Evaluation of Traffic Characteristics: A Case Study on NH-86, near S.A.T.I. college Vidisha

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***Abstract-* 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 decisions. The intention of spot speed studies are to record speed characteristics under prevailing traffic conditions at a specific location along a roadway. Because traffic engineering involves the collection and analysis of large amount of data for performing all types of traffic studies, it follows that spot speed study is also an important element in traffic engineering. Managing traffic within our communities is a growing task for traffic engineers. As traffic volume increases and public financial resources decrease, targeting improvement projects to anticipate growth patterns is critical. This paper represents traffic condition on civil lines route Vidisha NH-86 Madhya Pradesh.**

***Index Terms* –Spot speed, Mean Speed, Flow, 85th Speed**

I. INTRODUCTION

Speed plays a vital role in evaluating the safety of road network. Speed by definition is the distance travelled in unit time.
The typical unit of speed is kilometer per hour (kmph) or miles per hour (mph) . Basically there are two types of speed ; time mean speed and space – mean speed . Space mean speed is the length of a road section divided by the average travel time of several vehicles over this specific section. The time mean speed (spot) speed is the average spot speed of several vehicles measured at a given spot.

Area of study

Area of study is civil lines road, near S.A.T.I college, Vidisha , Madhya Pradesh is a National Highway -86 Which connects Kanpur in Uttar Pradesh with Dewas in Madhya Pradesh. The total length of NH-86 runs to 674 km Starting from national highway 3 in Dewas it runs northwards and ends at Kanpur at NH-2.

II. LITRATURE REVIEW

A. Introduction

A spot speed study is made by measuring the individual speeds of a sample of the vehicles passing a given point (spot) on a street or highway. These individual speeds are used to estimate the speed distribution of the entire traffic Stream at that location under the conditions prevailing at the time of study.

B. Uses of Spot Speed Data

The result of spot speed studies are used for many different purposes by traffic engineers, including:
1. Establishing the effectiveness of new or existing speed limits or enforcement practices.
2. Determining appropriate speed limits for application.
3. Establishing speed trends at the local, state, and national level to assess the effectiveness of national policy on speed limits and enforcement
4 .Specific design application determining appropriate sight distances, relationships, between speed and highway alignment, and speed performance with respect to steepness and length of grades.
5. Specific control applications for the timing of "yellow" and "all red" intervals for traffic signals, proper placement of signs, and development of appropriate signal progressions.
6.Investigation of high-accident locations at which speed is suspected to be a contributing cause to the accident experience.

C. Data Requirements

For this project the most important traffic characteristics to be collected from the Civil lines- Vidisha " include spot speed and flow. The key point of measurement is the vehicle volume count . Data was collected manually on 05.01.2016 during non-peak hour with short interval of 15 minutes and for each type of vehicles like cars, two wheelers, buses, utilities, trucks, multi axle trucks. From the flow data, flow and headway can derived. This study are used to determine the level of service for streets, document congestion and quantify the need for street

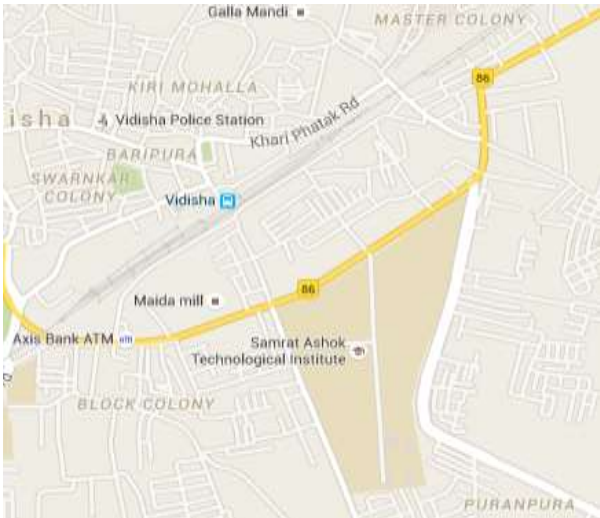

Figure 1. map of NH 86

D. Determine an Appropriate Selection Strategy

Except for studies conducted under low-volume conditions, it is impossible to obtain a radar measurement for every vehicle. For Every vehicle peak flow analysis, speeds are measured during the peak period. For assessing general speed trends or for setting speed limits, off-peak measurements are more appropriate.

The selection of the target vehicle that represents the vehicle population under study is also important. A good question to ask is, "What type or types of vehicles are of concern—cars, trucks, buses, or others?" Typically cars, station wagons, pickup and panel trucks, and motorcycles concern—cars, trucks, buses, or others?" Typically cars, station wagons, pickup and panel trucks, and motorcycles concern—cars, trucks, buses, or others?" Typically cars, station wagons, pickup and panel trucks, and motorcycles are classified as passenger cars. Other trucks and buses are classified as trucks. School buses and farm equipment may be recorded separately. When the target vehicle is defined, a selection strategy is developed to provide a random sample. A random sample will reduce the tendency to select the vehicles that stand out. For example, the observer could obtain a speed reading from every fourth vehicle or every tenth vehicle.

III. METHODOLOGY

A.Introduction

The objective of this study is to get traffic characteristics from civil lines route Vidisha NH-86 Madhya Pradesh include spot speed and flow.

This study are used to determine the level of service for streets

Document congestion and quantify the need for street improvements and also for a variety of purposes . For a spot speed study at a selected location, a sample size of at least 50 and preferably 100 vehicles is usually obtained (Ewing 1999). Traffic counts during a Monday morning or a Friday peak period may show exceptionally high volumes and are not normally used in the analysis; therefore, counts are usually conducted on a Tuesday, Wednesday, and Thursday.

Spot speed data are gathered using one of three methods: (1) stopwatch method, (2) radar meter method, or (3) pneumatic road tube method. The stopwatch method is the least expensive and least accurate of the methods.

Figure 2 . map of observation point

B. INSTRUMENT

Counter

A Counter meter is a commonly used to take the number. In this method, the observer stay at the point of interest and count the vehicles with the help of hand tallies using counter meter (Fig. 3).

Radar Meter

A radar meter is a commonly used device for directly measuring speeds in spot speed studies (Fig. 4). This device may be hand-held, mounted in a vehicle, or mounted on a tripod. The effective measuring distance for radar meters ranges from 200 feet up to 2 miles (Parma 2001). A radar meter requires line-of-sight to accurately measure speed and is easily operated by one person. If traffic is heavy or the sampling strategy is complex, two radar units may be needed.

C. DATA ANALYSIS AND CALCULATIONS

The results and analysis of the study are very important to ensure that the key objectives can be achieved. Expected result necessary to draw up at early stage before the project done, to be compared with the actual result. After the study is completed and the data have been tabulated the following steps may be considered as part of the typical data analysis. Specifically, the idea would be to identify key parameters associated with roadway speeds,
which may include any or all of the following:

1. **Mean Speed**: The average speed; calculated as the sum of all speeds divided by the number of speed observations.
2. **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 base line for establishing the speed based on a spot speed study.
3. **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).
4. **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.
5. **Mode**: The number that occurs most frequently in a series of numbers.
6. **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.
7. **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.

In analyzing spot speed data a number of significant values are obtained. Some of these values are computed directly from the data while others are determined from a graphic representation.
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Figure 3 Counter figure 4 Radar meter

1V. COMPUTATIONS

A. Speed Percentiles and How to Use Them

Speed percentiles are tools used to determine effective and adequate speed limits. The two speed percentiles 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 stream. 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 assumption that 85% of the drivers are traveling at a speed they perceive to be safe(Homburger et al. 1996). In other words, the 85th percentile of speed is normally assumed to be the highest safe speed for a roadway section. Weather conditions may affect speed percentiles. For example, observed speeds may be slower in rainy or snowy conditions. A frequency distribution table is a convenient way to determine speed percentiles. An example is given in “Table 2,” The frequency of vehicles is the number of vehicles recorded at each speed.

$$\Sigma\, fi(vi - v_m)\text{\^{}}2 = 31154.94 \quad (1)$$

$$\Sigma\, fi - 1 = 154\text{-}1 = 153 \quad (2)$$

The cumulative frequency is the total of each of the numbers (frequencies) added together row by row from lower to higher speed. The fourth column is a running percentage of the cumulative frequency.
The 50th and 85th speed percentiles are determined from the cumulative percent column. For example data in "Table 2,", the 50th percentile falls between 41 and 45 kmph and the 85th percentile falls between 56 and 60 kmph.
The calculation of speed percentiles is easier if a sample size of 100 vehicles is collected. When the sample size equals 100 vehicles, the cumulative frequency and cumulative percent are the same. The analysis of an example set of speed data is shown in "Table 3". The data are first grouped into intervals of 5 km/h. The
first two columns of the table show the grouping by lower limit, midpoint of mean (vi), and upper limit of each *group. Column 3 shows the frequency (fi) or number observed in* each group; column 5 shows the percentage of observation in class.
The cumulative percentages in column 6 are obtained by dividing each cumulative frequency by the total sample size and multiplying by 100. The mean square frequencies in Col. 7 (fi(vi)2) are calculated by multiplying the mean
frequencies FiUi (multiplying midpoints col.2 by corresponding frequencies col.4) the respective midpoints in Col. 2. These multiplications must be made accurately.The following values are then computed:

B .Mean or Average Speed

The arithmetic average or mean speed is the most frequently used speed statistic. It is a measure of the central tendency of the data and is computed from the formula :

$$\bar{v} = \frac{\sum f_i v_i}{\sum f_i} = 46.51$$

where: $\bar{v}$ = mean or average speed.
$\Sigma f_i V_i$= sum of the mean frequencies
Σf_i = total number of vehicles observed (total of Col.3)

s.no	Types of vehicle	5	10	15	20	25	30	35	40	45	50	55	60	
1	Car and taxi			20			25			18			23	86
2	Small van and utility			18			21			17			23	79
3	Moderate size lorry and large van			12			16			17			19	64
4	Truck			12			10			13			9	44
5	Bus			5			2			6			4	17
6	Motorcycle			105			109			101			112	427
	Total(veh/h)			172			183			172			199	726

Table 1 VEHICLE TALLLY SHEET

SAMPLE MEASUREMENT SHEET
FOR SPOT SPEED DATA COLLECTION
DATE: 5 January 2016
TIME: 10:30 A.M.
LENGTH: 50 METER
METHOD USED: PAVEMENT MARKING

TABLE 2

S.No.	Car/jeep	Three wheeler	Two wheeler	Cycle	H.C.V. (HEAVY COMMERCIAL VEHICLE)	L.C.V. (LIGHT COMMERCIAL VEHICLE)
1	2.94	3.49	2.87	5	5.8	3.45
2	2.51	3.9	2.89	8.2	5.4	3.46
3	4	4.8	2.94	6.9	3.48	3.45
4	2.5	3.48	2.9	8.2	3.22	2.91
5	2.85	4.31	3.43	6.89	5.9	3.2
6	4	3.9	2.68	8.2	3.48	3.21
7	2.49	3.49	3.1	6.9	6.9	3.45
8	2.4	4.31	3.43	5.8	3.48	3.9
9	3.22	4.31	3.1	6.9	3.21	3.45
10	4	3.48	3.17	5.8	3.48	4.1
11	2.6	4.32	3.3	6.89	8.2	4.1
12	5	4.5	3.15	8.23	5.9	3.9

13	2.3	3.9	3.43	8.24	6.9	3.25
14	5	4.33	2.87	8.25	6.92	3.84
15	2.7	4.5	3.91	8.32	3.98	4.6
16	2.54	3.9	3.43	8.23	4.01	4.7
17	2.68	4.33	3.15	8.1	4.23	3.85
18	2.32	4.5	4.3	8.12	4.5	4.65
19	2.36	4.5				
20	2.68					
21	3.95					

Figure 5 vehicle volume data count

Figure 6 marking of starting point for spot speed data Collection

*C .**Distributions in Time and in Space***

Data collected at a point over a period of time, e.g.: by stopwatch or radar meter, produce speed distributions in time, whose means are time mean speeds. Data obtained over a stretch of road almost instantaneously as by two successive aerial photographs , result in speed distribution in space and space mean speeds.

These distributions are not the same; time mean speed is higher than space mean speed. This can be understood if one visualizes a section of highway; a spot speed sample at one end taken over a finite period of time will tend to include some fast vehicles which had not yet entered the section at the start of the survey, but will exclude some of the slower vehicles which were within the highway section when the sample was started

Figure 7 spot speed data collection on measurement sheet

An aerial photograph, however, would include all vehicles within the highway section at the moment of exposure. The relationship between the two mean speeds is expressed by:

$\bar{V}t = \overline{Vs} + \frac{s_s^2}{\bar{v}} = 46.51+14.269 = 60.779$

where V*t* and V*s* are the time mean speed and space mean speed respectively, and *ss* is the standard deviation of the distribution in space.

Speed class(km/hr)	Class midvalue v_i	Class frequency (number of observations in class) F_i	$F_i * v_i$	Percentage of observation in class	Cumulative percentage of all observation	$F_i *(v_i-v_m)^2$	
21-25	23	4	92	2.6	2.6	2210.88	
26-30	28	8	224	5.2	7.8	2740.96	
31-35	33	20	660	13	20.8	3650.402	
36-40	38	27	1026	17.53	38.33	1955.34	
41-45	43	21	903	13.64	51.97	258.072	50th
46-50	48	18	864	11.69	63.66	39.9618	
51-55	53	19	1007	12.34	76	800.281	
56-60	58	14	812	9.09	85.09	1848.28	85th
61-65	63	9	567	5.85	90.94	2447.28	
66-70	68	6	408	3.9	94.84	2770.92	
71-75	73	5	365	3.25	98.09	3508.6	
76-80	78	3	234	1.95	100	8924.58	
Total		154	7162			31154.94	

TABLE 3 PERCENTAGE AND ANALYSIS OF SPOT SPEED DATA

D.Standard Deviation

All vehicles do not travel at the same speed, so there is a spread or dispersion of speeds about the mean. The standard deviation, *s*, is a statistical measure of this spread.

Assuming a normal distribution, the mean I plus and minus one standard deviation contains approximately 68% of the vehicles, plus and minus two standard deviations contains 95%, and plus and minus three standard deviations contains 99.8%. The standard deviation of the sample is computed by first calculating the variance of the sample and then taking the square root as follows:

$$\mathbf{s} = \sqrt{\frac{f_i\,(vi-v)^\wedge 2}{\Sigma f_i - 1}} = 14.269 \text{ km/h}$$

where: S = standard deviation of the distribution
$\Sigma f_i(v_i - v)$ = sum of the mean square frequencies
$\Sigma f_i(v_i - v)^\wedge 2$ = square of the sum of the mean frequencies (total of Col. 7 squared)

D. Standard Error of the Mean

The means of different samples taken from the same population are distributed normally about the true mean of the population with standard deviation of $s/\sqrt{\Sigma f}$ where *a* is the standard deviation of the entire population. In large samples (n ≥ >25) the standard deviation of the sample, s, is a good estimate of the standard deviation of the population. Therefore:

$$s_{\bar{v}}^2 = \frac{s^2}{\Sigma f}$$

$$s_{\bar{v}} = \sqrt{\frac{s^2}{\Sigma f}} = \frac{14.269}{154} = 1.322$$

Where $s_{\bar{v}}^2$ = variance of the mean
$s_{\bar{v}}$ = standard error of the mean
s^2 = sample variance (from equation)

V. GRAPHICAL ANALYSIS

The cumulative percentage calculated in "Table 3" is plotted against the upper limit of each speed group. A smooth S-shaped curve drawn approximately through the points (not connecting the points directly) is called the cumulative speed curve. Since the sample is used to estimate the total distribution, it is important that it be a smooth curve rather than a joining of points.

The data in "Table 3" are plotted and the corresponding cumulative speed curve is drawn in Fig 8. Significant values obtained from the curve shown on the figure are:

The vertical axis of the curve is the percentage of vehicles traveling at or below the indicated speed. Any specific percentile speed is the speed that corresponds to the desired percentile. The uses of some of the percentiles are as follows:

(1) The Median (50th Percentile) Speed is an alternative measure to the mean or average speed to describe the central tendency of the speed distribution. It is the speed which is exceeded or

equaled by exactly half the vehicles in the traffic stream and is not attained by the other half. In a symmetrical (perfectly normal) distribution, the median value equals the mean value. The median is obtained from the curve by reading the speed that corresponds to the 50% value.

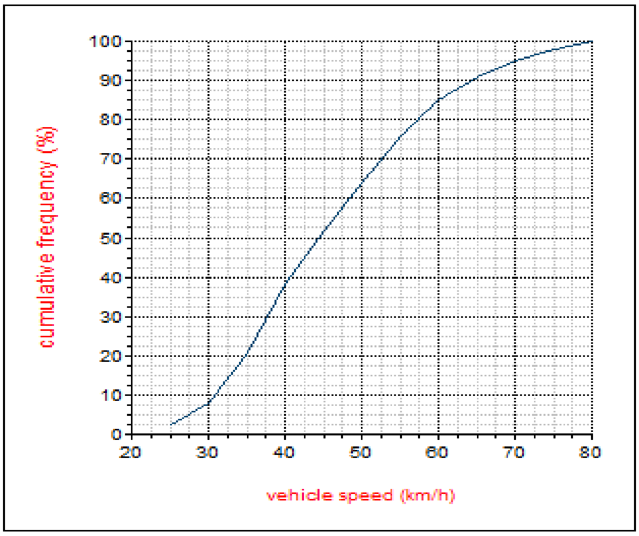

Figure 8 Cumulative Distribution

TABLE 4

PCU VALUES	PCU/HR	PERCENTAGE OF PCU
1	86	8.90
2	158	16.37
2.5	160	16.56
3	132	13.67
3	51	5.28
1	427	44.203
	966	100

(2) *The 85th Percentile Speed* , sometimes referred to as the critical speed, is used as a a guide in establishing reasonable speed limits.
(3) *The 15th Percentile* may serve as the guide for
establishing minimum speed limits. The vehicles traveling below this value tend to obstruct the flow of traffic, thereby increasing the accident hazard.

VI. CONCLUSION AND RECOMMENDATION

Unlike many other disciplines of the engineering, the situations that are interesting to a traffic engineer cannot be reproduced in a laboratory. Even if road and vehicles could be set up in large laboratories, it is impossible to simulate the behavior of drivers in the laboratory.

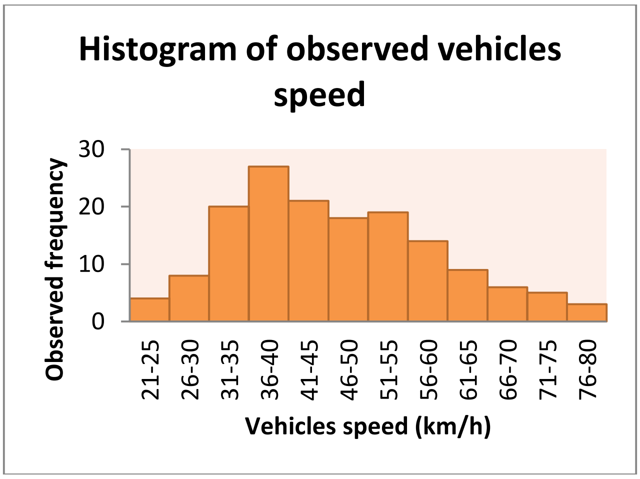

Figure 9. Histogram of Vehicles Speed

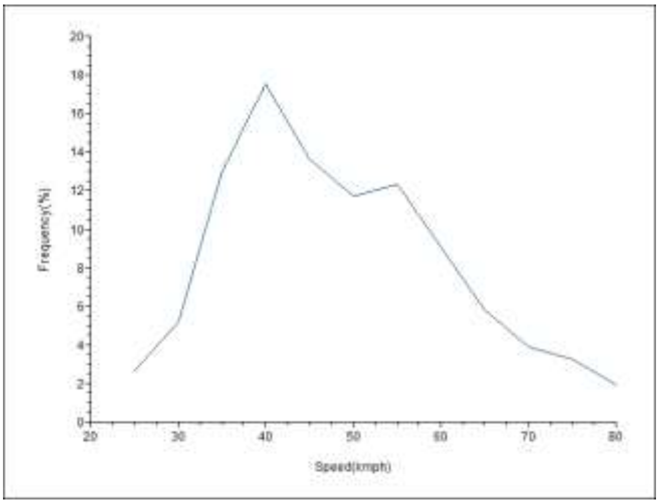

Figure 10. frequency distribution

Therefore, traffic stream characteristics need to be collected only from the field.
The data was collected on the civil line road - National Highway -86 and was analyzed with the Following results:
The data was collected on the civil line road - National Highway -86 and was analyzed with the Following results:

1. The maximum speed on the road is equal to 80. The drivers almost do not exceed this speed. It Was corroborated by our analysis where the vehicles were moved with the range of speed from 30 to 70 km/h.
2. The most part of vehicles moved with average speed 45 km/h .
3. During 1hour the number of vehicle passed observation point is 726 that also is equal to 966 pcu.
4. The two wheeler is the most appearing type of vehicles (427 vph).
5. Some of the results can have natural error that is result of purposefully decreasing of speed. Because observation group can be easily detected by drivers from the long distance.
6. . 6. This particular area does contain a signboards about speed limit of 30km/hr and some of the drivers over exceed the speed limit (km/h). so it should be ensured that drivers don't breakup speed limit

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