SPEED SPOT STUDY ON RAMA MANDI TO HOSHIARPUR ROAD BY COMPARING BETWEEN TIME MEAN SPEED AND SPACE MEAN SPEED

Submitted in partial fulfillment of the requirements

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by

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DECLARATION

I Javid Ahmad Khan (11209168) hereby declare that the dissertation work entitled **Speed Spot Study on Rama Mandi to Hoshiarpur road Jalandhar (Punjab) by comparing Between Time Mean Speed and Space Mean Speed** is an authentic record of my own work carried out as requirements of thesis for the award of M.Tech degree in Civil Engineering from Lovely Professional University, Phagwara, under the guidance of MR.AMIT KUMAR YADAV during JANUARY to MAY 2017. All the information furnished in this dissertation report is based on our own intensive work and is genuine.

Date: **Javid Ahmad Khan**

Place:

CERTIFICATE

This is to certify that the declaration statement made by this student is correct to the best of my knowledge and belief. He has completed this dissertation under my guidance and supervision. The present work is the result of his original investigation, effort and study. No part of the work has ever been submitted for any other degree at any University. The report is fit for the submission and partial fulfillment of the conditions for the award of M.Tech degree in Civil Engineering from Lovely Professional University, Phagwara.

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Lovely Professional University,
Phagwara, Punjab

ACKNOWLEGEMENT

This is report emphasizes all the necessary information as ―project problem I would like to say that the entire specified course is covered in this project report. I have done my dissertation in the university itself. This report is made by me. The project entitled SPEED SPOT STUDY ON RAMI MANDI TO HOSHAIRPUR ROAD BY COMAPRING BETWEEN TIME MEAN SPEED AND SPACE MEAN SPEED

I am very thankful to our faculty mentor MR.AMIT KUMAR YADAV and to the department of Civil Engineering in L.P.U.

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Finally I am very grateful to my parents who blessed me with their kind love and encouraged me in all stages of the work.

I seek your pardon if there is any fault in this report although. I have prepared this very carefully.

Signature of the student

JAVID AHMAD KHAN

ABSTRACT

Speed being an important factor in terms of safety, comfort, time and economics as we generally carries out the speed spot studies for the determination of speed percentiles and speed distribution of a free flowing traffic stream at a particular location. As the data we collect or gather will be evaluated and are then used for determine the speed limits usually two main percentiles are often used i.e. (50th and 85^{th}).which can be further analyzed for making important speed related decisions. The Aim of doing speed spot studies is to have a look at speed character .which are already existing on the road system as we know that traffic engineering generally involves collection of the data upon that factors the design speed is formed or posted for a particular road system as spot speed study is done for being an important traffic studies tool as it gives us idea about the traffic flow conditions under prevailing condition. As we know that usually the finial resource decrease with increasing population and due to increase in the traffic volume it has posed a challenge for the engineers to think about the situation and to handle large amount of traffic. As the data gathered from traffic theory are the important tools regarding the planning, designing and operational use of a road system due to rapid increase in the traffic volume it becomes very much difficult to maintain the design speed for a road system. Which results in the delay for reaching the destination or target point generally three parameters are to be used in the traffic theory are Volume, capacity and speed. The relation between these parameters has a great impact on traffic regulation and simulation. Speed data is collected on the mid-section of the 4 lane road stretch **Rama Mandi to Hoshiarpur.**in this study we have calculated the **Space mean speed** and **Time mean speed** and proven the relationship between the two i.e. **VT>VS**. This paper represents the traffic conditions on the road stretch **Rama Mandi to Hoshiarpur (NH3)** and tries to analysis the results obtained from the speed spot study during off-peak hours. From this paper we come to know about the recommendation for improvement in the existing road system to provide good level of service and to come up with the appropriate speed limits.

Key Words:: Speed, Volume, Percentile Speed, Speed Distribution, Level of Service (LOS),Time Mean Speed (VT), Space Mean Speed (VS)

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INTRODUCTION

1.1 BACKGROUND

Road network plays substantial part in social & economic program of a Country. Transportation sector is a dynamic element related with almost all activities of life. Road accidents are becoming serious problem in current situation all over the world. Road accidents due to traffic flow are the primary cause of death by injuries and overall 10th primary cause all over world according to (**WHO**):

- 1.2 million people die in road accident annually
- Total Number of victims that are injured or gets disabled in road accidents every year are about 50 million

Speed as being an important factor as it is concerned with the time, comfort, safety and economics as well. The quality of level and safety can be achieved by the speed on a given road system. We can define speed as the rate of movement of vehicle in a given distance per unit time. The typical speed units are kilometer per hour (kmph) or miles per hour (mph).time mean speed and space mean speed are the two types of speed .The Space mean speed can be defined as the average time taken by the various vehicles over the specific section or on the length of the section which are passing over that section. The Time mean speed or spot speed is the average speed at the spot of various vehicles at a given stretch. Spot study is carried out see the distribution of flow pattern under the prevailing conditions. Which are very useful in making many speed related decisions .Speed includes spot speed, journey speed and running speed. The main purpose of spot speed studies is to record speed characteristics under existing traffic conditions at a specific location along a roadway. Speed spot studies is an important element toward the engineering use as it provides the benchmarking of the speed percentiles which are further used in many speed related decisions like speed design ,managing of the traffic volume and posting of the speed limits.as we know that speed gets effected by no .of factors which include traffic volume and the type of road.as it can be observed that it is higher in case of express ways and highways and bit lower in the collectors and the street ways speed is also effected by the lane width and the sight distance As we know that Speed decreases with

an increase in traffic volumes. Traffic volume may be defined as the number of vehicles that passes a point along a roadway or traffic lane per unit time.

- It becomes compulsory to understand traffic speed characteristics as it is important requirement in the field of traffic engineering. As speed generally indicates the quality of service experienced by the traffic stream. To have knowledge of speed is an essential component of traffic engineering and projects related to geometric design of roads, regulation and control of traffic operations and improvements, accident analysis, before-and–after studies of road improvement schemes, assessing journey times, congestion along roads and in correlating capacity with speeds.
- The study we are conducting based on speed spot study so Spot speed is the speed or instantaneous speed of a particular vehicle when it passes a section over a given period of time. Spot speed is measured by the calculating the time taken by the vehicle to cross the section at a particular spot. These Spot speed studies are generally carried out to frame out the distribution curve for the road system and to analyses the median speed over the specific location on the cumulative frequency graph. Spot speed is generally measured by an enoscope, radar and timing procedures (stop watch method).Manually the speed spot study has been performed in order to carry out the whole process for our data and the data has been analyzed.

1.2 APPLICATIONSOF SPEED SPOT STUDY

According to **Robertson (1994)** some of the applications of speed spot study are as under:

1. Determining and evaluating prevailing traffic operations that are operated and evaluation

- Evaluation and determination of speed limits.
- Determination and Evaluating the percentiles (85^{th} and the 50^{th})
- Adjusting of the proper advisory speed limits to be designed.
- Setting out and establishment of no parking zones along the road surface.
- Traffic marking and signs and their proper placements along the road surface.
- The cycle time and their proper maintenance of the traffic signals.

2. Establishing of the design elements of the road elements

- By determining and establishment of the intersection points
- Sight distance and its proper passing sight distance

3. Assessing and monitoring the road safety purpose

- By verifying the data available with the speed related and problems related to speed
- Proper inspection and maintenance by investigating the matter from public as well as other officials
- By establishing the traffic trends and monitoring from ongoing the traffic studies.
- To measure the effectiveness of the use of the traffic engineering devices like signage, traffic markings and signals as part of national interest.

1.3 OBJECTIVES OF THE SPEED SPOT STUDY

- To measure speed spot speed and travel speed of vehicles and note traffic related Characteristics
- To present a detailed diagram of spot speed on the road stretch and calculate the travel speed calculations
- By calculating spot speeds and to prepare tables for statistical analysis of spot speeds.
- To draw or plot histograms, frequency and cumulative frequency curves of spot speeds.
- To determine average speed, pace, modal speed, speed limit (50th and 85^{th}percentile Speed) and design speed of spot speeds.
- To find Time mean speed (TMS) and Space mean speed (SMS) and to compare SMS and TMS.
- To determine and evaluating various parameters by using these speeds and also to prove some Relationships.
- To draw Speed (Space-Mean)-flow curve based on observed data that we collected.
- Superimpose typical speed-flow relationship diagram and find out the relationship.
- To find LOS (level of service) of the studied road and to draw detailed diagram.

1.4 WHY DO WE NEED A SPEED SPOT STUDY

There are many applications of speed and spot study as already mentioned above. There is other reason to conduct the speed spot study which includes:

- To determine traffic speed through high density roadways in order to show any need for speed limit signage, traffic calming measures or additional law enforcement that need to be taken into consideration for safety purpose.
- To determine proper speed limits, establish and setting of the for limiting of no pass zone and determine which includes assigning like traffic signs and road markings and to set appropriate signal time or cycle time of signal.
- To evaluate and verify speeding problems for a given stretch of road, by accepting speed as the main contributor to road accidents and crashes or to measure the effectiveness of traffic control devices.

1.5 SCOPE OF SPEED SPOT STUDY

- Traffic control applications or devices signage, markings and signals (yellow/all red timing – signal cycle time)
- Investigation and analysis of high-accident locations .where speed is important factor for the cause of the accidents.
- Educational use for the students who are associated with the highway and traffic engineering.
- To provide and to access the speed related decision on a roadway by analyzing its values like speed, geometric design, density and volume.
- Engineering use for planner to estimate the importance regarding the safety purposes as speed is a matter of concern in many crashes. SSD and OSD and their dependence on the speed.
- Traffic monitoring, traffic control and management of the traffic distribution existing on mixed traffic flow under prevailing conditions.
- Traffic law enforcement as a matter of national interest, traffic forecasting by predicating the causes and their impact as a matter of safety model calibration and validating.
- Traffic speed data are to be needed in planning phase, research phase, designing phase and regulation phase in traffic engineering is also used in establishing and developing priorities and schedules in traffic improvements.
- Traffic engineers obtain important information and knowledge to set different limits, setting different distances i.e. passing sight distance, stopping sight distance etc.

1.6 DESCRIPTION OF THE STUDY AREA

The study area that I have taken is a stretch between Rama Mandi to Hoshiarpur as it is shown on the map

Fig.1.61 Rama Mandi to Hoshiarpur Road Map (source: Google maps)

Speed spot analysis has been done on a stretch between **Rama Mandi – Hoshiarpur road (Apeejay School –vista resort)** as it is shown on the 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 Jalandhar city is connected with the rama Mandi to Hoshiarpur road stretch too it is compulsory to see the level of service provide by the road .as every year the growth of transportation sector increases on ground bases .by doing the speed spot study on the stretch we will be able to see the design speed posted or speed limits for the purpose of safety.

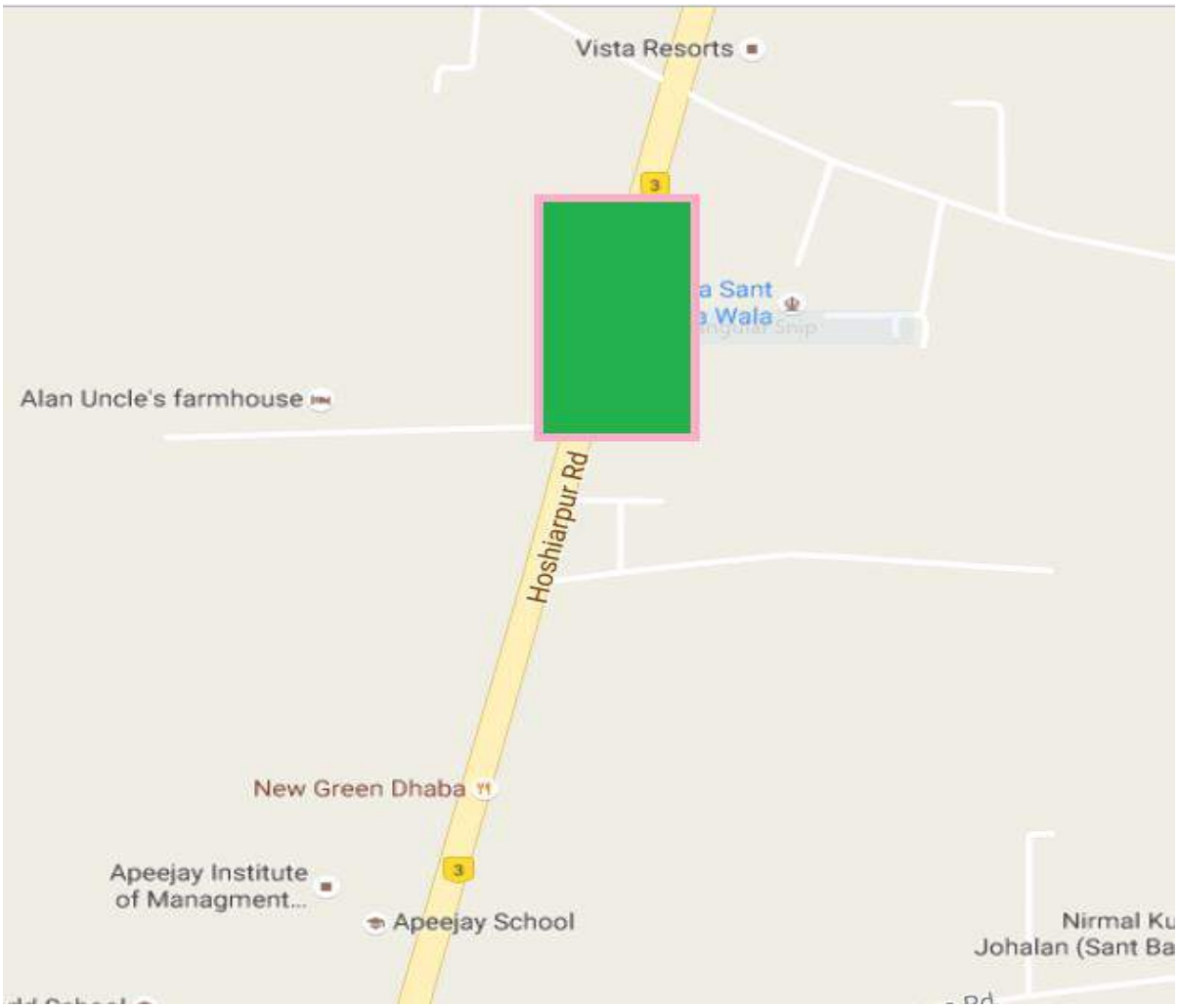

Fig.1.62: Location of the Study Points on the Map (source: Google maps)

CHAPTER-2

LITRATURE REVIEW

2.1 GENERAL

Speed being an important transportation consideration in terms of safety, comfort and economics .A lot of work has been done in the field of speed and spot studies .various studies upon the conclusion recommended various key factors responsible for the safety by analyzing the study of speed .some of the previous studies that I followed are as under:

1) **JAIME M.ABRHIM[1]:**highways are generally built for the society. They are not movable but they provide the service to the transport sector in turn which provides service to the humans for comfort.one of the main thing is the speed limit on Highways which are built by society for their comfort (Winch 1963).as one of the case study that is speed data from Ontario by using the institute of transportation .they suggested that the speed limits on the highway should be increased by using the method of 85^{th} percentile as the main asset according to that 85% of the drivers drive at the same speed under the free flow condition The method used is based on the 85th Speed percentile. This is the speed at which or below which 85 percent of drivers travel. It was observed that the speed limits posted on the specific location were not followed the site namely(401)the speed limit posted is 100 km/h but in real conditions it should be between 110-130 km/h and the other site that is (401) the speed limit should be increased from 105-110 km/h as on the existing ONTARIO highway
2) **A.K.M. ABIR[2]:**as we know that traffic engineering involves the use of different engineering methods to achieve the safe and efficient movement of goods and people along the road. Traffic flow is generally concerned with the safe and the efficient flow of traffic and in turn it is indirectly attached with the traffic flow pattern or distribution basically three parameters are prevailing in the traffic distribution that are volume, speed and capacity. In order to deal with the future needs the traffic management and planning to overcome needs the future needs of traffic related is to be done .due to change in the economic conditions the traffic volume has increased significantly and movement of the people towards city area for rapid growth of industrialization. Along with which the concern about speed have been rising for a long time. The current work

studies provide the traffic speed distribution in the city of Dhaka at a particular junction. Traffic speed data was collected and the analysis was carried out through primary

traffic flow surveys at Tejgaon fly over a junction to the Shatrasta round about in the Dhaka city the traffic speed data was collected by the manually method by speed spot.

3) **DIPAK K. THAKOR [3]:** in order to have a scientific planning of road system, it is important to have a proper data base of existing traffic parameters on the road system. The different traffic parameters have been observed and later evaluated on selected urban road, connecting Samarkhachokdi to Anand new bus station. Traffic volume study and spot-speed study have been conducted at both the ends of road system and analysis has been carried out. Capacity and level of service has been be carried out for this road. The speed spot was carried out with the manual method by timing procedure i.e. (stop watch method).
4) **DONALD S. BERRY AND DANIEL M. BELMONT[4]:**for designing and the operation of the speed limits it is important to have the idea of speed studies on the road flow pattern .Data gathered on the specific location is used for different engineering purposes .The study outlines different methods for analyzing distributions of vehicle speeds and travel times, correlates the relationship between speeds and travel times, it suggests which techniques is best suited for the requirements of the engineers, and points out the need of further study. The Highway Research Board of the National Research Council is now organizing a Committee on Speed Characteristics to assemble and analyze the related data on motor vehicle speeds under different conditions which includes physical, traffic, and environmental conditions. The work was done in the partial fulfillment in the University of California.
5) **Chu Cong MINH[5]:**a comprehensive analysis was carried out for the motor cycles and to analyses their behavior by the method of videotaping as some of the roads were having significant motor cycle proportion .for that purpose a site namely Hanoi and Vietnam has been found to ideal for data collection, as the road is undivided it contains mixed traffic conditions as it has exclusive motorcycle lanes. A relationship is to be framed between the flow and the speed on the specific and the location

adjustments were made for the present vehicles than motorcycles unit equivalent. Data were statistical and was further analyzed to demonstrate the speed behavior of motor cycles. The study will provide a basic understanding of the motorcycle behavior under the prevailing conditions on the road system. This can help in developing of new procedure for the highway capacity manual (HCM) which will be very helpful for developing countries like INDIA and provides the data needed to develop a simulation motorcycle modal.

6) **LI Ji-wei and JIANG Guiyang[6]:**by making use or utilizing the spot traffic elements as the data observation were recorded on the loop detector and by this we can estimate the average speed travel on the arterial road system more precisely and accurately ,and by later on analyzing the spot and the traffic parameters or elements and two main methods for estimation were formed and later on verified according to the need of the of traffic model simulation. The results yielded that the model significantly outperforms. The model that is made is entirely based on the modulus of coefficient and improves the estimation of the model and it possess higher degree of accuracy improves estimation effect of single model, and possesses during the period of congestion.
7) **LI Xinwei1 and WANG XiaoFei2**[**7]**:one of the basic method of safety operation freeway is obtained by the speed limitations posed on the road system it can be acquired by implementing the speed limits were systemically put forward to have complete excess on given road system which operates and serves freeway safety operation management and principles. One of the main objectives of the speed limit is to ensure safety application and economics related to the comfort level. Basically speed limits are assigned for the cause of the design purpose along the road system. By analyzing that study on different methods were adopted and for the purpose of implementation was at its priority, which includes speed limits, point speed limits and the sectional point and the speed limits over there. a case study was undertaken and have be applied to the Tongling- Tunaxi in the Anhui province .
8) **Shivam Vijayvargiya[8]:**A case study namely Vidisha NH -86 was analyzed for the purpose of speed analysis to determine the speed distribution and the normal

distribution on the road stretch and the speed percentiles was determined for making the speed related decisions .the main aim of speed studies is to gather the data and manipulate the data for design purpose or geometrical purpose for the field of speed character under the prevailing conditions. . As traffic engineering are involved in the collection and analysis of data for performing all types of traffic studies, as one of the studies is that spot speed study is also. As traffic volume increases every year and public financial resources goes on decreasing, and by targeting improvement in the big projects to anticipate growth patterns is critical. The work represents traffic condition on civil lines route Vidisha NH-86 Madhya Pradesh .speed spot studies have been analyzed and then comparing the

Time mean speed and space mean speed .speed related decisions regarding the speed limits have been analyzed

9) **Arash Moradkhani Roshandeh[9]:**the study was conducted on the Malaysia Federal route no 5 Skudai -Pontian- highway Speed spot study was conducted by the manual method by time measuring method (stop watch method) later the data was analyzed for various speed related decisions and traffic volume survey was also conducted to determine the capacity analysis of the road system. By observing the speed like spot speed, journey speed , running speed .basically three parameters volume, speed and, capacity were analyzed later on speed limits were observed on the observed data. Vehicle speed percentile (50^{th} and the 85^{th}) were analyzed.
10) **C.HU[10]:**n CHINA the speed his being violet very often as it results in the road accidents and as per the reports there were about 14.06% fatalities in road accidents in 2007, ahead of the main reasons for the accident, so the treatment of speed and validating the of speed limits is the main task of the traffic control department. The work generally covers the expected speed of driver; it basically studies the mechanism and its formation, and developing the interrelationship between the speed or model speed and the traffic volume model that is measured at the site or on the field .the model can be framed into an important tool for the effective controlling of the speed problems related to the road surface along the road system.as it is of great use for the

traffic police and helps in the improvement wherever it is needed The model can be of great use for traffic related problems.

11) **K.Ravinder**[11]**:**on (NH8 Delhi – Gurgaon)The speed - flow characteristics determine the fuel consumption and road user cost.it is important to understand the speed - flow characteristics, which directly dependent and influence the road user costs. In India, road transportation has come a special aspect that it plays a dominant role by virtue of its flexibility and the expansion that it has taken place in the road network and vehicle technology in the last three decades. The massive road expansion projects to six lanes and eight lanes are be taken into account in recent past it is important to study these changes in speed - flow characteristics along multilane highways, which will be helpful in estimating the road user costs. An attempt case study has been made to present the speed flow characteristics on Indian highways on multilane highways/expressways in plain terrain. For the present study NH8 Delhi – Gurgaon Access Controlled Expressway have been considered.

12) **W Muckerheide[12]:**because of the driving tends as to be the greatest risk to society on a daily basis and the fact is that there were many misunderstandings about traffic safety, the work has been done for public and includes substantial discussion in non-technical. Two hundred speed observation measurements were taken for free-flowing northbound traffic was taken near Sopa's restaurant in November in 2009, along with the Spot Speed Study criteria. The data was analyzed using a worksheet. The average speed is 48 mph by finding from data, 3 mph above usual the posted speed limit on the site. Speed limits are normally based on the 85th Percentile was (52 mph), average speed occurred at the 24th Percentile. The 10-mph pace speed is 43-53 mph and speed limits were suggested to be established at the upper limit of this pace speed. The Frequency Distribution is both extensive and heavily twisted positive several references showed that it should be more narrow lower speed variance or either symmetrical or else slightly skewed negative. Using the sources provided by the government six U-shaped curves from the lowest measured speed of 38 mph was set to be the equally-safe speed under free-flow conditions on the existing road to be approximately 64-65 mph, representing that actual un-safe speeds is greater than 65

mph under perfect conditions, a speed not extremely high if the posted speed is 10 mph too low

13) **Tanishita MasayoshiWee**, **Bert Van[13]:**speed variation and speed are generally supposed to be important issues in the accepting of traffic accidents. However there has not been a considerable amount of research which will emphases interaction between the mean speed and the rate of change of the mean speeds. Five-minute continuous intensive care data of the mean speed on a freeway (expressway in Japan). By Applying a two dimensional additive Poisson ratio model, we will come to know about not only mean speeds but also change in mean speeds affect per vehicle-kilometer traffic accident rates. The highest chances of an accident happen when speed reduces from 110 to 85 km/h. one more case of high accident probability occurs when the average speed increases from 65 to 90 km/h. it was also analyzed that accident rates are higher chances when there is sunny weather than when it is cloudy.

14) **Ana M. Pérez-Zuriagaand Francisco J[14]:**as the road design geometric process and their speed difference along the road section road is one of the basic or general method by which the consistency of the road can be understood like operating speed and its estimation is necessary and its deviations later on upon taking these considerations estimation models are built which are entirely based on speed spot data collection assuming some of the theories we generally assume

That the operating speed at the curves remains constant or same and the speed will be having some variations on the tangents. The work here in this paper emphasize the deceleration process by using the by (GPS) global positioning system devices. and by making use of these new models or the new methodology adopted perfect modes can be developed which yield good results and in this the hypothesis generally assumed ones can be checked and upon these studies can be carried out by this model. Making use of these models tangent to curve speed variations can be calculated by comparing it with the 85^{th} percentile speed differentials and the difference of the 85th percentile operating speed ($\Delta V85$)examining the percentage of slowing length that it takes at curves and by emerging two slowing representations with radius of horizontal curve and limitation of change curve as descriptive variables

15) **Boonsiripant , Saroch Hunter and Michael Guensler[15]:**Many studies classify potential relationships between speed characteristics and roadway safety More accurately the risk of crash involvement may be positively associated with speed variation and higher vehicle speeds are normally correlated with increased crash brutality Most previous studies usually depend on spot speed studies and by using automated traffic or manual method like counters or laser/radar guns at specific location on transportation services by assuming that spot speed capacities or measurements and laser speed outlines can be deliberated demonstrative of roadway operating speeds. However spot speed studies cannot detention the speed outline of each specific vehicle along entire route or driver/vehicle features that may pay to crash frequency. Use of GPS-equipped vehicle data acquired from the Travel Atlanta instrumented vehicle program to measure operating speed characteristics on urban streets in Atlanta, GA. It is has clear examined the relationship between the 85th percentile of supervised speed adjustment and crash frequency on these facilities. It is found that for given facility kinds, specifically collectors and local roads, speed adjustment may theoretically be used as a safety replacement in the development of a transmission tool to quickly categorize safety conditions on urban streets.

16) **P.Dav,S.Chandra,S. Gangopadhaya[16]:**as most of the presented studies in the collected works have generally agreed that the speed collected data on the highway stretch generally fallow the normal distribution. But the chances are that the it may fallow unimodal speed distribution in some cases the speed distribution might be a unimodal or it can bimodal. Bimodal

Curve is dependent on the variation of speed for different classes of vehicles which are moving on the highway. For these mathematical equations for the unimodal or bimodal speed distribution curves along different road highways here 17 different sectors have been carried out of two lane road ways in India.it was observed that that slow moving traffic volume is not the actual true pointer which can result in the bimodality in the speed data. From it the spread ratio can be defined as the difference between the 85^{th} percentile and the mean stream flow speed to the difference in the

mean traffic flow.15th percentile speed is improved connected by the plan of the speed distribution curve. The speed data follows the unimodal curve when the spread ratio is in the range of 0.69–1.35.

17) **L Karl[17]:**Speed shapes for motor vehicles on urban streets are subjective not only by the street design and traffic presentation, measures such as connections with pedestrians and cyclists, buses, on-street parking, departures from minor roads called side-friction events also affect driver performance. A bottom up research procedure was established and functional with a wide variety of immobile and mobile field surveys for study of separate driver behavior. Measured experiments in a driver emulator programmed to represent the studied field sites were also carried out. Speed outlines showed good similarity between pretend and experimental behavior for the event pedestrian approaches a crosswalk. Simulated speed performance of drivers passing an occupied bus stop showed that women drove with a lesser speed than men did. The results showed that crossing walkers engaged roadside bus stops and encounters with vehicles in the opposing direction of travel had a significant impact on driver speed choices.
18) **C Rodrigues[18]:**the method of speed spot forecast in a two-lane highway. The main aim is to assess the speed factor system by giving superior focus on the geometric elements on the road section and to fix those elements.fo this purpose to flexible models were made for two different or dissimilar and by determine heir operating speed is estimated as the function of road geometrics and one sided complaints contributes to the change in the driving behavior and the vehicle charters permitting the estimation of the any speed percentiles of the roads. The models are appropriate to horizontal curves and tangents and deliberate both on-site characteristics and combined variables characterizing the road section. The result demonstration is a rich influence of section features on different percentile spot speeds, illuminating that recent driving experience And prospects about the quality of the geometric design influence the way a driver approaches a precise road component. This study contributes to addressing some of the limitations of existing speed models identified

19) **B Paul,U Jaina and L.Joy**[**19]:**by developing the 85th percentile speed or the operating speed models at the curves it can be arranged or combined at the mid curve is generally based on the shoulder width, degree of the curve radius and the length of the horizontal curve .it was done on the Kerala two lane rural highway condition. The data collected is based on the speed data quantity at a particular section or point and the survey was done by the manual method by hand stop watch method. The geometric limits or elements such as radius of curve, width of shoulder, length of the curve all these limits are to be analyzed and to see their impact on the operating speed models at the mid- curve and 85thpercentile operating speed prediction model can be used for the regression or liner or multiple investigation purpose to predict the growth rate by the model. Which can result in the better and into the current standards of Kerala, it will play an important role in the designing purpose or reshaping of the horizontal alignments for the road system.

20) **E. Rosen,U.Sander[20]:**it is good to have Knowledge of the quantity of fierceness accepted by the human body is vital while developing and applying pedestrian safety approaches. When approximating the possible aids of new countermeasures, the pedestrian fatality risk as a function of effect speed is of specific position. By proper understanding. Constructed on the largest in-depth, pedestrian accident study undertaken to date, derive a better-quality risk function for adult pedestrians hit by the front of passenger cars. The results show far lower fatality risks than generally reported in the traffic safety literature. As compared to the towards severe injury accidents in earlier studies. However, a strong requirement on impact speed is to be found with the fatality risk at 50 km/h is more than twice as high as the risk at 40 km/h and being more than five times higher than the risk at 30 km/h in precise, the range of future pedestrian safety policies and research should be widened to include accidents with impact speeds exceeding 50 km/h.

CHAPTER-3

APPROACH AND METHODOLOGY

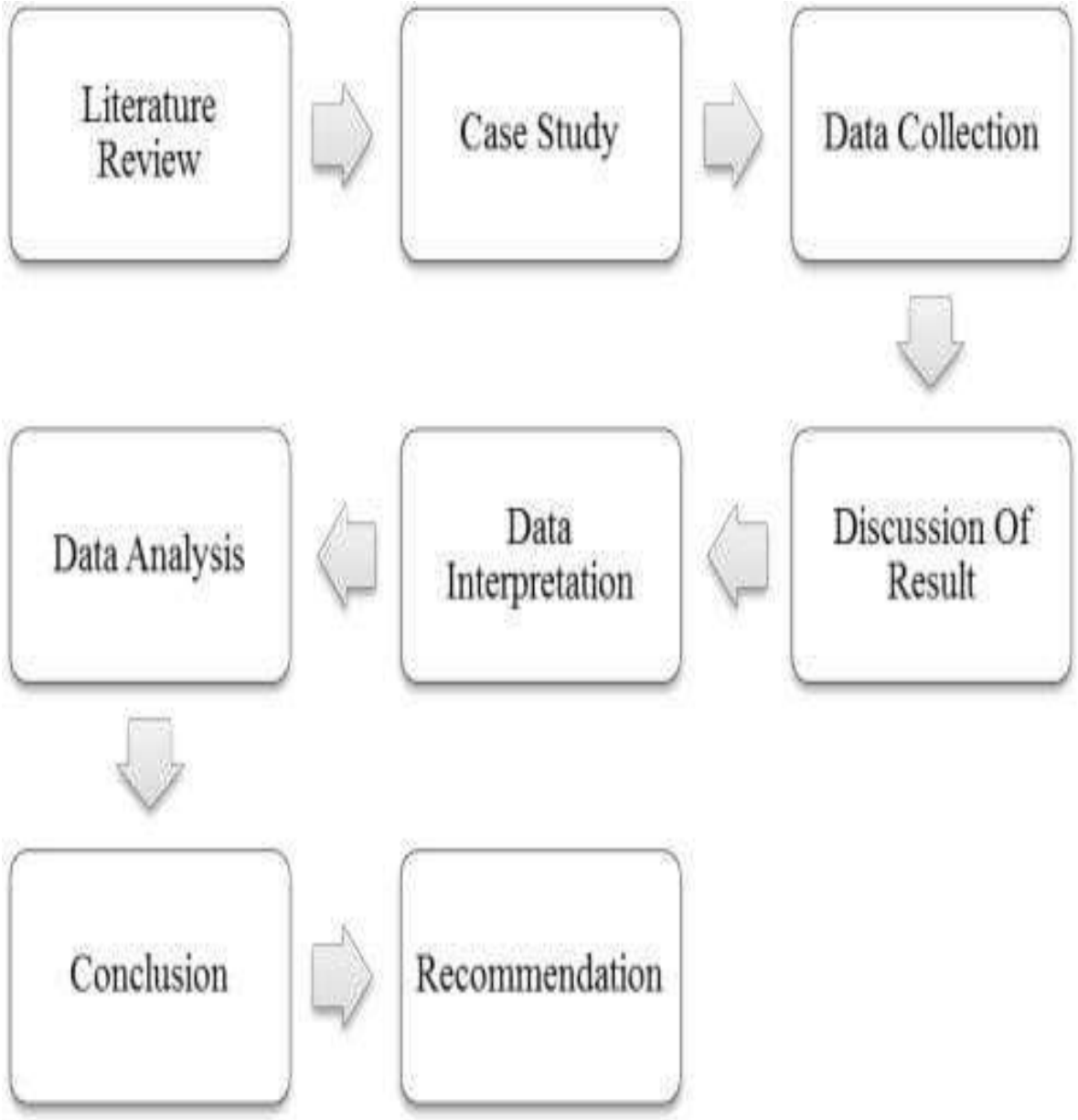

Fig.3.11: Methodology chart (source: flow diagram made manually)

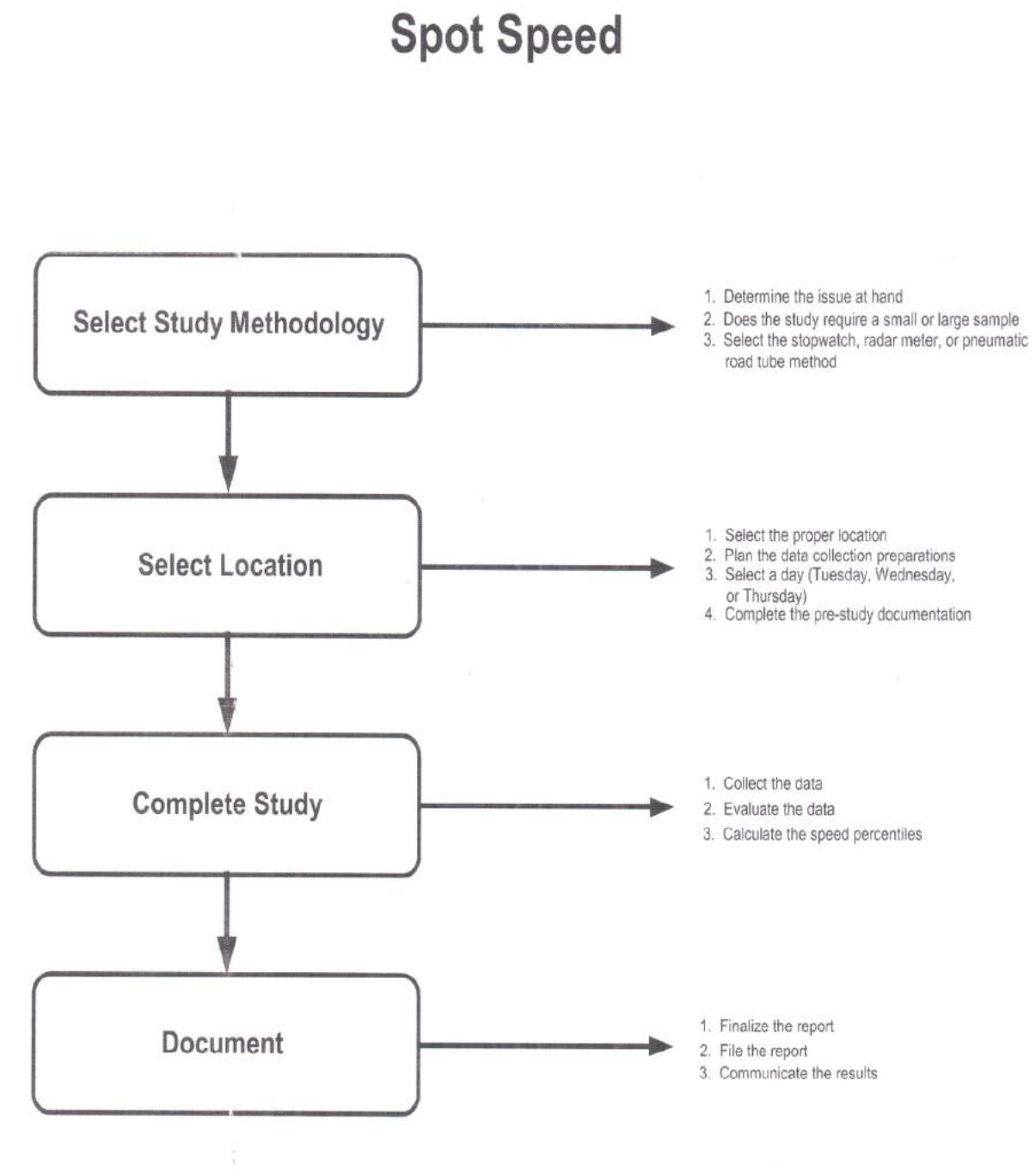

Fig.3.12: Flow Diagram for Spot Study (source: Dataflow guides)

3.2 SPEED STUDIES

Speed is an important transportation consideration 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 speed. As speed is the one of the important factor of the quality travel and safety of road system.by the definition of speed it is the rate of movement of vehicles and the distance it covered in per unit time. The unit of speed is kilometers per hour (kmph) or miles per hour (mph.).one of the main purpose of the speed stud is to determine the traffic parameters like operating speed and speed spot .spot speed are usually taken over a short section to analyze the traffic parameters and to establish the speed percentiles. The intent is to determine the speeds that drivers select, unaffected by the existence of congestion. This information is used to determine general speed trends, to help determine reasonable speed limits, and to assess safety.

3.2.1 DEFINATIONS

1. **Running speed**: It can be defined as the average speed that is maintained over a particular course over a section when the vehicle is traveling and can be calculated by dividing the length of course by the time duration that it takes to cover the distance when the vehicle was in motion
2. **Journey speed**: It can be defined as the speed or effective speed of the vehicle when it is having a journey between two destination points divided by the total time taken to reach that destiny which includes stopped time.
3. **Time mean speed**: It may be defined as average speed of all the vehicles passing over a particular section on the road for a specified time period.

4. **Space mean speed:** 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.
5. **85th Percentile Speed**: The speed at or below which 85 percent of a sample of free flowing vehicles is traveling; this is typically used as a baseline for establishing the speed (based on a spot speed study.
6. **95th Percentile Speed:** The speed at or below which 95 percent of a sample of free flowing vehicles is traveling (based on a spot speed study).
7. **Median (50th Percentile Speed):** The speed that equally divides the distribution of spot speeds 50 percent of observed speeds are higher than the median; 50 percent of observed speeds are lower than the median.
8. **Mode:** The number that occurs most frequently in a series of numbers.
9. **Speed Variance:** The difference in travel speeds for vehicles on the road. Mathematically, variance is the average of the squares of the difference to the mean for each observed speed
10. **Pace:** A 10 mile-per-hour increment in speeds that encompasses the highest portion of observed speeds; often is the mean speed plus/minus five miles per hour.

Basically two types of speed that is **Time mean speed** and the **Space mean speed** we can define **TIME MEAN SPEED** as the average speed at a particular spot of several vehicles .while we can define **SPACE MEAN SPEED** as the length of the section divided by the average time taken by the various vehicles at a particular section for the geometric design purpose of the road it is necessary to have the idea pf speed studies in order to estimate the realistic time of speed over the road section and at which speed vehicles travel over the speed. And upon the basis of speed studies we can categories that design speed or speed limits and other related geometric elements including the horizontal curvature, vertical curvature, sight distance and super elevation. These are important factors in terms of road safety all are based on the speed studies.

As we know that speed spot studies are generally conducted to have an estimate of the distribution of vehicles or flow pattern under the free flow conditions at a particular section on the highway system. This analysis is carried out by recording the speeds of the vehicle sample over that specific location and generally when measure or we have to analyze the studies over a short distance and we usually prefer spot studies. When we measure the traffic parameter over a short distance, spot study is carried out by measuring a short distance depends on the design speed taking that stretch according to the guide lines of IRC on the highway section. As we know that speed spot is carried out to have an idea regarding the speed distribution on the road system and the data gathered then can be used to have the speed percentile analysis and many other speed relate decisions. Generally speed spot study has many safety applications which are as under:

- Speed trends and their usage
- Automatic traffic control planning
- Good tool for accidental analysis
- Designing tool like geometric elements
- Education and research use

3.3SPEED SPOT

Speed spot study can be defined as the average or the instantaneous speed over a particular section and the time taken to cover that section. Well as we already know that speed spot studies have no. of applications like it can be used for geometric purpose, estimation of future traffic conditions .and becomes compulsory to have a proper estimation of the design speed on the road as the traffic volume in years goes on the increasing note .in order to facilitate the good travel period we need to have a proper eye on the speed consideration as it relates to safety, time and economics. It can also be used in designing the curves like horizontal and the vertical and to establish the speed, sight distances and super-elevation can be determined. Spot Speed studies are directed to estimate the distribution of speeds of vehicles in a stream of traffic at a particular location on a highway.

3.3.1 APPLICATIONSOF SPEED SPOT STUDY

According to **Robertson (1994)**some of the applications of speed spot study are as under:

1. Determining and evaluating prevailing traffic operations that are operated and evaluation

- Evaluation and determination of speed limits.
- Determination and Evaluating the percentiles (85^{th} and the 50^{th})
- Adjusting of the proper advisory speed limits to be designed.
- Setting out and establishment of no parking zones along the road surface.
- Traffic marking and signs and their proper placements along the road surface.
- The cycle time and their proper maintenance of the traffic signals.

2. Establishing of the design elements of the road elements

- By determining and establishment of the intersection points
- Sight distance and its proper passing sight distance

3. Assessing and monitoring the road safety purpose

- By verifying the data available with the speed related and problems related to speed
- Proper inspection and maintenance by investigating the matter from public as well as other officials
- By establishing the traffic trends and monitoring from ongoing the traffic studies.
- To measure the effectiveness of the use of the traffic engineering devices like signage, traffic markings and signals as part of national interest.

3.3.2 PURPOSE OF THE SPOT SPEED STUDIES

The various purposes of speed spot are designing phase, planning phase and the research phase .Some of the other purposes are as under

A). **Design purposes:**

a) Structural and geometric design of pavements, bridge, and other highway facilities. Structural design is based on repetition of wheel load on the pavement in entire design life. AADT is needed with traffic growth rate to compute design wheel repetition. Geometric design is based on peak hour volume to avoid congestion.

B). **Improvement purposes:**

a) To allocate limited maintenance budget rationally, it is important to know the traffic carried by a particular roadway section in order to decide the importance of the road and fixing its relative priority.
b) To examine the existing operating service condition of a roadway section.
c) To check the need (warrant) traffic control devices determine
d) The type of improvement measure needs to be taken.
e) To measure the effectiveness of traffic control measure

C). **Planning Purposes:**

a) To give Accurate information on the amount of traffic on the roads is vital for the planning of both road maintenance and improvement policies
b) To make Expansion in terms of construction missing links, by-pass, alternative road etc.

D). **Dynamic Traffic Management Purposes:**

a) Up to date and continuous flow congestion information is essential for optimizing.
b) Traffic signal design and thereby improving junction performance
c) Network productivity by providing information to the road user

3.3.3 SPEED SPOT DATA IS OBTAINED BY FOLLOWING METHOD

- Stop Watch Method
- Radar Meter Method
- Pneumatic Road Tube Method

3.3.4 STOP WATCH METHOD:

It is one of the easy way to find out the speed spot study in stop watch method is generally used for small sample size which is taken over a short section on high way for a small period of time The .This method is quick and inexpensive for the collection of data stopwatch method is a quick and Inexpensive method for collecting speed data

Key steps in stop watch method

- Acquire suitable length for study.
- Choice appropriate site and its layout.
- Recording the observations from stop watch observations on stopwatch.
- Determine the vehicle speed
- Create frequency distribution tables from the data gathered and determine the speed percentiles from the data table

Fig. 3.31: stop watch (source: Google image)

3.3.5 PROCEDURE FOR STOP WATCH METHOD FOR SPEED SPOTSTUDY

- Two observers are at the starting point one holding stop watch and other one with pen and the sheet to write down the readings
- The third observer is having a flag in his hand at the end point of the section to indicate the vehicle has crossed the section
- As the vehicle enters the section the stop watch is started as soon as the front wheels touches the reference line
- The third observer standing at the end point raises the flag to indicate the vehicle has crossed the section
- As soon as the flag is raised the stop watch is stopped and the elapsed time taken by the vehicle is noted down on the sheets
- This procedure is simultaneous carried out for different group of vehicles
- Sample size of usually 50(10 trucks ,10 buses ,10 four wheelers ,10 three wheelers and 10 two wheelers) is generally carried out on the site to yield good results
- After analyzing the time elapsed by individual vehicle the vehicle speed is calculated for every vehicle to cross the section
- After calculating the speed ,normal distribution and cumulative frequency distribution are carried out to find out the speed percentiles
- Usually (50^{th} and 85^{th}) percentiles are carried out to find out the desired speed limits on particular road system
- Bar charts and the graphs are made on the excel sheets to carry out the further requirements for speed percentiles
- Time mean speed and space mean speed are analyzed and their relationship is to be analyzed for the particular road system

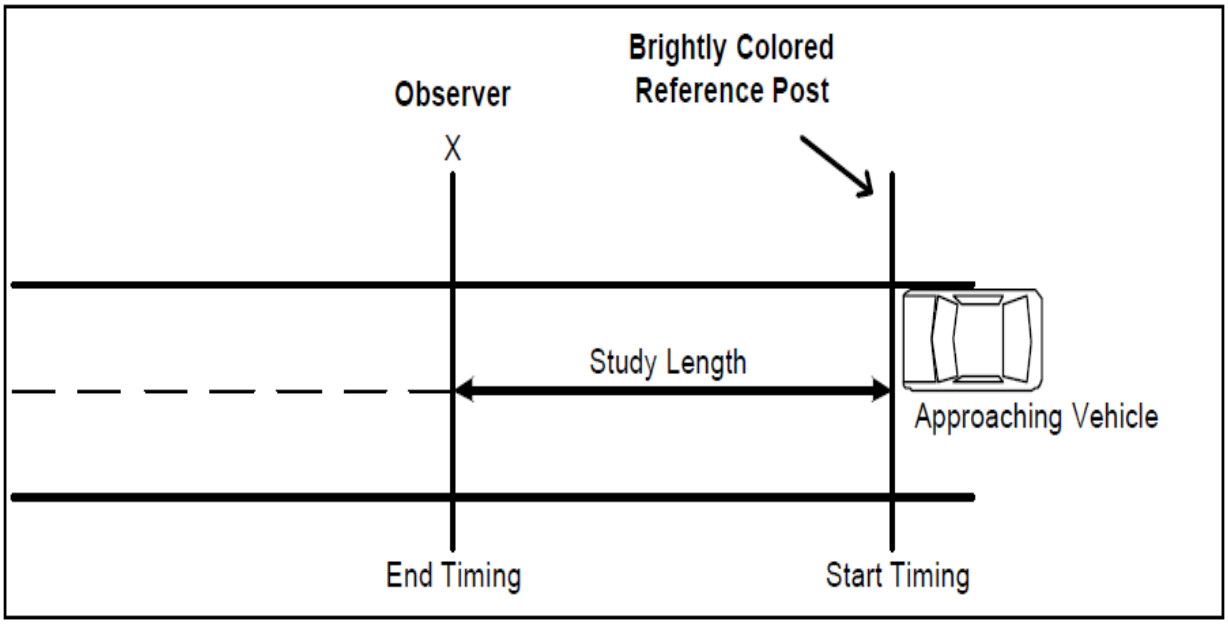

Fig.3.32: layout of the stopwatch speed spot study (source: user guide sparx)

Preparation or checklists for stop watch method

- A tape (60)m
- Stop watch
- Data collection forms
- Reference points at the two ends
- Select time and day
- Consult local enforcement authorities
- Observers three (3)

3.3.6 SELECTION OF SITE CRITERIA

- For this purpose any location can be taken where the traffic is flowing under free flow conditions.
- The road geometry should be plain without any obstruction or slope.
- In order to get the accurate results the road condition should be such that driver should be comfortable driving.
- There should not be any intersection which may result in the different behavior of the drivers.
- There should be no speed breakers or the precaution signs and the driver should be travelling with the natural style
- It is required to have experimentations under the free flow of traffic on the road system E
- The drivers should not aware of the situation while experiment is going on.

3.3.7 Length of section by IRC Guidelines

According to the IRC guide lines have been provided for selecting the required length in order to do the speed spot study for National Highways table 3.3.1 is providing the information for the appropriate length that we need to choose for speed spot study

Table 3.31: IRC guidelines for selecting length

Stream speed(KMPH)	Length in (M)
Less than 40	27
40 to 65	54
Greater than 65	81

3.3.8PROCEDURE FOLLOWED

- Two observers are at the starting point one holding stop watch and other one with pen and the sheet to write down the readings
- The third observer is having a flag in his hand at the end point of the section to indicate the vehicle has crossed the section
- As the vehicle enters the section the stop watch is started as soon as the front wheels touches the reference line
- The third observer standing at the end point raises the flag to indicate the vehicle has crossed the section
- As soon as the flag is raised the stop watch is stopped and the elapsed time taken by the vehicle is noted down on the sheets
- This procedure is simultaneous carried out for different group of vehicles
- Sample size of usually 50(10 trucks ,10 buses ,10 four wheelers ,10 three wheelers and 10 two wheelers) is generally carried out on the site to yield good results
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- After calculating the speed ,normal distribution and cumulative frequency distribution are carried out to find out the speed percentiles
- Usually (50^{th} and 85^{th}) percentiles are carried out to find out the desired speed limits on particular road system
- Bar charts and the graphs are made on the excel sheets to carry out the further requirements for speed percentiles
- Time mean speed and space mean speed are analyzed and their relationship is to be analyzed for the particular road system

3.4 EXPERMENTATION

3.4.1 Equipment's required

1. **Stop watch**
2. **Measuring tape**
3. **flag**

A section of 60 m was taken on a road section (**Rama Mandi to Hoshiarpur**) near the Apeejay institute speed spot study was done for sample size of 100 vehicles which includes trucks, buses, three wheelers, four wheelers and two wheelers the day was sunny. Dated (21, 22, 23, 24, 25) November 2016 .the observations were done for 2 hr for every particular class on consecutive days during off peak hours.

Fig.3.41: marking reference lines on the stretch (Rama Mandi-Hoshiarpur) NH-3(source: image taken by camera phone)

In the work to carry it to the experimental part we require at least three observers to carry out the speed spot on the site on the highway system. After analyzing all the necessary important factors in selecting the site .a stretch of 60 m was taken by measuring it with a tape .two observers will stand at the initial point where the vehicle is approaching one with the stop watch in hand and the other one with the speed sheet in hand to write down the time elapsed or time taken the vehicle to cross the section and the third observer is at the end point to give the indication of the leaving the vehicle from the section.

After all this setup the test sample are evaluated of different classes and analyzing their speeding behavior and once the observers are set in the right position the test samples may be selected randomly and the observer standing at the initial first point will start the stop watch as soon as the vehicle approaches enters into the section and will stop the stop watch when the vehicle leaves the section .the third observer will wave the flag indicating that the vehicle left the section .the stop watch should be stopped immediately as soon as the flag is waved and the time taken by the sample should be noted down.

Fig.3.42: observer at the starting point writing the readings observed on stop watch (source: image taken by camera phone)

Other observer is at the end point gives the indication of the vehicle that leaves the section .the observer with stop watch looks at the indication at its stops the stops the stop watch imeadietly and the observer writing down the total time elapsed by a paticular vehicle to cross the sectionlater on the speed of the vehicle is calculated

Fig.3.43: observer at the end point (source: image taken by camera phone)

3.5 THE SPEED SPOT DATA IS GATHERED IN THIS TABLE AS SHOWN

The data obtained from the site is written in the speed sheet which is shown below in table 3.51

TABLE 3.51: SPEED DATA SHEET

Spot Speed Study
Data Collection Form

Location:_____ Observer/s (group #)_____
Date:_____ Time:_____ Direction of Travel:_____ Posted Speed:_____

Weather Conditions: _____
Safety officer_____

Vehicle number	Speed, mph	Vehicle number	Speed, mph	Vehicle number	Speed, mph	Vehicle number	Speed, mph

3.6 Calculation of vehicle speed

To calculate vehicle speed, use the predetermined study length and the elapsed time it took the vehicle to move through the course (as recorded on the stopwatch data form) in the following formula (Robertson 1994):

V =D/1.47*T **(3.61)**

Where

V = spot speed (mph), *D* = length (feet), and

T = elapsed time (seconds). In the equation,

1.47 is a constant that converts units of feet per second into miles per hour.

For example, if the spot speed study length is 100 feet and the motorist's elapsed time is 2.5 seconds motorist is traveling at

100feet/1.47*2.5 =27mph **(3.62)**

3.6.1 Determination the 50th and 85th percentile speeds

$$SD = \frac{\text{PD} - \text{Pmin}(\text{Smax} - \text{Smin}) + \text{Smin}}{\text{Pmax} - \text{Pmin}}$$

Where,

SD= speed at PD

PD= percentile desired

P max= higher cumulative percent

P min= lower cumulative percent

S max= higher speed

S min= lower speed.

3.6.2 SPEED PERCENTILES AND HOW TO USE THEM

Speed percentiles are the usually the speed limits that are generated to determine the effective adequate speed limits. Usually two main percentile limits are used commonly (50^{th} and 85^{th}) percentiles. The 50^{th} percentile is the average or median speed in which 50% of the vehicles tend to flow on the average speed that is 50^{th} percentile for that group of class of vehicles along the road section.85^{th} percentile is usually used to set the design speed over a road system or we can say 85% of the drivers of vehicles tends to travel at or below 85kmph or it is safe design speed for a particular road system.it can be used in recommending or evaluating the posted speed limits.85^{th} percentile is normally considered to be safe maximum safe speed on a particular road system or required design speed .98^{th} percentile speed is generally used for the design geometric purpose or to assign the design speed for the road way system

Well Speed percentiles will get affected by the obstruction posed on the road system, bad weather like in rainy time we may get other results. That is why spot speed is carried out on a sunny day traffic flow should be free, there should not be any sort of obstructions that may affect the driver's behavior

Speed percentile is calculated by this formula

$$SD = \frac{\text{PD} - \text{Pmin}(\text{Smax} - \text{Smin}) + \text{Smin}}{\text{Pmax} - \text{Pmin}}$$

Where,

SD= speed at PD

PD= percentile desired

P max= higher cumulative percent

P min= lower cumulative percent

S max= higher speed

S min= lower speed.

3.6.3 THUMB RULE IN SPEED PERCENTILES

A thumb rule generally 5-mph is some time used for the determination of the of the 85^{th}percentile of too high as compared to observed or the actual posted speed limit 5-mph.and in some cases if the 85th percentile of speed is 5mph or more above the speed that is posted at that time the situation need to be evaluated. And in case if the 85^{th} percentile is 3.4 mph above the posted speed limit, it will not be having issue. and if the situation occurs like if the 85^{th}

percentile speed would be 5 mph or more above the posted speed limit .It is recommended to take the following steps for its adjustment the following actions could have been considered:

- We need to adjust the speed limits that are posted.
- By increasing the speeding enforcements or laws.
- By maintaining the traffic calming measure by recruiting it.
- Make public awareness and to make special efforts to conduct about it.

3.7 RADAR METER METHOD

Radar meters are most of the time or frequently being used to carry out spot study. In this speed can be directly measured by measuring the frequency difference in between the emitted and the reflected wave by the radar for the coming vehicle. The radar meter targets the vehicle and the waves ,frequency between the emitted and the reflected wave gives the actual measurement of the vehicle travelling on the road system It is radar meter which is targeted to a vehicle, so the wave, the frequency between the emitted and reflected wave that the difference is used to calculate the speed. Normally Doppler Effect comes into play in this whole process and it works on principle of Doppler Effect.

This is recent advancement made toward the field of traffic engineering for collecting the data of speed studies as it collects automatically and records and employs a radar transmitter receiver unit. The radar meter transmits high frequency of electromagnetic in a narrow beam toward the targeted vehicle moving in the line of sight. The frequency gets changes depend upon the speed of the vehicle and the data gets collected into the receiver unit. And upon the calibration we get the data of speed study of vehicle .these radar meters are generally used by the traffic engineers, traffic police. Radar meter has some of the practical limitations which are as:

- In most of the cases when the traffic volume is flowing under the normal conditions .there are possibilities of recording the wrong the inputs as may be the test sample gets obstructed by the other vehicle
- And the accurate results of speed are measured accurately from radar gun or meter only when the wave reflected goes directly along the axis of movement.in some case it is not possible

Fig.3.71: radar meter (source: google image)

the wave reflected back depends upon the size of the vehicle and the detection of the observation may affect as big vehicles like buses, trucks send the strongest signal in return to the radar meter and for the small vehicles it may sometimes not get detected the .and for that cases the readings should be noted separately for small and large vehicles . some vehicles are having the radar detector which may result in the different behavior of the drivers as radar unit is operating in that vicinity .and the drivers may slow down their speed of the vehicle .this may affect the study Drivers will slow down when warned by a detector.

Key steps in radar speed method includes

- Choice appropriate site and location of the radar meter gun
- Define a suitable collection approach
- Recording of observations on radar meter for speed spot data form.
- Make frequency circulation board and then determine the speed percentiles.

It is required to have proper placement of the radar meter for the study as otherwise it may yield in different results the line of sight should be parallel to the approaching vehicle. Keeping g the radar meter in the right position is determined by the capabilities of radar unit the effective range of radar meter ranges up to 2 miles but as the distance increase the effectiveness of the results decrease. An accurate sketch of the site should be documented, including number of lanes, position of observer, and description of reference points.

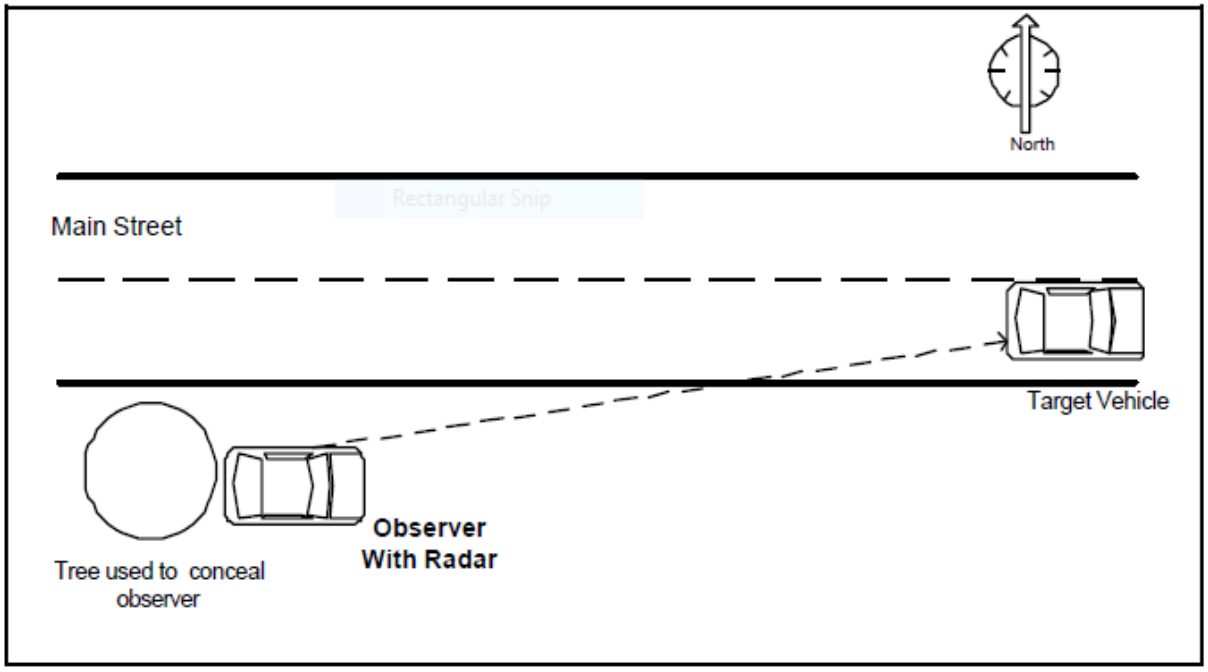


Fig.3.72: Radar gun layout for taking readings (source: user guide sparx)

3.8 PNEMUTIC TUBE METHOD

The pressure contact strips are mainly of pneumatic or electric .They are used for recording the information of the vehicle entering and leaving the section or base length in this process when the vehicle pass over the first reference tube laid on the road an impulse s sent .which activates an electromagnetically and controls the stop watch in the hands of the observer. And when the vehicle touches or enters the second reference tube on the road surface it automatically stops the stop watch. And the reading are noted down or saved into the computer. This method is generally used for longer data collection time periods as compared to those of stop watch and radar meter .these tubes are placed on the roads in the travel lanes are connected to the recorder which is located inside at the road section.

Fig.3.81: pneumatic road tubes (source: google image)

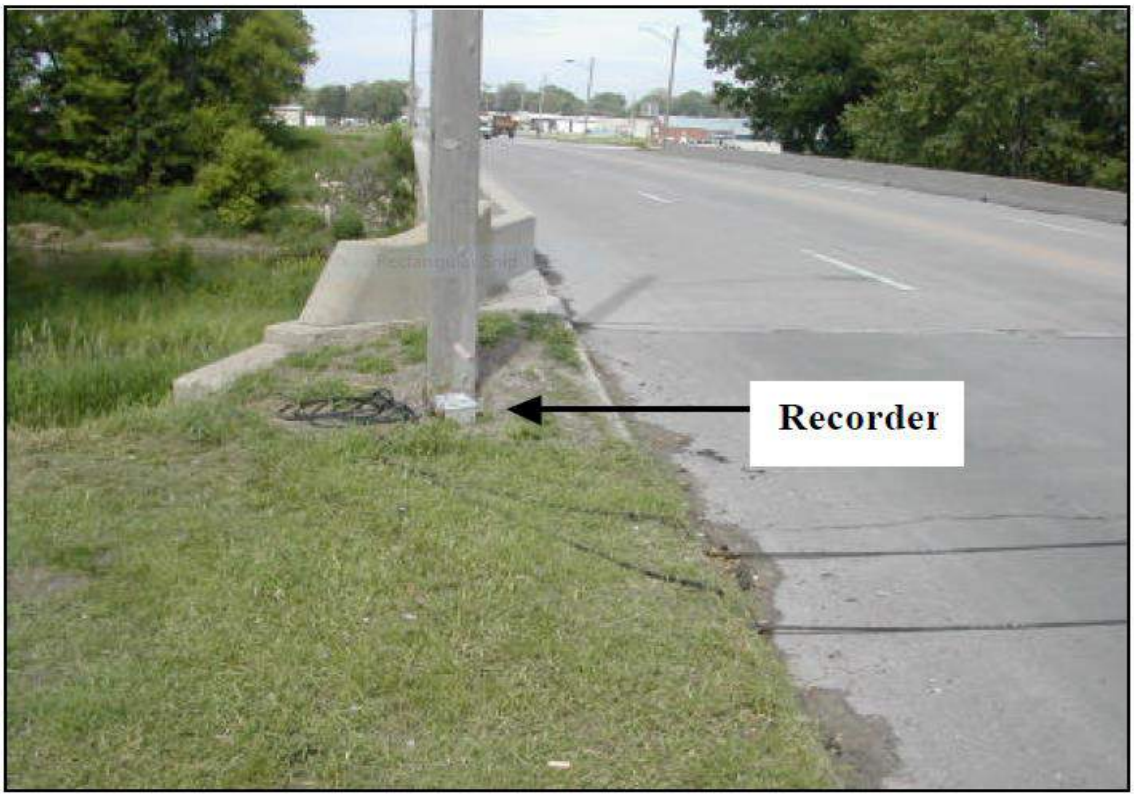


Fig 3.82: Road tubes and recorder (source: google image)

The recorder is automatic and it can store the data as it is capable to store a large amount of data of the individual vehicle or large amount of traffic volume the data is stored automatically. Later on the data can be downloaded from the recorder to a computer or laptop or portable disk drive.

Key steps in the pneumatics tube method

- Do important office preparations as it requires the grant the permission
- Organize and adjust data collection instruments
- Check the data and recover equipment.
- Produce the frequency distribution tables and then determine the percentile speed.

CHAPTER-4

DATA COLLECTION AND ANAYLISIS

4.1 GENERAL

The data was collected on the **Rama Mandi-Hoshiarpur (NH3)** a stretch between **(Apeejay institute-vista resorts)** was taken to analyses the speed spot of the group of vehicles .the study was done on 21.11.2016 the observations were taken (12-2) pm for five days during off peak hours up to date 25.11.2016 .A sample size of 50 vehicles was taken to analyze their speeding behavior on the particular stretch .the sample size consists of 10(truck),10(buses),10(four wheelers),10(three wheelers) and 10(two wheelers).A stretch of 60m was taken as per IRC guidelines as National Highways have a design speed of (80-100) kmph.A simple procedure was followed which is as under:

- Two observers are at the starting point one holding stop watch and other one with pen and the sheet to write down the readings
- The third observer is having a flag in his hand at the end point of the section to indicate the vehicle has crossed the section
- As the vehicle enters the section the stop watch is started as soon as the front wheels touches the reference line
- The third observer standing at the end point raises the flag to indicate the vehicle has crossed the section
- As soon as the flag is raised the stop watch is stopped and the elapsed time taken by the vehicle is noted down on the sheets
- This procedure is simultaneous carried out for different group of vehicles
- Sample size of usually 50(10 trucks ,10 buses ,10 four wheelers ,10 three wheelers and 10 two wheelers) is generally carried out on the site to yield good results
- After analyzing the time elapsed by individual vehicle the vehicle speed is calculated for every vehicle to cross the section
- Usually (50^{th} and 85^{th}) percentiles are carried out to find out the desired speed limits on particular road system
- Bar charts and the graphs are made on the excel sheets to carry out the further requirements for speed percentiles
- Time mean speed and space mean speed are analyzed and their relationship is to be analyzed for the particular road system

4.2 SPEED DATA

The observation were done for consecutive five days for different section the observations were done for two hours every day for different classes table 4.21 gives us data on site for TRUCKS and BUSES

Table 4.21: speed data calculation

SPEED SPOT STUDY							
DATE:21/22.11.2016				START TIME: 12PM			
NAME:JAVID KHAN				END TIME: 2 PM			
LOCATION:NH-3(RAMA MANDI –HOSHAIRPUR ROAD)				WHEATHER: SUNNY			
TRUCKS				BUSES			
Dist. M	Time Sec.	Speed m/s	Speed km/hr.	Dist. m	Time Sec.	Speed m/s	Speed km/hr.
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

Below given table 4.22 is the data that we obtained for the another two classes that is Four wheelers and Three wheelers

Table 4.22: speed data calculation

SPEED SPOT STUDY							
DATE:23/24.11.2016				START TIME: 12PM			
NAME:JAVID KHAN				END TIME: 2 PM			
LOCATION:NH-3(RAMA MANDI –HOSHAIRPUR ROAD)				WHEATHER: SUNNY			
FOUR WHEELERS				THREE WHEELERS			
Dist. M	Time Sec	Speed m/s	Speed km/hr.	Dist. m	Time sec	Speed m/s	Speed km/hr
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

Table 4.23 is providing the data that we obtained for the two wheelers

Table 4.23: speed data calculation

DATE:25.11.2016 START TIME: 12PM

NAME:JAVID KHAN END TIME : 2 PM

LOCATION:NH-3(RAMA MANDI –HOSHAIRPUR ROAD) WHEATHER: SUNNY

SPEED SPOT STUDY

TWO WHEELERS

Dist.(m)	Time(sec)	Speed(m)	Speed(km/hr)
60	4	15	54
60	4.3	14	50.23
60	4.2	14.3	51.43
60	4.1	14.6	52.68
60	3.9	15.4	55.68
60	3.8	15.8	56.84
60	4.5	13.3	48
60	4.3	14	50.23
60	4	15	54
60	4.6	13	46.96

4.3 PERCENTILE ANALYSIS

Percentile analysis has been done for the trucks which are shown in the table 4.31 by finding out the cumulative percentage.

Table 4.31: calculation of speed percentiles

TRUCKS				
Speed(km/hr)	frequency	Cumulative frequency	Cumulative percentage	Speed percentile
30-35	0	0	0	
35-40	1	1	10	
40-45	4	5	50	
45-50	1	6	60	
50-55	4	10	100	

Table 4.32 is showing the percentile analysis of the buses which is below in the table

Table 4.32: calculation of speed percentiles

BUSES				
Speed(km/hr)	frequency	Cumulative frequency	Cumulative percentage	Speed percentile
50-55	3	3	30	
55-60	0	3	30	
60-65	0	3	30	
65-70	4	7	70	
70-75	3	10	100	

Table 4.33 represents the percentile speed of the four wheelers

Table 4.33: calculation of speed percentiles

FOUR WHEELERS				
Speed(km/hr)	frequency	Cumulative frequency	Cumulative percentage	Speed percentile
30-35	5	5	50	
45-60	3	8	80	
60-75	1	9	90	
75-90	0	9	90	
90-105	1	10	100	

Table 4.34 represents the percentile analysis of the three wheelers

Table 4.34: calculation of speed percentiles

THREE WHEELERS				
Speed(km/hr)	frequency	Cumulative frequency	Cumulative percentage	Speed percentile
30-32	1	1	10	
32-34	3	4	40	
34-36	3	7	70	
36-38	2	9	90	
38-40	1	10	100	

Table 4.35 represents the speed percentile of the two wheelers

Table 4.35: calculation of speed percentiles

TWO WHEELERS				
Speed(km/hr)	frequency	Cumulative frequency	Cumulative percentage	Speed percentile
43-46	0	0	0	
46-49	2	2	20	
49-52	3	5	50	
52-55	3	8	80	
55-58	2	10	100	

4.4 BAR CHART

A bar chart is generally a graphical representation of the common speed of most of the vehicles accruing most no. of times considering frequency along with the speed is shown with the help of histograms.

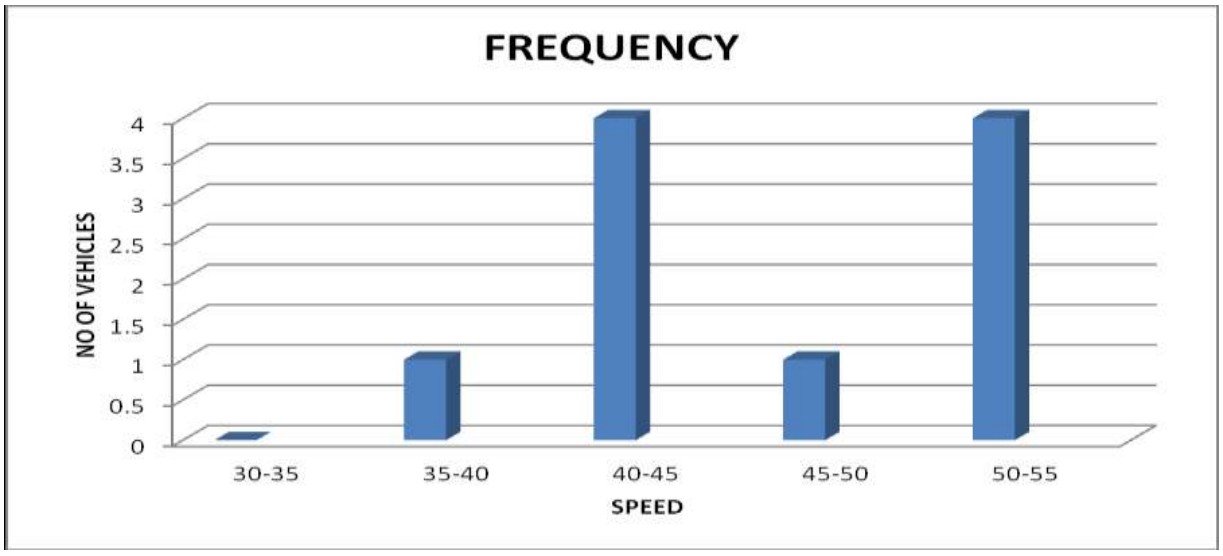


Fig.4.41: Histogram for trucks

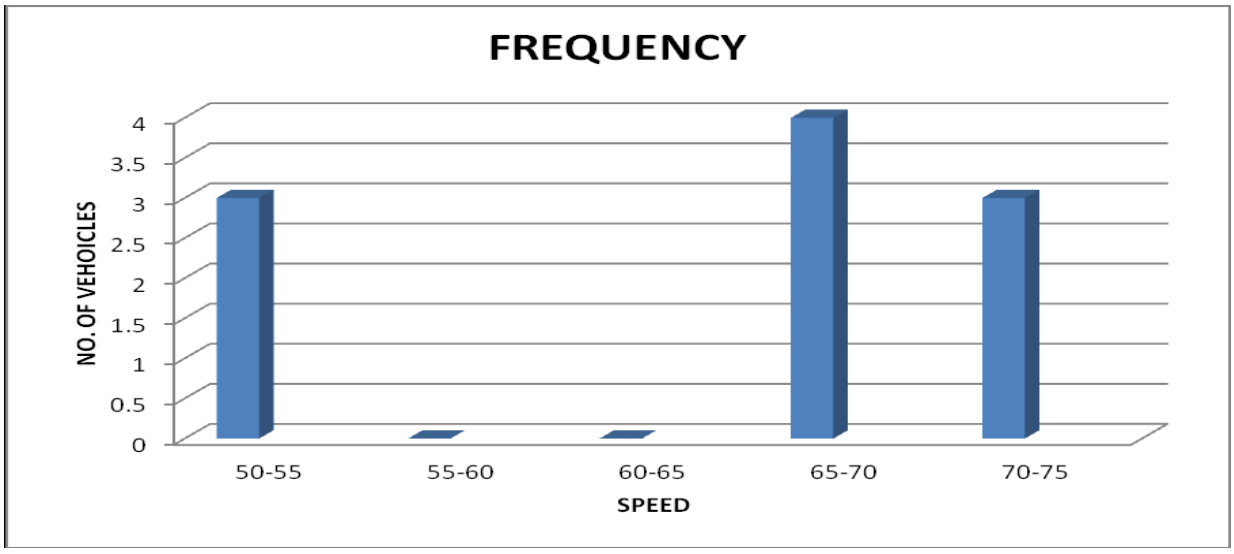


Fig.4.42: Histogram for buses

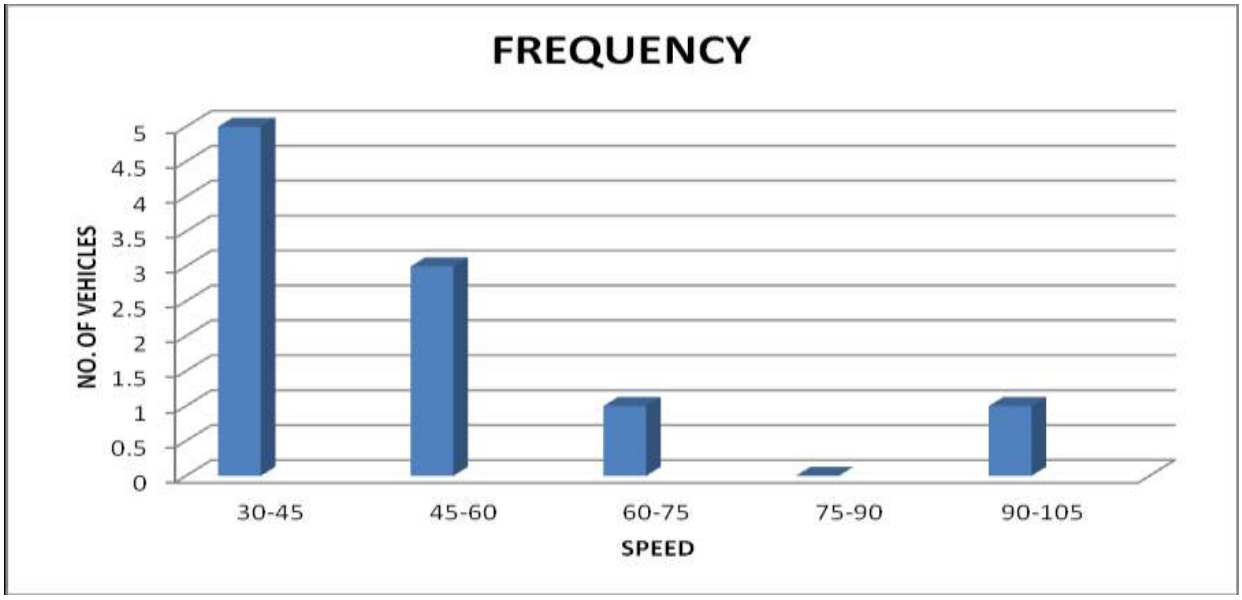


Fig.4.43: Histogram for four wheelers

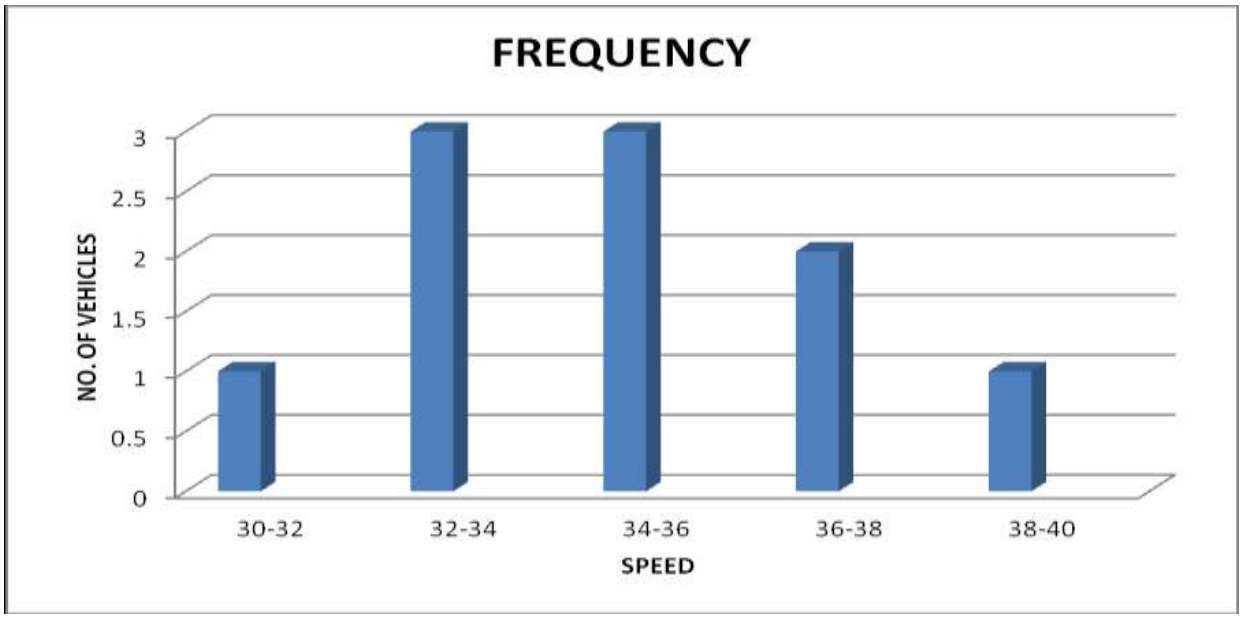


Fig.4.44: Histogram for three wheelers

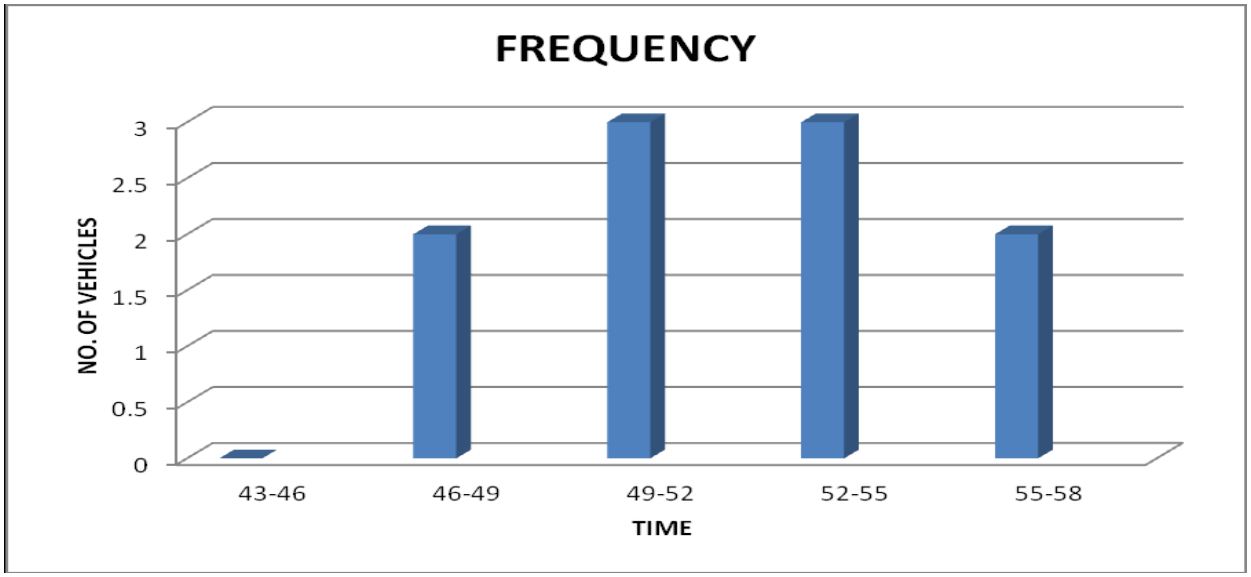


Fig.4.45: Histogram for two wheelers

4.5CUMULATIVE FREQUENCIES:

Cumulative frequencies obtained from the data along with the different speed limits that we have formed with the data available is shown with the help of graphs

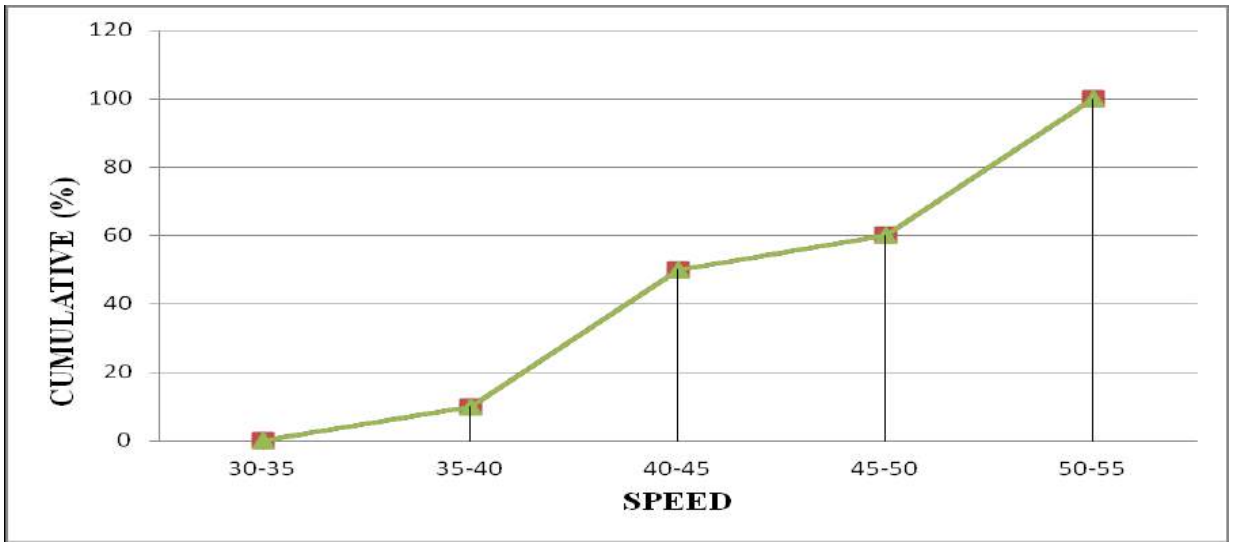


Fig4.51: Cumulative frequency graph for trucks

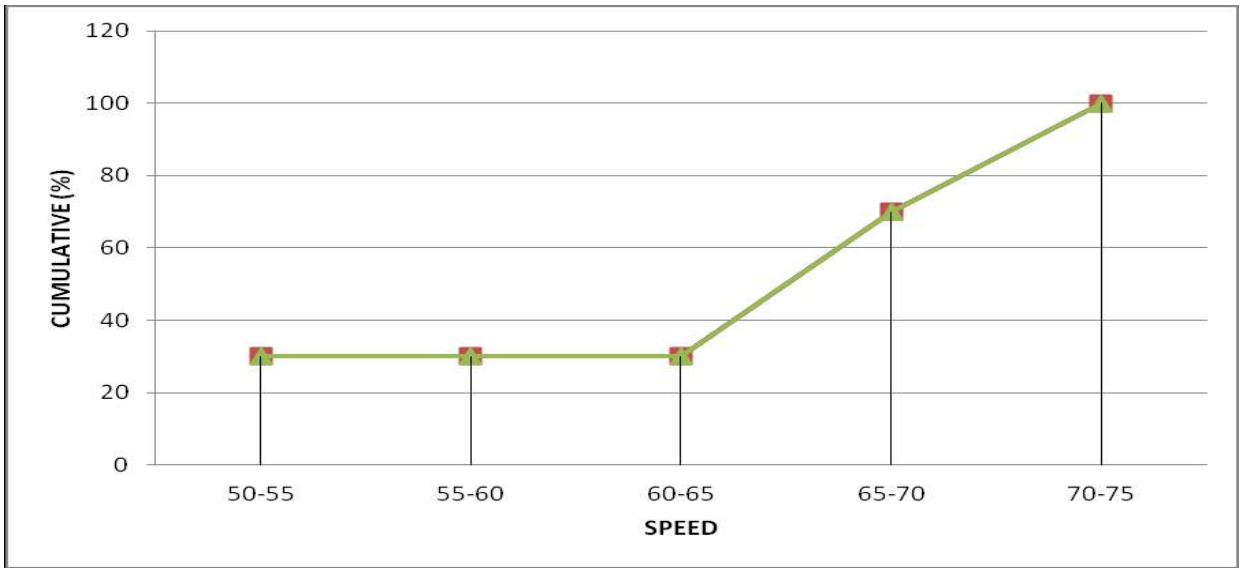


Fig.4.52: Cumulative frequency graph for buses

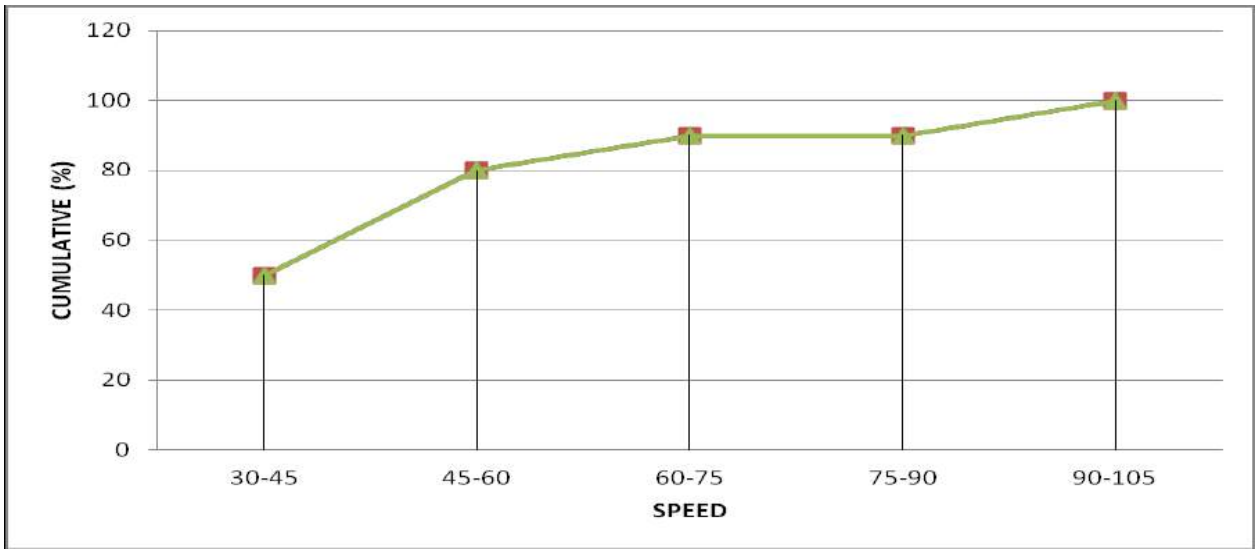


Fig.4.53: Cumulative frequency graph for four wheelers

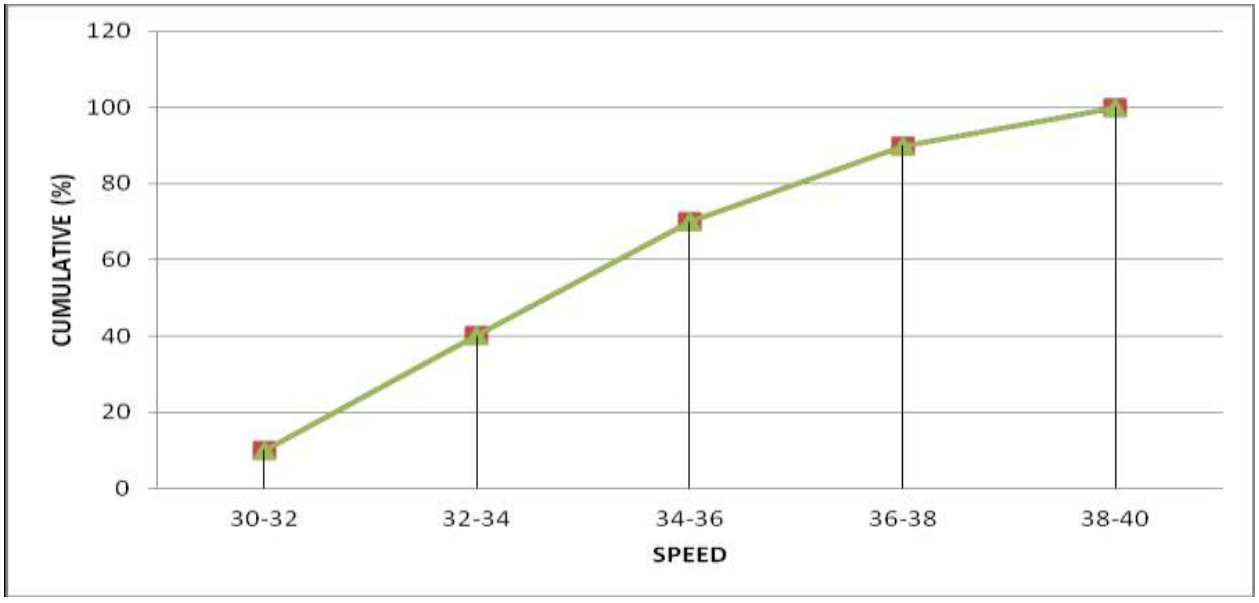


Fig.4.54: Cumulative frequency graph for three wheelers

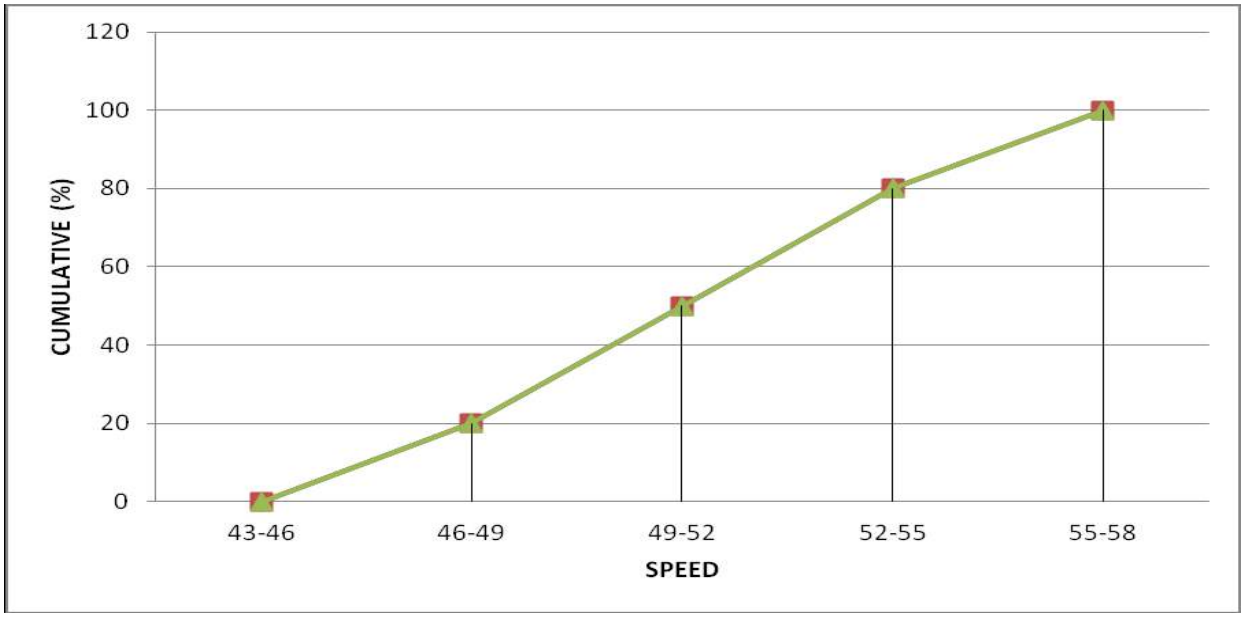


Fig.4.55: Cumulative frequency graph for two wheelers

4.6 SPEED PERCENTILES AND USE

Speed percentiles are the usually the speed limits that are generated to determine the effective adequate speed limits. Usually two main percentile limits are used commonly (50^{th} and 85^{th}) percentiles. The 50^{th} percentile is the average or median speed in which 50% of the vehicles tend to flow on the average speed that is 50^{th} percentile for that group of class of vehicles along the road section.85^{th} percentile is usually used to set the design speed over a road system or we can say 85% of the drivers of vehicles tends to travel at or below 85kmph or it is safe design speed for a particular road system.it can be used in recommending or evaluating the posted speed limits.85^{th} percentile is normally considered to be safe maximum safe speed on a particular road system or required design speed .98^{th} percentile speed is generally used for the design geometric purpose or to assign the design speed for the road way system

Well Speed percentiles will get affected by the obstruction posed on the road system, bad weather like in rainy time we may get other results. That is why spot speed is carried out on a sunny day traffic flow should be free, there should not be any sort of obstructions that may affect the driver's behavior

Speed percentile is calculated by this formula

$$SD = \frac{\text{PD} - \text{Pmin}(\text{Smax} - \text{Smin}) + \text{Smin}}{\text{Pmax} - \text{Pmin}}$$

Where,

SD= speed at PD

PD= percentile desired

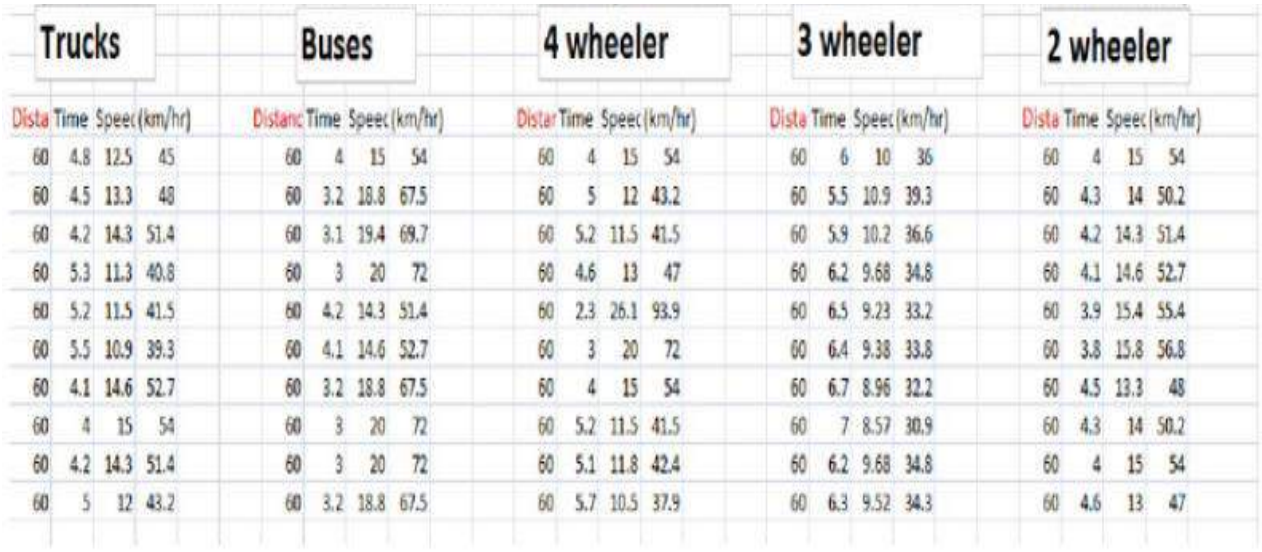
P max= higher cumulative percent

P min= lower cumulative percent

S max= higher speed

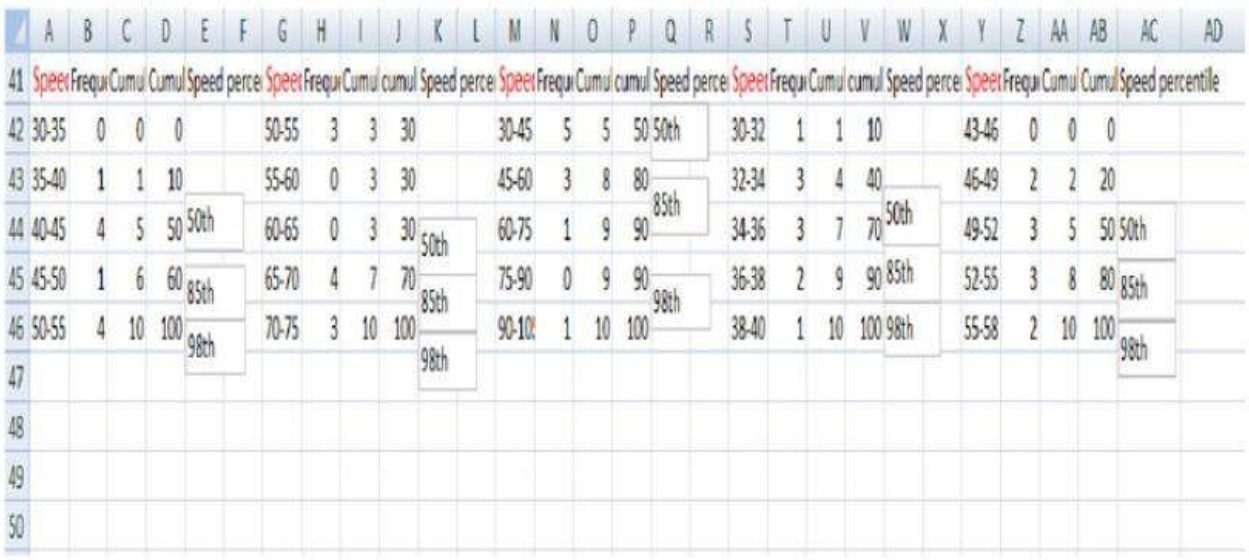
S min= lower speed.

The above formula is used only when the sample size we take without taking the special class of vehicles when the vehicles travelling on the road system are free flowing i.e. is the vehicles ae mixed that we can set the speed limits for the mixed traffic in that case the we use the above formula for



Trucks				Buses				4 wheeler				3 wheeler				2 wheeler			
Dista	Time	Speed	(km/hr)	Distanc	Time	Speed	(km/hr)	Distar	Time	Speed	(km/hr)	Dista	Time	Speed	(km/hr)	Dista	Time	Speed	(km/hr)
60	4.8	12.5	45	60	4	15	54	60	4	15	54	60	6	10	36	60	4	15	54
60	4.5	13.3	48	60	3.2	18.8	67.5	60	5	12	43.2	60	5.5	10.9	39.3	60	4.3	14	50.2
60	4.2	14.3	51.4	60	3.1	19.4	69.7	60	5.2	11.5	41.5	60	5.9	10.2	36.6	60	4.2	14.3	51.4
60	5.3	11.3	40.8	60	3	20	72	60	4.6	13	47	60	6.2	9.68	34.8	60	4.1	14.6	52.7
60	5.2	11.5	41.5	60	4.2	14.3	51.4	60	2.3	26.1	93.9	60	6.5	9.23	33.2	60	3.9	15.4	55.4
60	5.5	10.9	39.3	60	4.1	14.6	52.7	60	3	20	72	60	6.4	9.38	33.8	60	3.8	15.8	56.8
60	4.1	14.6	52.7	60	3.2	18.8	67.5	60	4	15	54	60	6.7	8.96	32.2	60	4.5	13.3	48
60	4	15	54	60	3	20	72	60	5.2	11.5	41.5	60	7	8.57	30.9	60	4.3	14	50.2
60	4.2	14.3	51.4	60	3	20	72	60	5.1	11.8	42.4	60	6.2	9.68	34.8	60	4	15	54
60	5	12	43.2	60	3.2	18.8	67.5	60	5.7	10.5	37.9	60	6.3	9.52	34.3	60	4.6	13	47

Fig.4.62: excel speed calculation



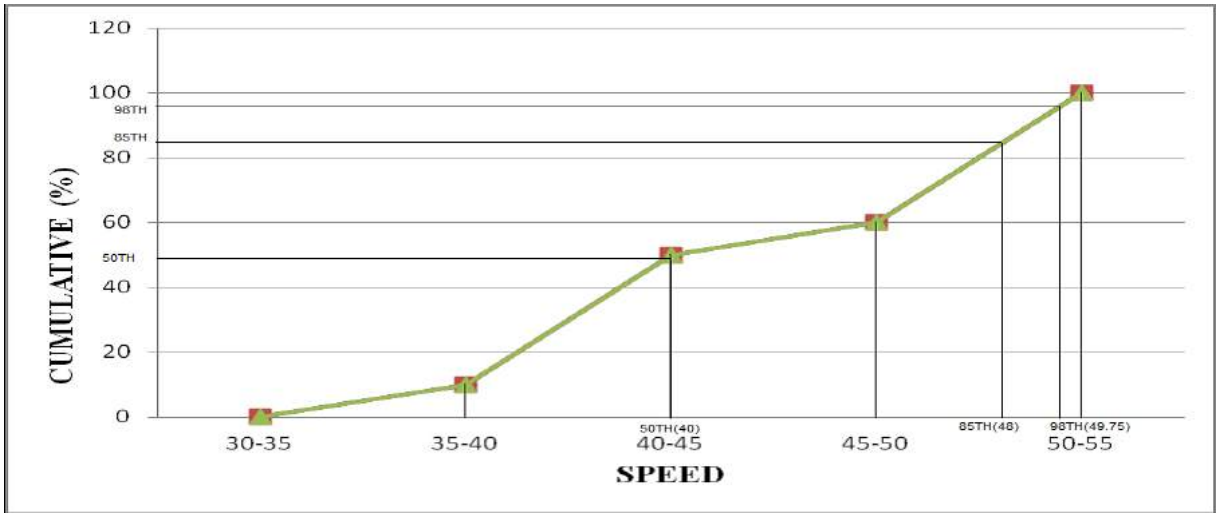
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
41	Speed	Frequ	Cumul	Cumul	Speed	perce	Speed	Frequ	Cumul	cumul	Speed	perce	Speed	Frequ	Cumul	cumul	Speed	perce	Speed	Frequ	Cumul	cumul	Speed	perce	Speed	Frequ	Cumul	Cumul	Speed percentile	
42	30-35	0	0	0			50-55	3	3	30			30-45	5	5	50	50th		30-32	1	1	10			43-46	0	0	0		
43	35-40	1	1	10			55-60	0	3	30			45-60	3	8	80	85th		32-34	3	4	40			46-49	2	2	20		
44	40-45	4	5	50	50th		60-65	0	3	30	50th		60-75	1	9	90			34-36	3	7	70	50th		49-52	3	5	50	50th	
45	45-50	1	6	60	85th		65-70	4	7	70	85th		75-90	0	9	90	98th		36-38	2	9	90	85th		52-55	3	8	80	85th	
46	50-55	4	10	100	98th		70-75	3	10	100	98th		90-10	1	10	100			38-40	1	10	100	98th		55-58	2	10	100	98th	
47																														
48																														
49																														
50																														

Fig.4.63: showing of speed percentiles on excel sheet

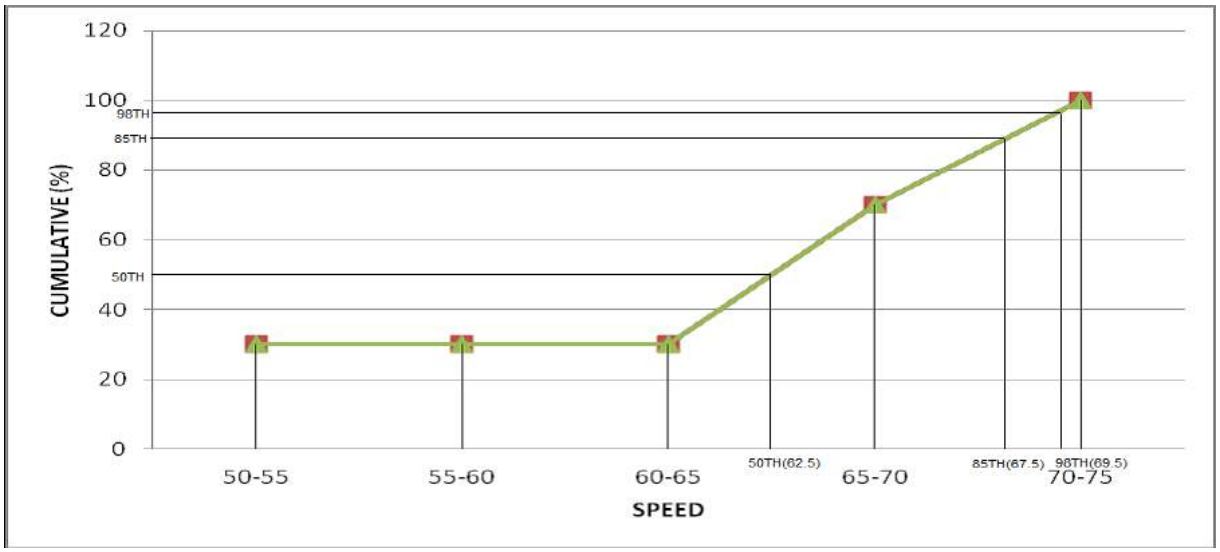
4.7 Analyzing of 50th, 85th, and 98th percentile speed graphically

calculating the speed percentiles as it is visible on the excel sheet the range of speed that falls under the category of the different percentiles usually (50th and 85th) although 98th percentiles is also calculated for designing the design speed limits of the road system, is shown graphically by drawing perpendicular lines cumulative frequency vs speed .meeting at a point will yield desired percentiles that is shown as:

1) TRUCKS

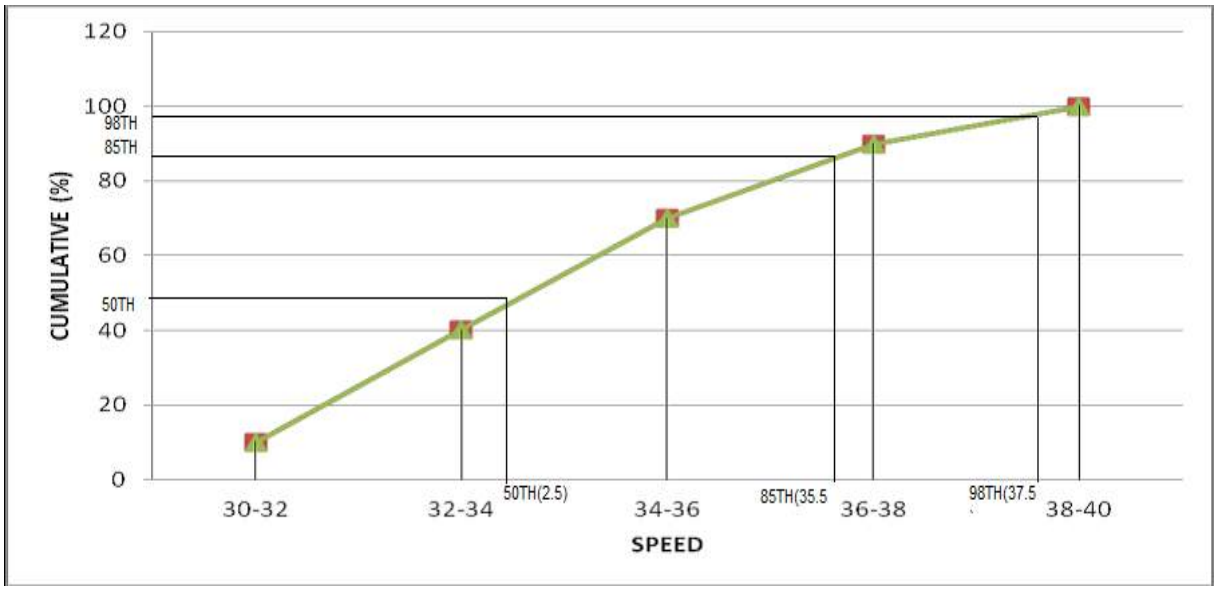


2) BUSES

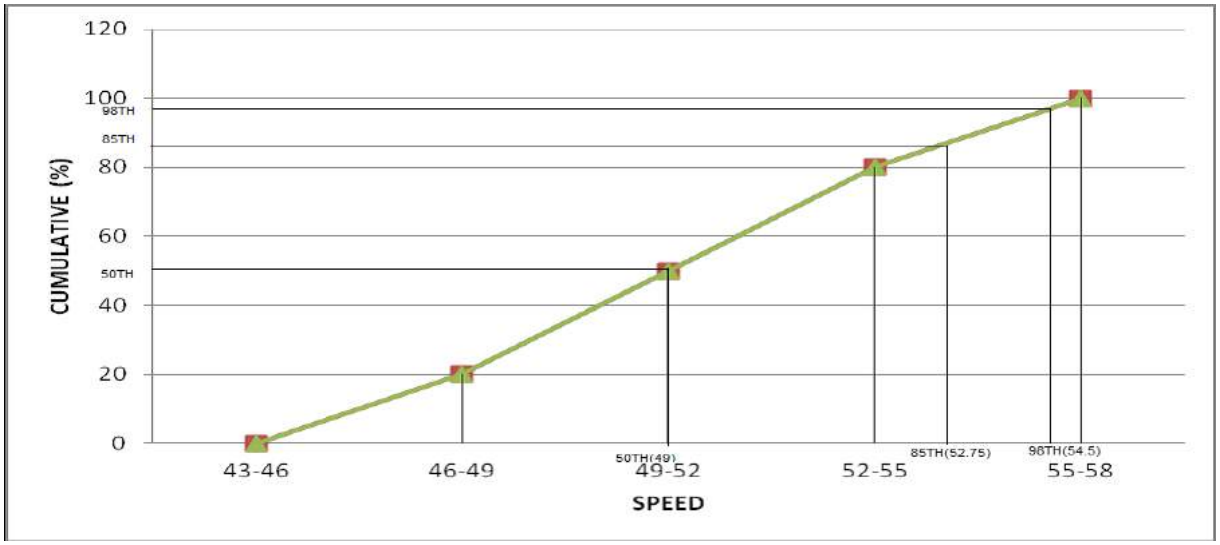


3) FOUR WHEELERS

4) THREE WHEELERS



5) TWO WHEELERS



The table below 4.6.1 is the required percentiles that we have analyzed using the cumulative graphs and speed from that the data have being interpret and the percentile have been observed from the graphs for separate classes as we taken the sample size of 50 including (10 trucks,10 buses,10 four wheelers,10 three wheelers and 10 two wheelers) by drawing the graphs for each class it is easy to get the required percentile (50^{th},85^{th} and 98^{th}) for the road stretch that we have chosen by the help of speed spot analysis

Table 4.61: determination of speed percentiles

PERCENTILE	TRUCKS	BUSES	FOUR WHEELERS	THREE WHEELERS	TWO 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

4.8 TIME MEAN SPEED

Time mean speed: It may be defined as average speed of all the vehicles passing over a particular section on the road for a specified time period.

In the below chart we have calculated the time mean speed for different section of vehicles .this has been done in order to see the time mean speed for the vehicles and later it is compared with the space mean speed in next chart

	A	B	C	D	E	F	G	H	I	J	K	L
1	speed mid value (v)	volume of trucks (qt)	volume of buses (qb)	volume of 4 wheeler (qs)	volume of 3 wheeler (qt)	volume of 2 wheeler (qc)	trucks (qt.v)	buses (qb.v)	4 wheeler (qs.v)	3 wheeler (qt.v)	2 wheeler (qc.v)	
5	15	0	0	0	0	0	0	0	0	0	0	
6	25	0	0	0	0	0	0	0	0	0	0	
7	35	1	0	1	10	0	35	0	35	350	0	
8	45	5	0	5	0	2	225	0	225	0	90	
9	55	4	3	2	0	8	220	165	110	0	440	
10	65	0	4	0	0	0	0	260	0	0	0	
11	75	0	3	1	0	0	0	225	75	0	0	
12	85	0	0	0	0	0	0	0	0	0	0	
13	95	10	0	1	0	0	950	0	95	0	0	
14	Total q	10	10	10	10	10						
15	Total q.v						480	650	540	350	530	
16												
17	Time mean speed vt= total (q.v)/ total (q)											
18												
19												
20												
21												
22							48	65	54	35	53	

Fig.4.71: excel sheet for time mean speed (source: manually made)

4.9. SPACE MEAN SPEED

Space mean speed: 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

Space mean speed is being calculated in the chart from the observation and this is compared with the time mean speed and to find out the relation between the two

	A	B	C	D	E	F	G	H	I	J	K	L
1	speed mid value (v)	volume of trucks (qt)	volume of buses (qb)	volume of 4 wheeler (qs)	volume of 3 wheeler (qt)	volume of 2 wheeler (qc)	trucks (qt/v)	buses (qb/v)	4 wheeler (qs/v)	3 wheeler (qt/v)	2 wheeler (qc/v)	
5	15	0	0	0	0	0	0	0	0	0	0	
6	25	0	0	0	0	0	0	0	0	0	0	
7	35	1	0	1	10	0	0.028571	0	0.028571	0.285714	0	
8	45	5	0	5	0	2	0.111111	0	0.111111	0	0.044444	
9	55	4	3	2	0	8	0.072727	0.054545	0.036364	0	0.145455	
10	65	0	4	0	0	0	0	0.061538	0	0	0	
11	75	0	3	1	0	0	0	0.04	0.013333	0	0	
12	85	0	0	0	0	0	0	0	0	0	0	
13	95	10	0	1	0	0	0.105263	0	0.010526	0	0	
14	Total q	10	10	10	10	10						
15	Total q/v						0.317672	0.156083	0.527181	0.285714	0.189899	
16												
17	space mean speed vs= total (q)/ total (q/v)											
18												
19												
20												
21												
22												
23							31.479	64.068	50.024	34.999	52.659	
24												

Fig.4.81: excel sheet for space mean speed mean speed (source: excel sheet)

4.9 COMPARISON OF TIME MEAN SPEED AND SPACE MEAN SPEED

table 4.9.1 by comparing the results between the time mean speed and space mean speed .This quit clear that the calculation of **Time Mean Speed (VT)** in all these case is having greater readings as compared to the **Space Mean Speed (VS)** .from the above table we have compared all the values hence our desired work of the paper holds true which implies **Time Mean Speed (VT)** is always greater than the **Space Mean Speed (VS)** i.e**. (VT>VS)**

Table 4.91: comparing the results VT and VS

SPEED	TRUCKS	BUSES	FOUR WHEELERS	THREE WHEELERS	TWO WHEELERS
TIME MEAN SPEED	48	65	54	35	53
SPACE MEAN SPEED	31.479	64.068	50.024	34.99	52.659

Hence **VT>VS** which holds true

Hence in table 4.9.1 by comparing the results between the time mean speed and space mean speed .This quit clear that the calculation of Time Mean Speed **(VT)** in all these case is having greater readings as compared to the Space Mean Speed **(VS)** .from the above table we have compared all the values hence our desired work of the paper holds true which implies Time Mean Speed (VT) is always greater than the Space Mean Speed (VS) i.e. **(VT>VS**)

CHAPTER-5

DATA INTERPRETATION

5.1 GENERAL

- Dealing with traffic studies or we can say speed studies the histograms that we have drawn into the study the histogram usually depicts that the speed of vehicles tends to cluster about its mean value with and frequency usually drops as speeds goes down from the mean value. And the maximum frequency can be observed at the peak value

- Speed percentiles gives us idea of speed behavior regarding the particular percentage of vehicles travelling below the percentile speed on the road for that purposes the cumulative frequency graphs gives us the idea of the percentiles of speed (50^{th},85^{th},and 98^{th})

- 98^{th} percentile speed is actually used for geometric design consideration and it represents 98% of the vehicles tend to travel at the same speed for a particular road system.

- 85^{th} percentile is generally used for the designing the speed limits.

- 50^{th} percentile is the maiden speed in which 50% of the vehicles are going faster or 50% of the vehicles are travelling lesser than on the road system

- Time mean speed and space mean speed have been analyzed and their relationships have been proved which holds true **VS < VT**

5.2 CONCLUSION

- Due to increasing populations over the years as we know that the transportations sector is related with the population of the area vehicle distribution over the particular road is increasing at an alarming rate resulting in the traffic congestions and thus reducing the level of service provided by the road surface as the roads were built since long ago .due to high level of traffic on it .it is unable to provide the required service

- The road surface are not maintained properly speed limits board along the road surface is missing.so the drivers are not aware of the speed limit.

- The design speed is usually followed under the circumstances but the thing to instant growth of the vehicles over the years

- The median on the carriage way should be of proper width as we have seen there where road section where the maiden is totally absent which can results in accidents.

- Traffic engineering tools like traffic signs ,signals and markings are not present on the road surface

- Private sector vehicles are given preference over the public which results in the growth rate of vehicles

- Therefore comprehensive measures must be taken to have a check on the growing populations

- Speed as being an important asset in terms for transportation usually people of age limits have different speedy behavior on the road system

- Traffic distribution on the existing road as we observed have different percentile speed depending on the cumulative frequency graph. Which determines and evaluate the speed percentiles

- Histograms for separated classes have be analyzed and the results have been observed that the speed of vehicles tends to cluster about the mean position along with the frequency decreases and speed also departs from the mean

- Speed spot is an instantaneous speed generally taken over a small section and the length of the section is taken according to the guidelines of IRC

- Carrying out speed spot study is an important tool which has many present safety applications which can be used for road systems

- 98^{th} percentile is used for design speed for the roads
- 85^{th} percentile may be used for designing speed limits
- 50^{th} percentile is the average speed of the vehicles that are travelling on the road section

5.3 RECOMMENDATIONS

As speed spot study was conducted on the road stretch **(Rama Mandi** to **Hoshiarpur**) the main aim was to get familiar about the design speed posted for the National highway (NH3) is followed or not. But due to traffic distribution on the existing road it was observed that the speed behavior of most of the vehicles was normally in the design limits

- Law enforcement agencies like Traffic police have to be alert the road system that observed I did not see the traffic police were operating there .inspection of checking of documents should be checked frequently for the safety purpose

- The road system should be designed with proper shoulder, medians keeping the volume of the road system in view.

- Usage of traffic engineering tools like signs ,signals and markings should be used effectively

- Posting of speed limits is one of the important work to be done in this field to impart message for the traffic users to maintain their speeds accordingly

- It is important to have focus on the public transport rather than private transport

- Parking facilities should be improved along the road surface which will result in the reduction of congestions

- Maintenance of roads is one of the key factor that have a great impact on speed behavior

- The cycle time of the signals should be checked on the regular bases.

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