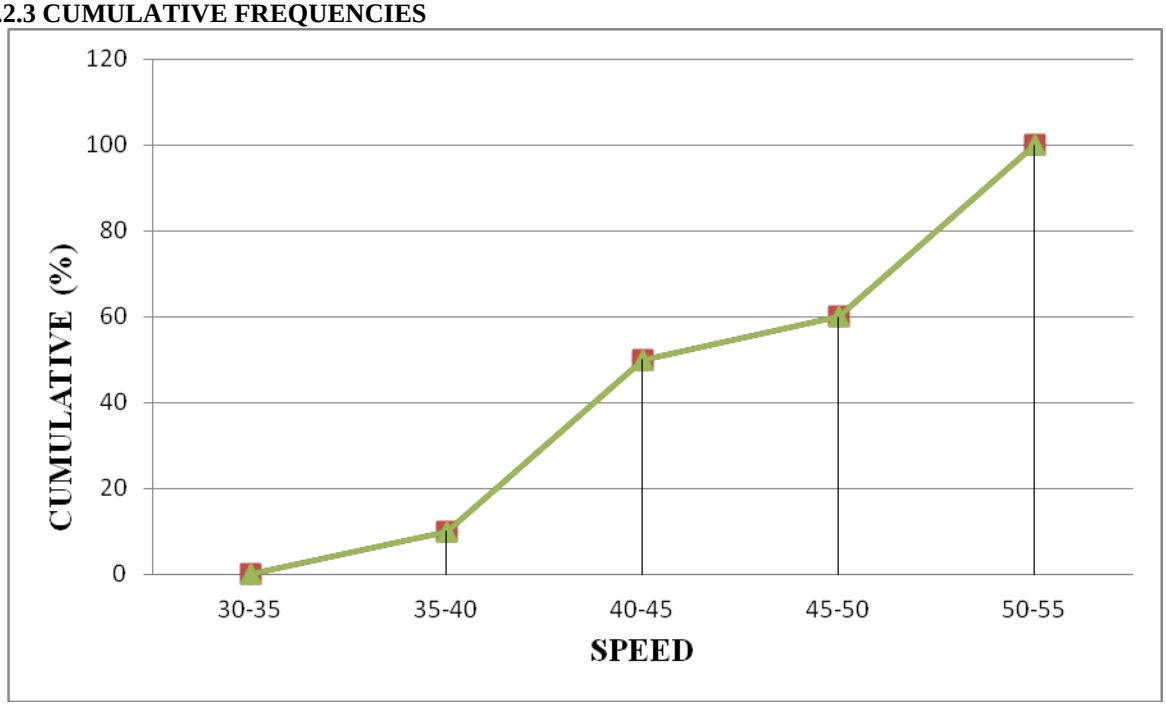

Figure 4.34 Cumulative Frequency Graph for Trucks.

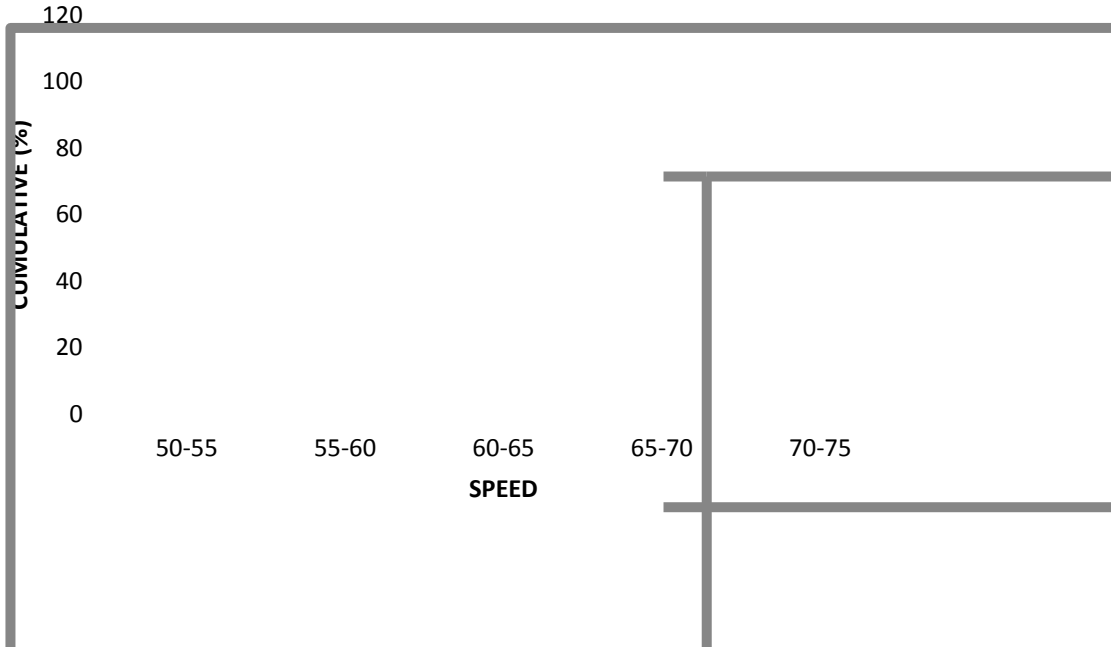

Figure 4.35 Cumulative Frequency Graph for Buses.

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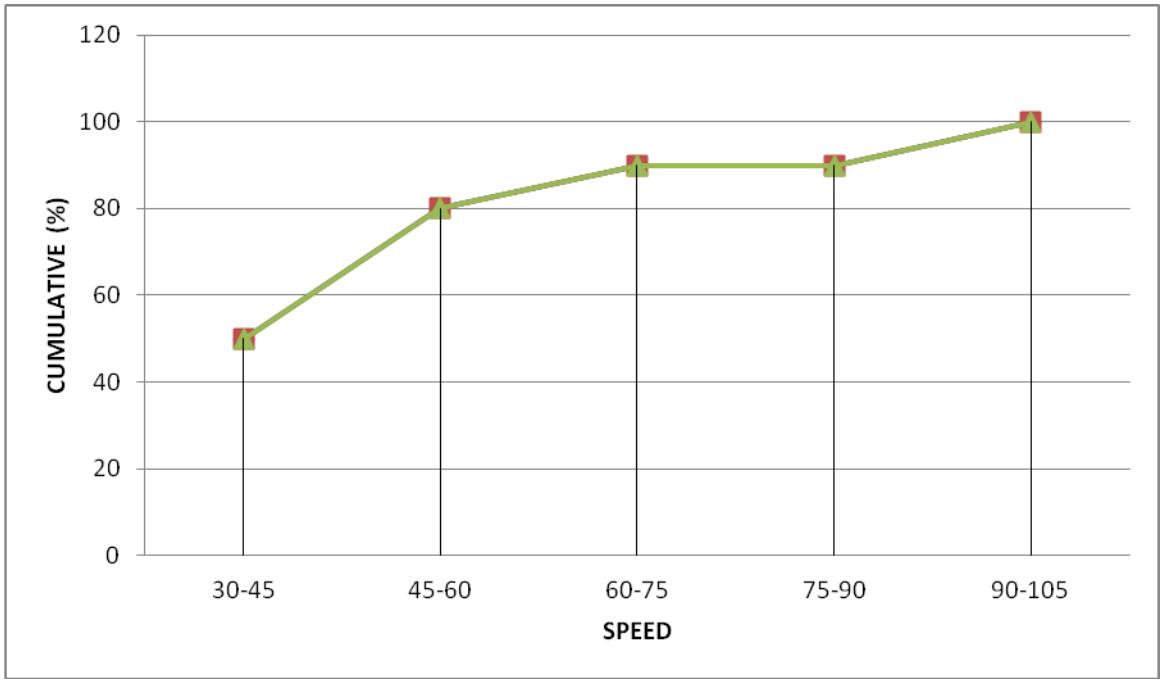

Figure 4.36 Cumulative Frequency Graph for 4 Wheelers.

Figure 4.37 Cumulative Frequency Graph for 3 Wheelers.

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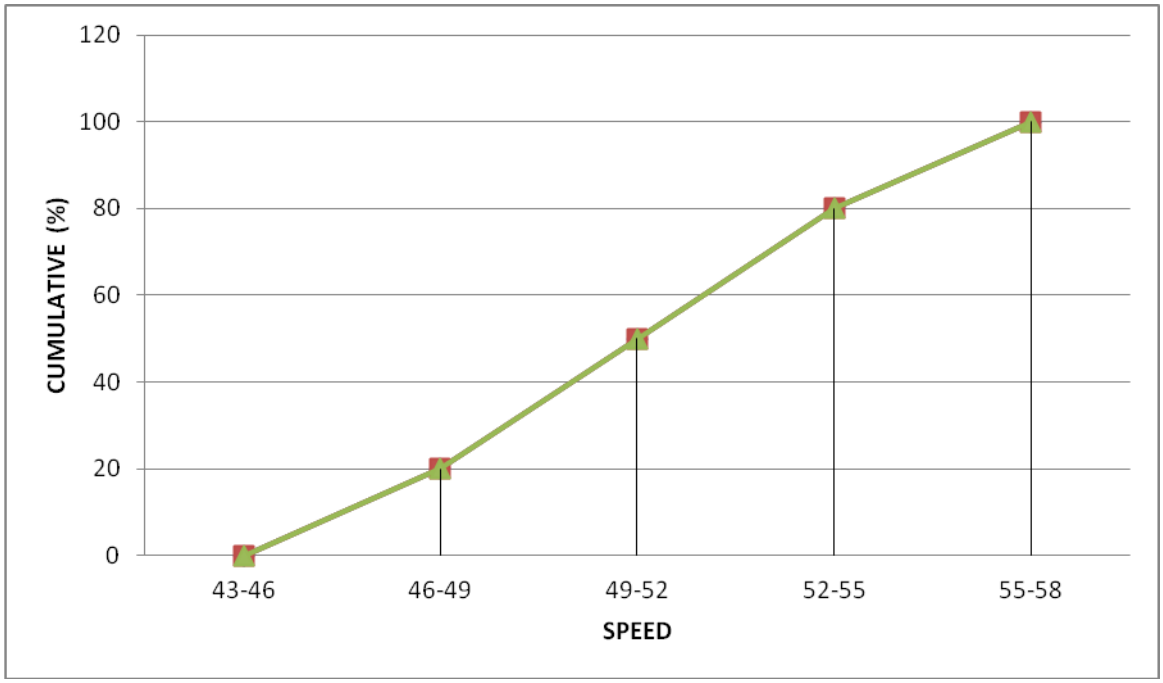

Figure 4.38 Cumulative Frequency Graph for 2 Wheelers.

4.2.4 SPEED PERCENTILES AND HOW TO USE THEM:

The speed percentiles are the apparatus which are used to determine effective and sufficient speed limits. The two speed percentiles which are most important to understand are the 50th and the 85th percentiles. The 50th percentile is the median speed of the observed data set. This percentile represents the speed at which half of the observed vehicles are below and half of the observed vehicles are above. The 50th percentile of speed represents the average speed of the traffic flow.

The 85th percentile is the speed at which 85% of the observed vehicles are traveling at or below. This percentile is used in evaluating/recommending posted speed limits based on the supposition that 85% of the drivers are traveling at a speed they perceive to be safe. In other words, the 85th percentile of speed is normally assumed to be the maximum safe speed for a roadway section or the design speed.

The 98^{th} percentile speed of the vehicles is the design speed below which 98 percent of all the vehicles of this category travel on the road. This speed has been used for geometric design purpose.

Climatic conditions may affect speed percentiles. For example, observed speeds may be lesser in rainy or snowy conditions.

Table 4.31: Percentile speed for the vehicles.

From the above figures, the percentile speeds for the vehicles can be interpreted as follows:

Percentile					
	TRUCKS	**BUSES**	**4 WHEELERS**	**3 WHEELERS**	**2 WHEELERS**
98^{th}	49.75	69.5	87	37.5	54.5
85^{th}	48	67.5	58	35.5	52.75
50^{th}	40	62.5	30	32.5	49

V. RECOMMENDATIONS AND CONCLUSION- CHAPTER 5

5.1 Recommendations

Traffic studies have been done between Jalandhar and Phagwara roads. It has been observed that traffic volume is high in both

morning and evening peak hours due to which low level of service results in more travel time and causes congestion. Hence, certain recommendations are made agreeing to the study.

- Use of Advanced Management Transportation Systems (AMTS), which will definitely provide timely information to the commuters and will help commuters to decide which path to follow.
- The traffic police mechanism system need to be reinforced, because during study I have observed the scarcity of law enforcement agency.
- Maintenance of road needs to be done so as to take commuters less travel time and smooth riding excellence.
- The roads, shoulders and medians should be designed according to the volume on the roads and type of vehicles.
- It has also been observed that no speed limit parameters were seen during the study, this needs to be implemented, so to help commuter's not to exceed beyond speed limits which will be increasing the accident rates and not to ride vehicles at lower speeds which results congestion.
- More focus should be given on public transport rather than private; this will help to reduce the congestion.
- Parking facilities need to be improved, which also acts as commuters more travel time and due to this congestion comes into picture.

5.2 Conclusion

The study analyzed that the volume of vehicles is 52% more than that of previous 10 years. As number of vehicles has increased much rapidly resulting in congestion. If same percentage of vehicles will grow in next 5 or 6 years then there will be serious congestion on the roadways and commuters will face very much difficulty. It is a clear message that the regulatory bodies will have to take a big leap, especially in terms of traffic management in cities like Phagwara. So we need to step up and bring a change on road capacity and maintain the proper level of service or reduce it to minimum. If more and more public transport are utilized, then there are more chances of reducing the Level of Service (LOS) to minimum level. From our study we had observed a LOS C and D. LOS C belongs to stable flow or near free flow but on the other hand LOS D is the approaching unstable flow in which speeds decreases while traffic increases, which is increasing the travel time of commuters and at times it causes headache to the drivers and commuters as well.

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ABBREVIATIONS

ITS Intelligent Transportation Systems or Frameworks
APTS Advanced Public Transportation Systems
ATMS Advanced Traffic Management Systems
ATIS Advanced Traveler Information Systems or Frameworks
ATCS Advanced Technology consulting Systems or Frameworks
VOTT Value of Travel Time
VOT Value of Time
V/C Volume/Capacity
PCU Passenger Car Unit
LOS Level of Service