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SUGGESTIVE MEASURE TRAVEL TIME AND CONGESTION UNDER HETEROGENEOUS TRAFFIC CONDITIONS

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ABSTRACT

Movement in non-rural areas effects well-being as well as traffic of that area. Greater the congested activity, worse will be the traffic impacts. These traffic impacts can be minimized by movement diminishment, or by moving more passengers from personal to alternate methods of transport with less negative effects for which a comprehensive traffic study needs to be done. In the present study, Phagwara, area of Jalandhar has been taken for such analysis. These studies can be used to control traffic jams on roads due to increment in vehicles. The study can also be used for saving time at intersections. Travel time data is an important parameter of many Intelligent Transportation Systems/ Frameworks (ITS) applications. Quantity of vehicles in India has been increasing enormously resulting in blockage and pollution of urban areas during peak periods. If we can control congestion to a certain limit, things like pollution will also get minimized and there will be less accident rate due to less delay to the road users. This all is possible only when we are able to shift more passengers from their personal vehicles to public transport/ vehicles by providing them better comfort and good services. We can also provide latest technologies to the public vehicles so that the passenger gets attracted to these facilities. For achieving the goal, Advanced Public Transportation System/ Frameworks (APTS) plays a great role. ITS applications should be added to the movement circumstances in India so as to reduce the effects caused by traffic congestion. India is a developing country and has low economy rate so this is not possible for any developing country to implement in each and every city. Our main aim is to find out the traveller/ Passenger Car Unit (PCU) for many types of vehicles in non-homogeneous situations. The study shows that the traffic volume increasing enormously with non-homogeneous traffic on the roadway of Six-Laned Two-way traffic. The relation between volume of traffic and speed of vehicles represents third- and fourth-degree curve.

***KEY-WORDS**: Intelligent Transportation System, Passenger Car Unit, Traffic Volume, value of time, Phagwara, speed.*

INTRODUCTION

The information of travel time is very useful parameter of many ITS applications. Belonging to a period of time not long ago, the vehicles in India has increased in a very great amount, leading to highly developed traffic jams and congestion along with pollution in urban areas, particularly during peak/ festival periods. So, we need to use a useful strategy to deal with such conditions or to shift more crowd from personal vehicles/ transport to public vehicles/ transport by providing better comfort, better services, latest technologies and so on. In these situations, APTS is one of the essential applications, that can greatly improve the traffic conditions in India. Its one of the applications will be to give clear/ correct timings to the travelers/ passengers which causes less wastage of time at transport stops. This requires a uniform information buildup strategy, fast and dependable forecast system and informing the passengers for the same. Its extent is to study and to utilize worldwide situating framework information collected from open transportation and making 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. If we execute the proposed calculation, it has been observed that it will be more promising and would be profitable for the betterment of advanced public transportation systems (APTS) in India.

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 shifting from personal to different modes of transport with less effects, like 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".

1.1. OBJECTIVE OF THE STUDY

Following are the main objectives of the study:

- Critically evaluate system architectures of the popular ATCS, which is Advanced Technology Consulting Service or systems.
- Suggest a system which is best for the movement of traffic in heterogeneous conditions.
- With the help of field data we can study the vehicle progression model also we can study saturation flow model from same.
- It also controls jams because of increment in vehicles.
- It also Saves time at intersections.

1.2. DESCRIPTION OF STUDY AREA

PHAGWARA, JALANDHAR is the area for my research studies. The area 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. 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-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.

1.3. BRIEF LITERATURE REVIEW:

Travel clogging is one of the most important fears 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.

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.

1.4. IMPACTS OF TRAFFIC CONGESTION ON TRAVEL TIME

Increased travel times and the uncertainty brought about by jamming impacts the efficiency of logistics processes. Weisbrod et al., 2001 direct and indirect costs related with jamming have been broadly calculated and reported. This research studies the impact of jamming on commercial vehicle tours in an urban area. 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.

1.5. 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.
-

1.6. IMPACT ON PRICES.

Arnott, R, and Small, K.A., 1994 obstruction pricing is defined as, charging motorists during peak hours to give them confidence to either control their travel times or to use an alternative route which are not obstructed at climax or peak hours.

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.

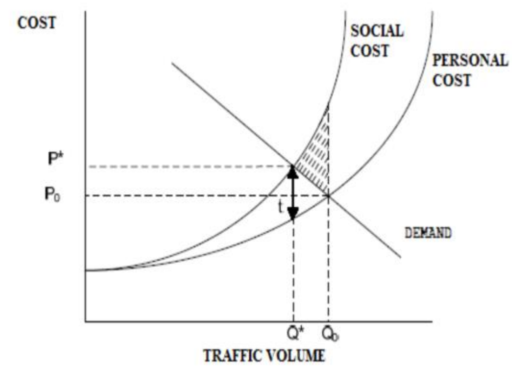


Fig.1:Economics of Overcrowding Pricing (Morrison, 1986)

1.7. 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. 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.

1.7.1. 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, 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.

1.7.2. 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.

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.

1.8. IMPACT OF TRAFFIC CONGESTION ON ROAD ACCIDENTS

Traffic clogging and street mishaps are two significant externalities formed by means of road consumers. 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.

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.

2. METHODOLOGY

2.1. 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 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.

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 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.

3. DATA COLLECTION AND ANALYSIS

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 every day 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 analyzed 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.
- Also, the cumulative frequency curves were plotted to determine the various percentile speeds.

3.1. VOLUME STUDY DATA.

Direction of Traffic: NANAK NAGRI to PHAGWARA.

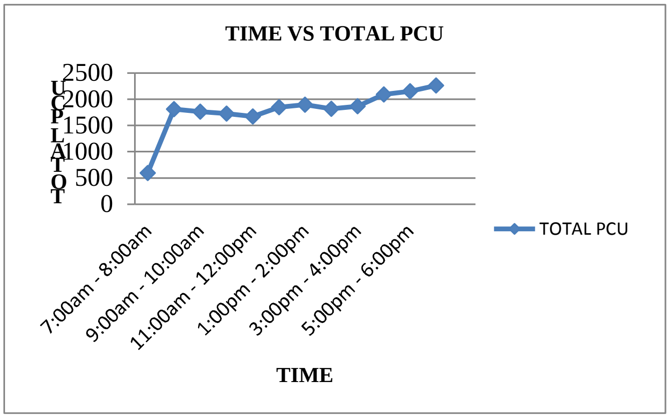
Table 1: Hourly Classified Traffic Volume for Traffic going towards PHAGWARA.

Traffic Volume Observation Sheet At Section Between Nanak Nagri And Phagwara

LOCATION: MEHAT DAY: MONDAY DIRECTION OF TRAFFIC: NANAK NAGRI To PHAGWARA

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**		
7:00AM-8:00AM	97	72	185	60	18	8	25	465	593.65
8:00AM-9:00AM	455	230	576	85	28	15	105	1494	1808.75
9:00AM-10:00AM	340	185	616	75	30	16	122	1384	1763
10:00AM11:00AM	328	168	680	37	18	13	130	1374	1727.4
11:00AM-12:00PM	335	159	630	33	15	9	138	1319	1673.25
12:00PM-1:00PM	357	110	729	38	20	12	163	1429	1848.45
1:00PM-2:00PM	353	120	720	55	25	10	168	1451	1898.75
2:00PM-3:00PM	385	108	570	50	40	15	170	1338	1818.35
3:00PM-4:00PM	335	125	580	56	47	18	175	1336	1867.15
4:00PM-5:00PM	400	115	680	98	55	13	180	1541	2089.2
5:00PM-6:00PM	432	117	740	150	21	11	183	1654	2150.9
6:00PM-7:00PM	485	98	825	138	15	13	194	1768	2262.55
Total Volume	4302	1607	7531	875	332	153	1753	16553	21501.4
Total PCU	3226.5	1928.4	7531	1225	996	459	6135.5	21501.4	



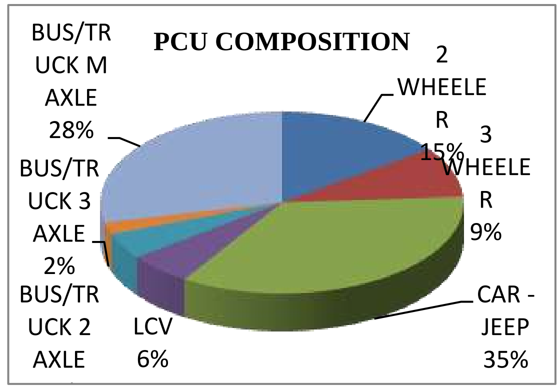


Fig.2: Variation of classified total PCU with time.

Fig.3: Pie Chart showing Traffic Composition Entire Day

Same has been repeated for the traffic going towards from Phagwara to Nanak Nagri.

Table 2: Peak Hour flow for Both Direction of Traffic (Monday)

Location	Direction of Traffic	Period	Total PCU
Mehat	Towards Phagwara	Entire day 12 hours	21501.4
		Morning Peak hour	1808.75
		Evening peak hour	2262.55
	Towards Nanak Nagri	Entire day 12 hours	21267.3
		Morning Peak hour	1495.45
		Evening peak hour	2310.4

Table 3: Level of Service for Both Directions of Traffic (Monday)

Location	Direction	Time	PCU/Hour	Road lane width (m)	No. of Lanes	Design Service Volume	V/C per Ratio	LOS
MEHAT	Towards Phagwara	Morning Peak Hour	1808.75	3.5	3	3600	0.5	B
		Evening Peak Hour	2262.55	3.5	3	3600	0.62	D
	Towards Nanak Nagri	Morning Peak Hour	1495.45	3.5	3	3600	0.42	B
		Evening Peak Hour	2310.4	3.5	3	3600	0.64	D

Above was repeated for a complete week to get the complete data.

3.2-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. 11:30AM to 12:30PM.

- 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 analyzed 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.

3.2.1 Speed Study Sheet:

Table 4: Speed Data Analysis.

Spot Speed Study							
Date: 01-10-2021. Start Time: 11:30am Name: Munazil Mushtaq Khanday. End Time: 12:30pm 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	4.7	12.7	45.9	60	4.1	14.6	52.6
60	4.9	12.2	44	60	3.5	17.1	61.6
60	3.9	15.3	55.3	60	3.2	18.7	67.3
60	5.1	11.7	42.3	60	2.9	20.6	74.2
60	5.3	11.3	40.7	60	4..1	14.6	52.6
60	5.4	11.1	40	60	4.3	13.9	50
60	4.2	14.2	51.2	60	3.3	18.1	65.2
60	4.1	14.6	52.6	60	3.1	19.3	69.5
60	4.3	13.9	50.2	60	3.4	17.6	63.4
60	5.1	11.7	42.3	60	3.1	19.3	69.5
4-WHEELER				**3-WHEELER**			
Dist.	**Time**	**Speed(m/s)**	**Speed(km/h)**	**Dist.**	**Time**	**Speed(m/s)**	**Speed(km/h)**
60	3.9	15.4	55.4	60	6.1	9.8	35.3
60	4.8	12.5	45	60	5.4	11.1	40
60	5.1	11.8	42.5	60	5.8	10.3	37.1
60	4.7	12.8	46.1	60	6.3	9.5	34.2
60	2.2	27.3	98.3	60	6.4	9.3	33.5
60	3.1	19.4	69.9	60	6.5	9.2	33.1
60	4.2	14.3	51.5	60	6.5	9.2	33.1
60	5	12	43.2	60	7.2	8.3	29.9
60	5.2	11.3	40.7	60	6.1	9.8	35.3
60	5.6	10.7	38.5	60	6.4	9.3	33.5
2 WHEELER							
Dist.	**Time**	**Speed(m/s)**	**Speed(km/h)**	**Dist.**	**Time**	**Speed(m/s)**	**Speed(km/h)**
60	4.1	14.6	52.6	60	3.7	16.2	58.3
60	4.2	14.3	51.5	60	4.6	13	46.8
60	4.1	14.6	52.6	60	4.2	14.3	51.5
60	4	15	54	60	4.1	14.3	51.5

60	4.1	14.3	51.5	60	4.5	13.3	47.9

Table 5: Percentile Analysis.

SPEED	**FREQUENCY**	**CUMULATIVE FREQUENCY**	**CUMULATIVE PERCENTAGE**	**SPEED PERCENTILE**	**TRUCKS**
30-35	0	0	0	-	
35-40	1	1	10	-	
40-45	4	5	50	50th	
45-50	1	6	60	85th	
50-56	4	10	100	98th	
SPEED	**FREQUENCY**	**CUMULATIVE FREQUENCY**	**CUMULATIVE PERCENTAGE**	**SPEED PERCENTILE**	**BUSES**
50-55	3	3	30		
55-60	0	3	30		
60-65	2	5	50	50th	
65-70	4	9	90	85th	
70-75	1	10	100	98th	
SPEED	**FREQUENCY**	**CUMULATIVE FREQUENCY**	**CUMULATIVE PERCENTAGE**	**SPEED PERCENTILE**	**4-WHEELER**
30-45	5	5	50	50th	
45-60	3	8	80	85th	
60-75	1	9	90		
75-90	0	9	90	98th	
90-105	1	10	100		
SPEED	**FREQUENCY**	**CUMULATIVE FREQUENCY**	**CUMULATIVE PERCENTAGE**	**SPEED PERCENTILE**	**3-WHEELER**
29-32	1	1	10		
32-34	3	4	40	50th	
34-36	4	8	80	85th	
36-38	1	9	90	98th	
38-40	1	10	100		
SPEED	**FREQUENCY**	**CUMULATIVE FREQUENCY**	**CUMULATIVE PERCENTAGE**	**SPEED PERCENTILE**	**2-WHEELER**
43-46	0	0	0		
46-49	2	2	20		
50-52	4	6	60	50th	
52-55	3	9	90	85th	
55-59	1	10	100	98th	

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

Table 6: Percentile Speed For The Vehicles

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

3.2.2 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:

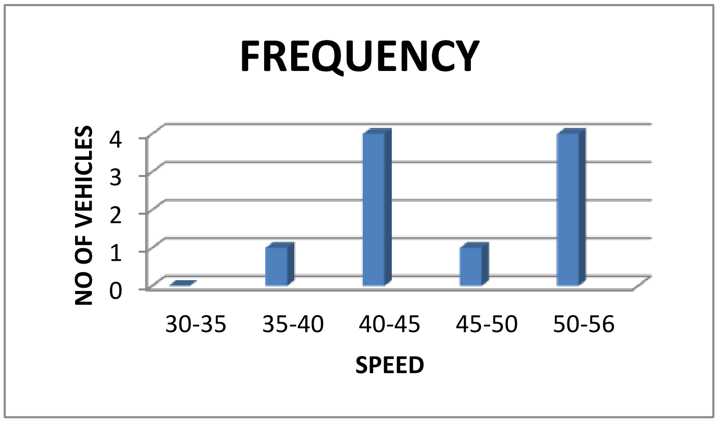


Fig. 4: Histogram for Trucks.

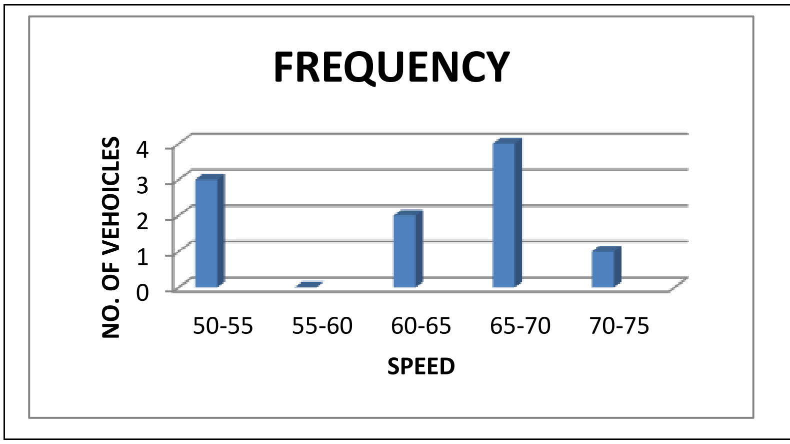


Fig.5: Histogram for Buses.

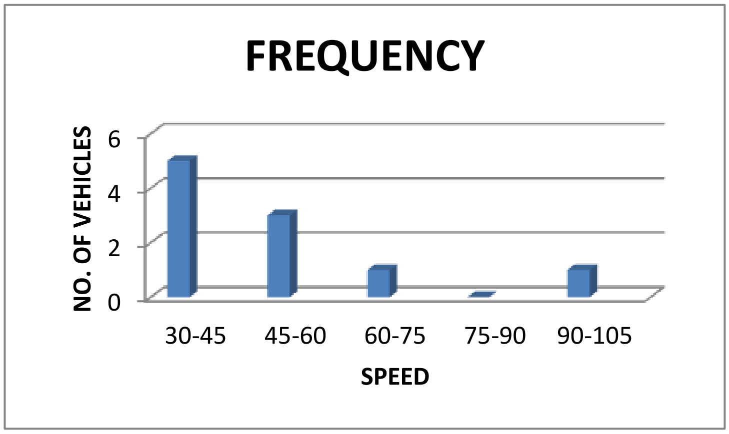


Fig.6:Histogram for 4 Wheelers.

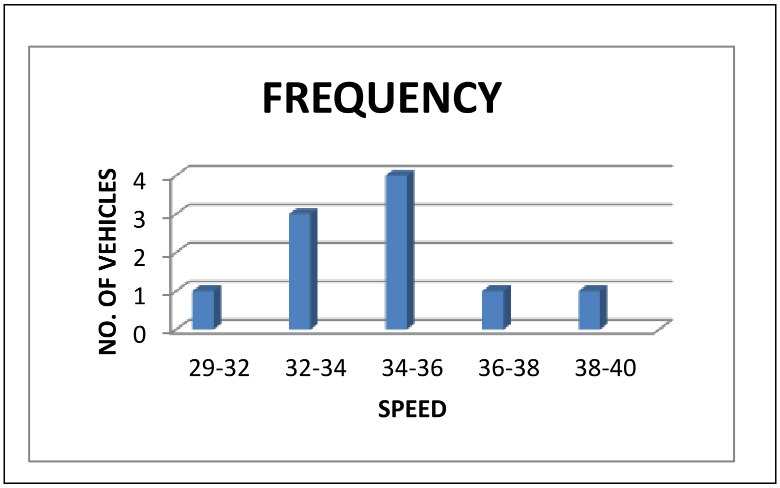


Fig.7: Histogram for 3 Wheelers.

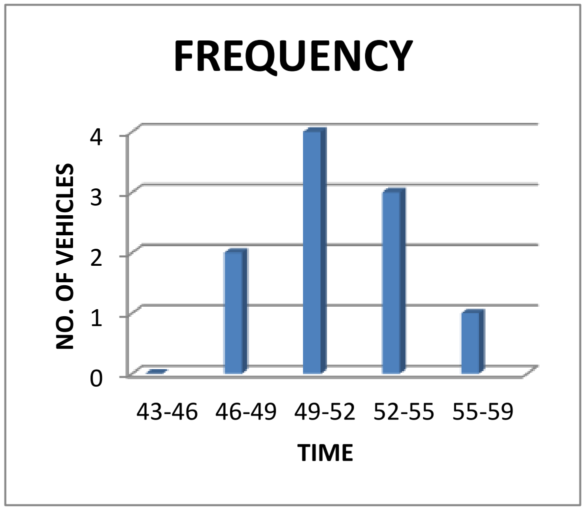


Fig.8: Histogram for 2 Wheelers.

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.

3.2.3 Cumulative Frequencies

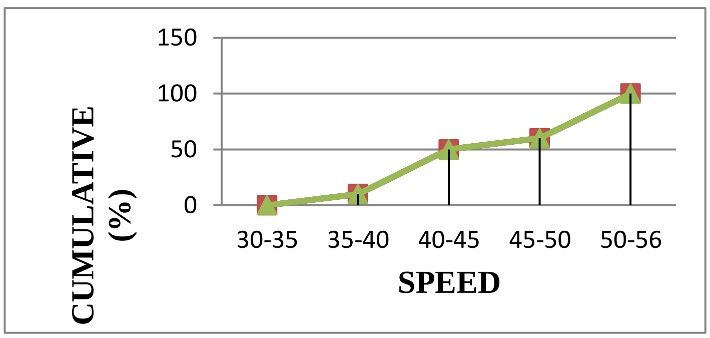


Fig. 9: Cumulative Frequency Graph for Trucks.

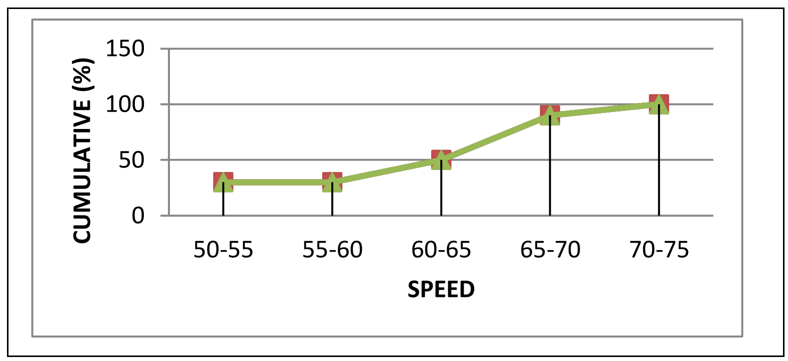


Fig.10: Cumulative Frequency Graph for Buses.

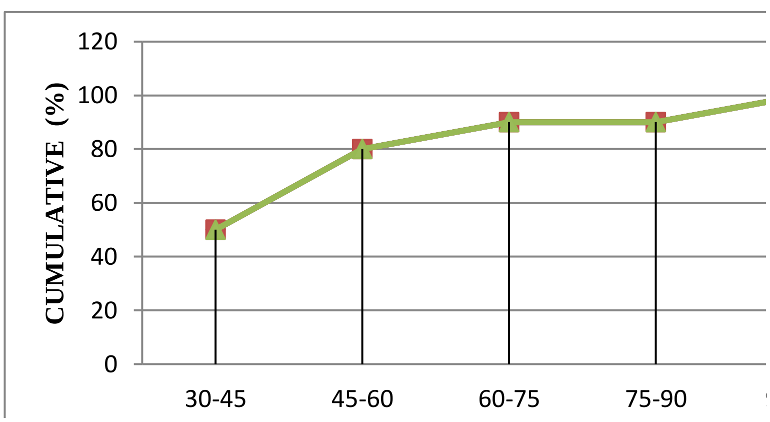


Fig.11: C-Frequency Graph for 4 Wheelers.

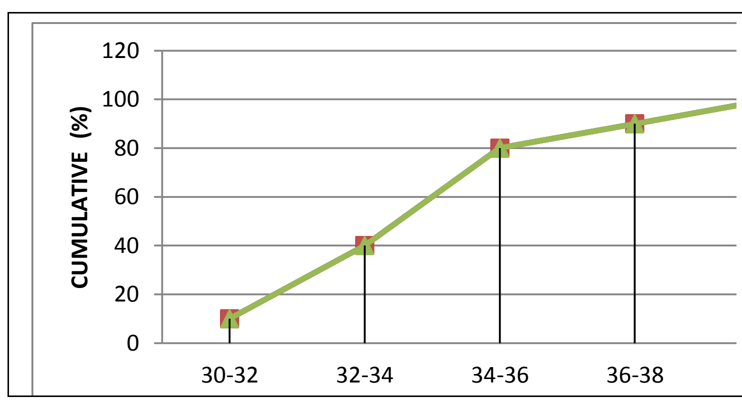


Fig.12: C-Frequency Graph for 3 Wheelers.

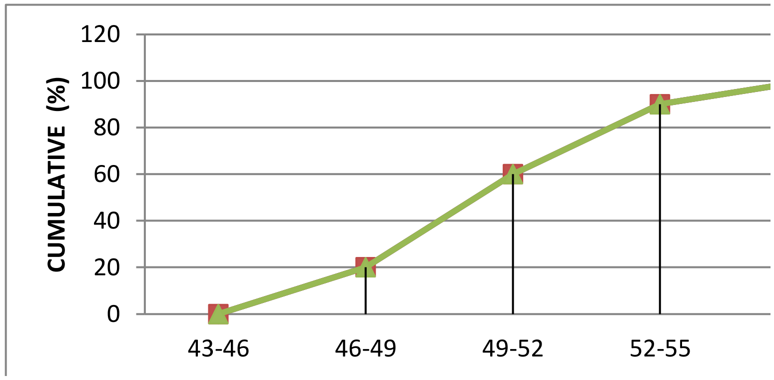


Fig.13: Cumulative Frequency Graph for 2 Wheelers.

3.2.4 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 98th 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.

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

Table 7: Percentile speed for the vehicles.

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

4. CONCLUSION AND RECOMMENDATIONS.

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 is utilized, then there are more chances of reducing the

Level of Service (LOS) to minimum level. From our study we have 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 speed 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.

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.

1. 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.
2. The traffic police mechanism system need to be reinforced, because during study, I have observed the scarcity of law enforcement agency.
3. Maintenance of road needs to be done so as to take commuters less travel time and smooth riding excellence.
4. The roads, shoulders and medians should be designed according to the volume on the roads and type of vehicles.
5. 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.
6. More focus should be given on public transport rather than private; this will help to reduce the congestion.
7. Parking facilities need to be improved, which also acts as commuters more travel time and due to this congestion comes into picture.

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