Spot Speed Survey & Analysis – A Case Study on Jalandhar-Ludhiana Road, NationalHighway-1, India

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Abstract: **The Present Vehicle Spot Speed Study concentrates on measuring the speed characteristics at predetermined area under the natural conditions.The present spot speed studies are coordinated to assess the movement of rates of vehicles in a surge of activity at a particular region on a roadway. The proposed look into work goes from breaking down the modular speed of vehicles, highway outline component ,upper and lower speed restrain for regulation, planning and analysis, traffic operation, control and direction. The range, time and conditions of the study may be coordinated by its objective and expansion. In case approach paces to a merging are required, the estimations should be taken upstream of the intersection point going before vehicle deceleration for a possible stop at the intersection point. If the study requires free-stream speeds, the estimations should be taken in the midst of off-zenith times. A comparable method of reasoning should be taken after for estimations required in the midst of night conditions, wet black-top, and so forth. There are two ordinarily utilized ways to deal with gather vehicle speeds at spot areas: singular vehicle choice strategy and all-inspecting vehicle technique. The individual vehicle assurance system includes using a manual speed estimation method and is generally used for transient speed estimations. This segment focuses on the individual vehicle assurance methodology. In this present survey the average speed, variance & standard deviation, median speed, modal speed & percentile speed of various category of vehicles are determined and analyzed with the accident data of the area thereby finding the reason for the occurrence of accidents and determining the safe speed limits in the area and also providing measures for the improvement of road safety measures on national highway-1 like deciding existing movement operations and assessment of activity control gadgets, setting up roadway plan components, and measuring adequacy of activity control gadgets or movement programs, including signs and markings, activity operational changes, and speed implementation programs.**

Keywords: Spot Speed, Modular Speed, Percentile Speed, Median Speed, Transient Speed.

I. INTRODUCTION

Speed is an essential measure to assess security of the street organize. Speed is likewise a critical transportation parameter in light of the fact that other than wellbeing, it identifies with time, solace, comfort, and financial aspects. As indicated by Currin (2001), rapid conveys high hazard, while low speed is moderately protected. The plan speed ought to be made relying upon the sheltered speed point of confinement of the street. [1] Speed is one of the activity operational components that ought to be considered in the outline of the street geometrics.

A. Scope

Spot speed studies are coordinated to assess the movement of rates of vehicles in a surge of activity at a particular region on a roadway. [2] The proposed look into work goes for breaking down the modular speed of vehicles, highway outline component ,upper and lower speed restrain for regulation, planning and analysis , traffic operation –control and direction. [3]

B. Objective

Figure out if complaints about speeding in the study location are valid and to assess the impacts of present physical enhancements present on the location and then build up passing and non-passing zones based on the speed study and then correlating data obtained from speed study with the accident data of the particular location and then finally preparing the draft for the planning of geometric alignment and also building the speed zone for the safety of road users based on the spot speed data.

II. METHODOLOGY

A comparable method of reasoning should be taken after for estimations required in the midst of night conditions, wet black-top, and so forth. There are two ordinarily utilized ways to deal with gather vehicle speeds at spot areas: singular vehicle choice strategy and all-inspecting vehicle technique. The individual vehicle assurance system includes using a manual speed estimation method and is generally used for transient speed estimations. [4]The all-looking at methodology uses automated as a piece of road or roadside estimation equipment (e.g., pneumatic tubes, standard acknowledgment circles, point circles, et cetera.) And is fitting to use for structure execution checking system. This segment focuses on the individual vehicle assurance methodology.

The data is collected in view of arbitrarily inspecting singular vehicle speed over short time period. It depends on upon watching the time required by vehicle to cover a short separation of Roadway. [3]Mid-Block of the road andstraight and level sections of highways are selected to calculate the spot speed of the vehicles whereas junctions, crossing points are avoided as accurate determination of spot speeds cannot be done. The survey is done during peak hours of a day during weekdays where a regular traffic flow is present and external influences like traffic signals and busy access roads are avoided as vehicles tend to reduce their speeds at these points hence giving raise to inaccuracy. [6]

III. AREA UNDER SURVEY

The study region is extended from NH1 and village road in Chaheru to that of Ludhiana. Chaheru is a town in the locale of Kapurthala, Punjab, India. Closest urban regions are Phagwara and Jalandhar. According to the 2011 measurements, by the Indian Government, Chaheru has 509 families, and a population of 2,458 out of which 1248 are men.

Ludhiana is a metropolitan city in Punjab, and is the biggest city north of Delhi. It is the biggest city in the state, with an expected populace of 1,693,653 as of the 2011 Evaluation. The populace increments significantly amid the collecting season because of the relocation of workers from the eastern conditions of Uttar Pradesh, Bihar, Odisha and Delhi. Ludhiana is found 98 kilometers (61 miles) west of the state capital Chandigarh on NH 95 and is halfway situated on National Expressway 1, which keeps running from the Indian capital New 51%), A few noteworthy National Roadways, NH1, NH95, NH11, NH20 go through the city. The transportation administrations are given by state possessed Punjab Roadways and private transport administrators.

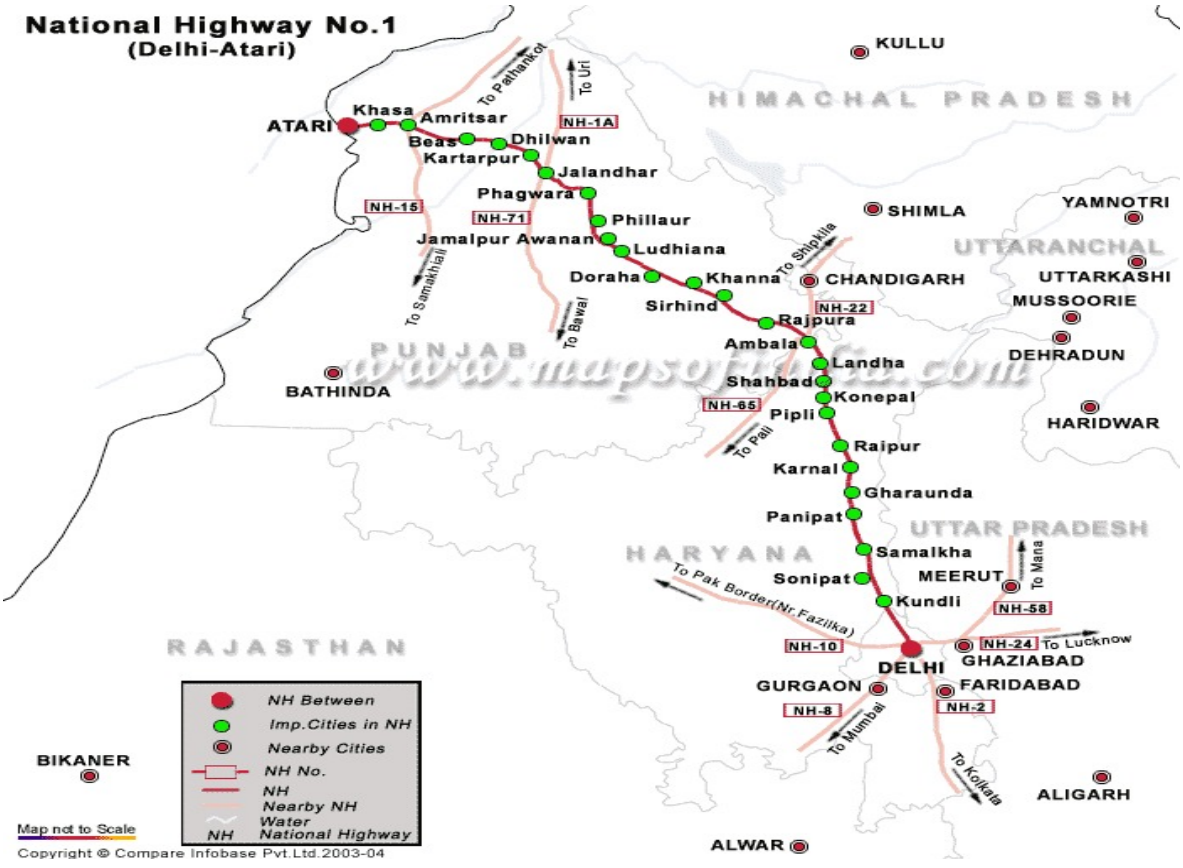

Fig. 1 National Highway No. 1 (Delhi-Atari)

IV. DATA ANALYSIS

The collected data is processed by a few elucidating measurements to get a few thoughts regarding the appropriation of the speed information. (Take note of that numerous measurable investigations utilized as a part of activity building whether the accepted information is regularly appropriated. ➔ In this way, the objective is to check whether they are truly regularly appropriate.

A. Typical Descriptive Statistics:

1. Average speed
2. Variance and standard deviation
3. Median speed
4. Modal speed (or Modal speed range ➔ Needs a histogram)
5. The i^{th}-percentile spot speed

B. *Analysis of Spot Speed data:*

1. To prepare frequency distribution curve.
2. Select number of classes typically between 8 – 20 (another framework: choose stretch out for a class size of 8, then choose keep running for a class size of 20, by detaching the refinement among maximum and minimum speeds by 8 then by 20, then selecting a range between these greatest and min ranges).
3. The mid value for each class is used as a speed value for that class frequency distribution curve (speed mid qualities versus frequency distribution curve).
4. Cumulative distribution (maximum breaking points of speed classes versus frequency distribution curve)

V. RESULTS & DISCUSSIONS

LOCATION: CHAHERU	**DATE: 2/10/16**
WEATHER: SUNNY DAY	**TIME: 10 A.M. TO 2P.M.**
TYPE OF ROAD : NH1	**BASE LENGTH: 50m**
MEASUREMENT TECHNIQUE: MANUALLY	**VEHICLE: BUSES(50)**

TABLE 1. Frequency Distribution of Buses

SPEED RANGE Kmph	MID SPEED (x)	FREQUENCY (f)	%FREQUENCY (%f)	%CUMMULATIVE FREQUENCY (%c.f)	(f_x)
40-50	45	0	0	0	0
50-60	55	3	6	6	165
60-70	65	21	42	48	1365
70-80	75	17	34	82	1275
80-90	85	8	16	98	680
90-100	95	1	2	100	95
100-110	105	0	0	100	0
		∑f=50			∑fx =3580

AVERAGE SPEED FOR BUSES $= \sum fx / \sum f = (3580/50) = 71.6$ kmph

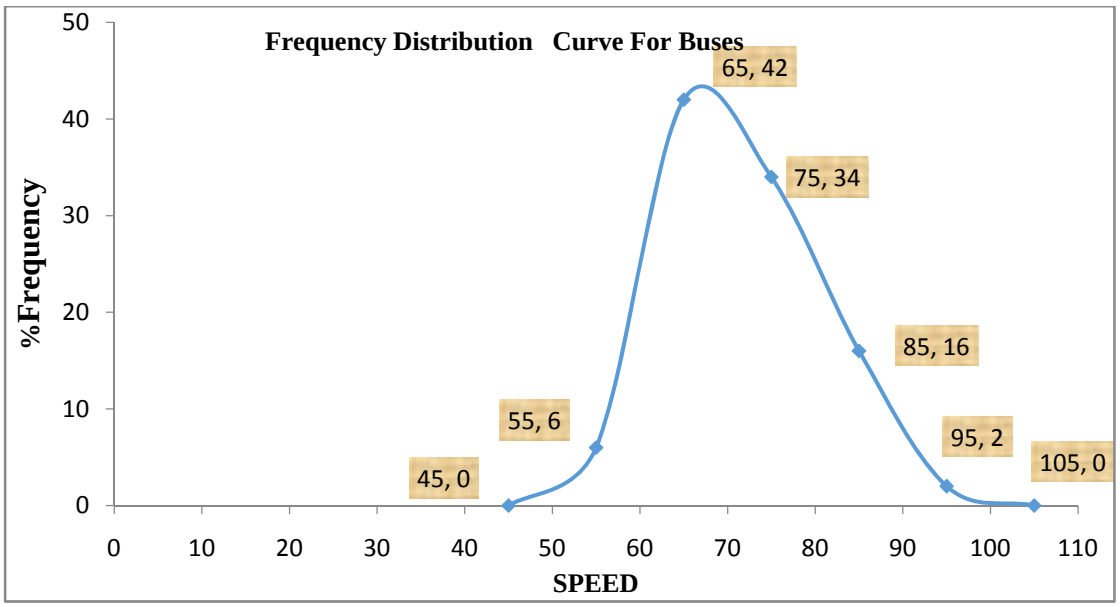

Fig. 2 Frequency Distribution Curve for Buses

From frequencyDistribution curveModal speed =65kmph

Therefore the most preferred speed at which maximumProportion of buses travel is the modal speed = 65 kmph

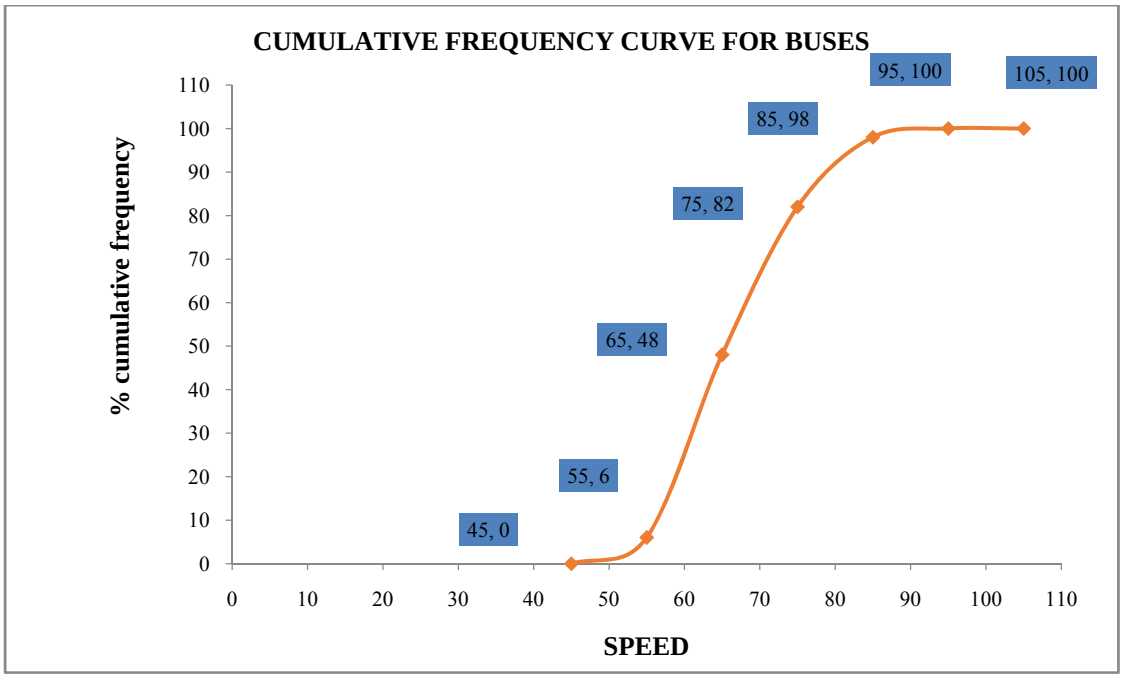

Fig. 3 Cumulative Frequency Curve for buses

For NH1 Chaheru for Buses

1. Upper Speed = 85^{th} Percentile Speed= 80 Kmph
2. Lower Speed = 15^{th}PercentileSpeed= 60 Kmph
3. Design Speed = 98^{th}Percentile Speed= 85 Kmph
4. Median Speed = 50^{th} Percentile Speed=70 Kmph

TABLE 2. Data Analysis for buses

SPEED RANGE Kmph	MID SPEED (v)	(q)	(q.v.)	(q/v)
40-50	45	0	0	0
50-60	55	3	165	0.0545
60-70	65	21	1365	0.3230
70-80	75	17	1275	0.2266
80-90	85	8	680	0.0941
90-100	95	1	95	0.0105
100-110	105	0	0	0.0
		∑f=50	∑qv =3580	∑ q/v = 0.7087

Space mean speed (Vs.) = $\sum \frac{q}{v} / \sum f$ = (0.7087)/ (50)= 0.01417 kmph

Time mean speed (Vt) = $\sum qv / \sum f$ = (3580)/ 50= 71.6 kmph

Standard deviation(S2)= Vs. (Vt -Vs)= 0.01417(71.6 - 0.01417) = 1.014

TABLE 3. Frequency Distribution of Cars

LOCATION: CHAHERU				**DATE: 2/10/16**	
WEATHER: SUNNY DAY				**TIME: 10 A.M. TO 2P.M.**	
TYPE OF ROAD : NH1				**BASE LENGTH: 50m**	
MEASUREMENT TECHNIQUE: MANUALLY				**VEHICLE: cars(50)**	
SPEED RANGE Kmph	**MID SPEED (x)**	**FREQUENCY (f)**	**%FREQUENCY (%f)**	**%CUMMULATIVE FREQUENCY** (%c .f)	(fx)
30-40	35	0	0	0	0
40-50	45	2	4	4	90
50-60	55	6	12	16	330
60-70	65	11	22	38	715
70-80	75	13	26	64	975
80-90	85	11	22	86	935
90-100	95	3	6	92	285
100-110	105	2	4	96	210
110-120	115	2	4	100	230
		∑f=50			∑fx =3770

AVERAGE SPEED FOR CARS = $\sum fx / \sum f$ = (3770/50) = 75.4 kmph

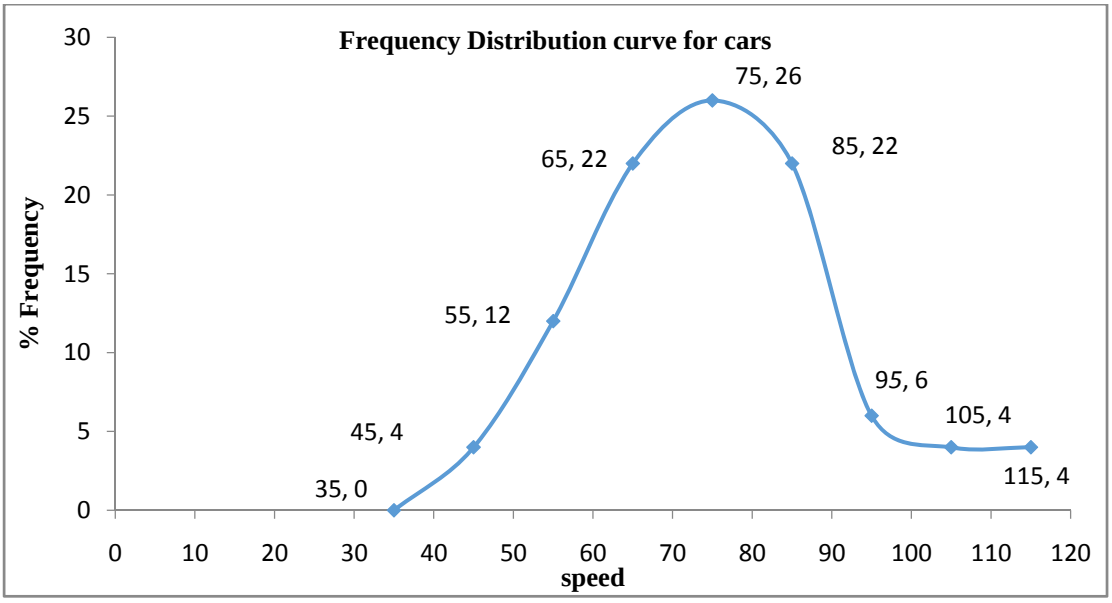

Fig. 4 Frequency Distribution Curve for Cars

From frequencyDistribution curveModal speed =75 kmph

Therefore the most preferred speed at which maximumProportion of cars travel is the MODAL SPEED = 75KMPH

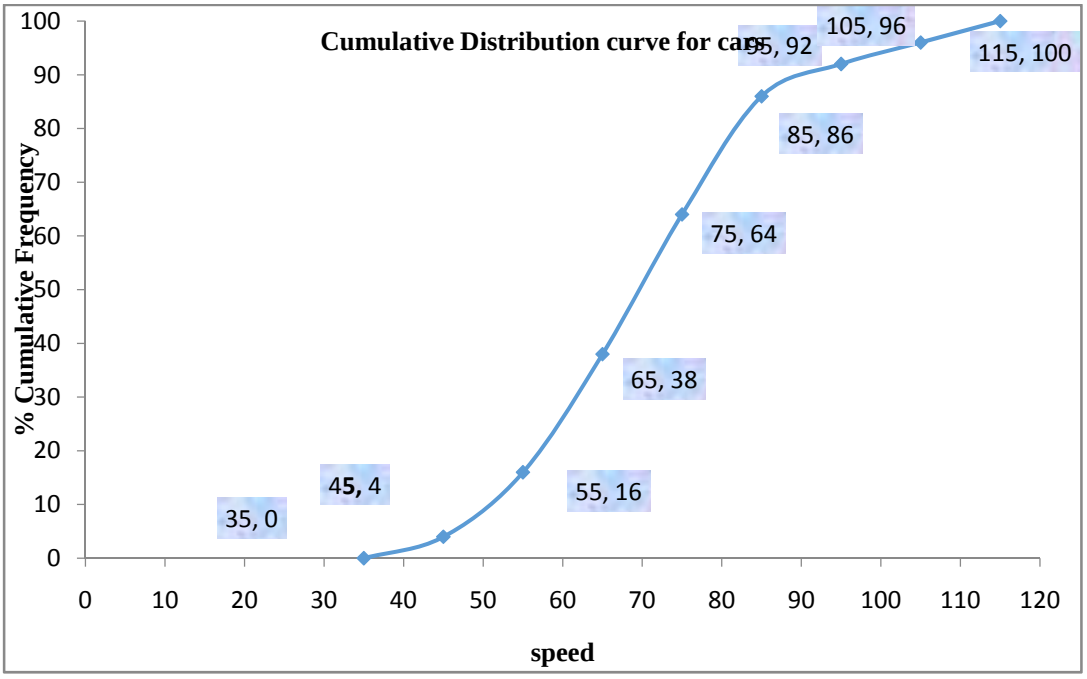

Fig. 5 Cumulative Distribution Curve for Cars

FOR NH1 CHAHERU FOR BUSES

1. UPPER SPEED = 85^{th} percentile speed=80 kmph
2. LOWER SPEED = 15^{th}percentilespeed= 60 kmph
3. DESIGN SPEED = 98^{th}percentile speed= 85 kmph
4. MEDIAN SPEED = 50^{th}percentile speed= 70 kmph

TABLE 4. Data Analysis for Cars

SPEED RANGE Kmph	MID SPEED (v)	(q)	(q.v.)	(q/v)
30-40	35	0	0	0
40-50	45	2	90	0.0444
50-60	55	6	330	0.1090
60-70	65	11	715	0.1692
70-80	75	13	975	0.1733
80-90	85	11	935	0.1294
90-100	95	3	285	0.0315
100-110	105	2	210	0.0190
110-120	115	2	230	0.0173
		∑f=50	∑qv =3770	∑ q/v = 0.6931

Space mean speed (Vs) $= \sum \frac{q}{v} / \sum f$ = (0.6931) / (50) =0.0138 kmph

Time mean speed (Vt) $= \sum qv / \sum f$ = (3370)/ 50= 75.4 kmph

Standard deviation (S2) = Vs. (Vt -Vs)= 0.0138 (75.4 - 0.0138) = 1.04

TABLE 5. Frequency Distribution of Trucks

LOCATION: CHAHERU			**DATE: 2/10/16**		
WEATHER: SUNNY DAY				**TIME: 10 A.M. TO 2P.M.**	
TYPE OF ROAD : NH1				**BASE LENGTH: 50m**	
MEASUREMENT TECHNIQUE: MANUALLY			**VEHICLE: Trucks(50)**		
SPEED RANGE Kmph	**MID SPEED (x)**	**FREQUENCY (f)**	**%FREQUENCY (%f)**	**%CUMMULATIVE FREQUENCY (%c .f)**	**(fx)**
20-30	25	0	0	0	0
30-40	35	2	4	4	70
40-50	45	15	30	34	675
50-60	55	21	42	76	1155
60-70	65	10	20	96	650
70-80	75	2	4	100	150
80-90	85	0	0	100	0
90-100	95	0	0	100	0
		∑f=50			∑fx =2700

AVERAGE SPEED FOR CARS $= \sum fx / \sum f$ = (2700/50) = 54 kmph

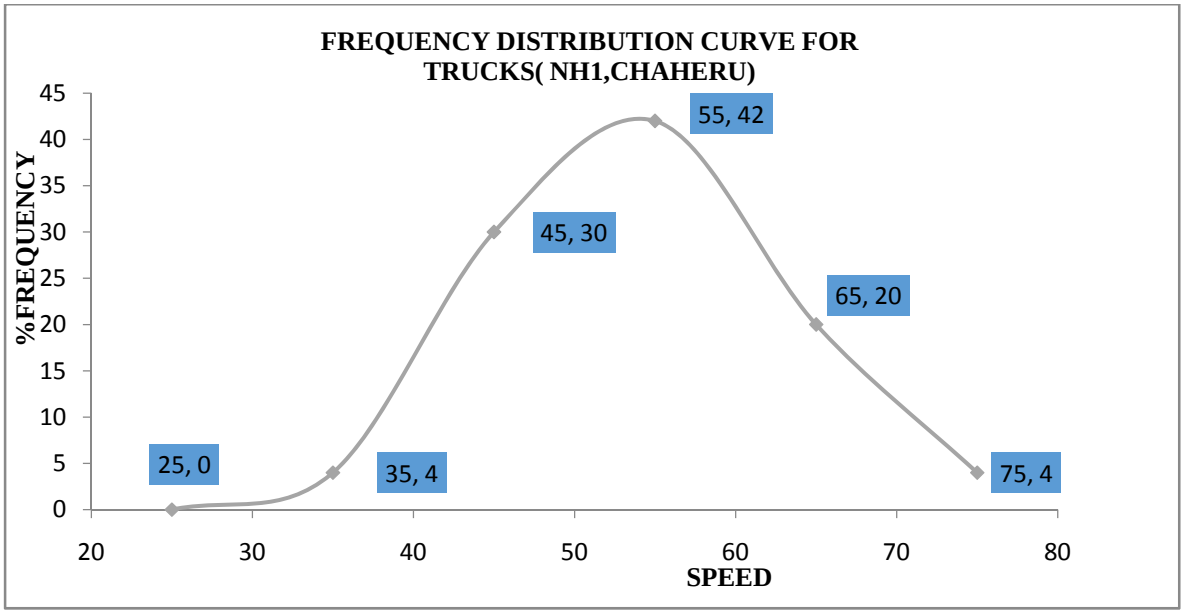

Fig. 6 Frequency Distribution Curve of Trucks

From frequencyDistribution curveModal speed =55kmph

Therefore the most preferred speed at which maximumProportion of trucks travel is the MODAL SPEED = 55 KMPH

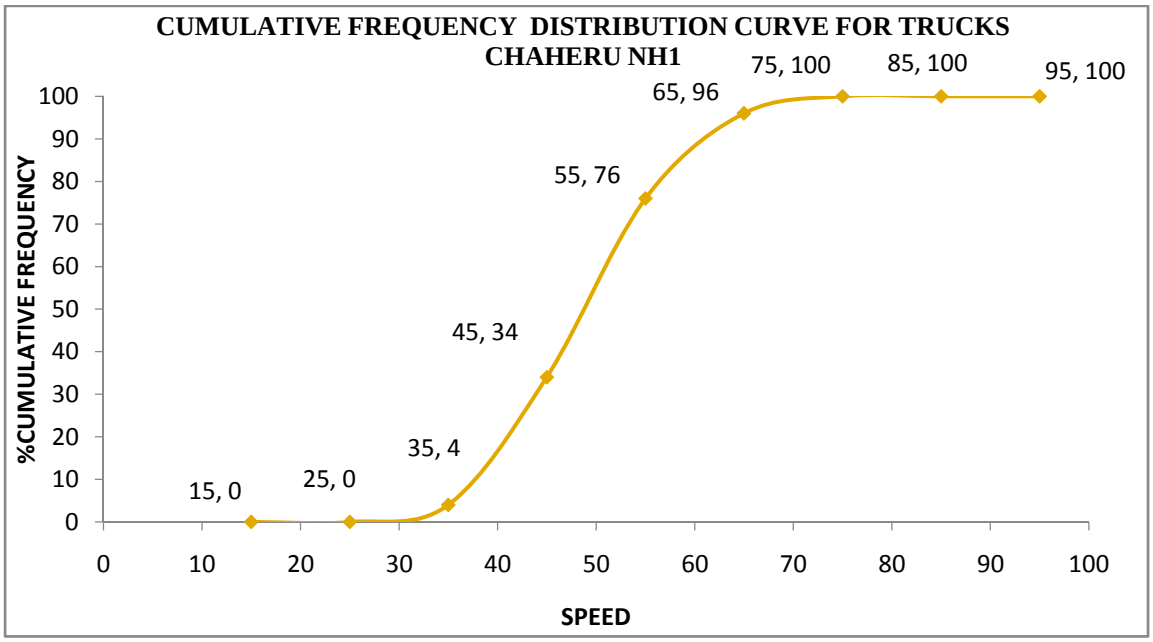

Fig. 7 Cumulative Frequency Distribution Curve of Trucks

1. UPPER SPEED = 85^{th} percentile speed = 60 kmph
2. LOWER SPEED = 15^{th} percentile speed = 40 kmph
3. DESIGN SPEED = 98^{th} percentile speed = 70 kmph
4. MEDIAN SPEED = 50^{th} percentile speed = 50 kmph

TABLE 6. Data Analysis of Trucks

SPEED RANGE Kmph	MID SPEED (v)	(q)	(q.v.)	(q/v)
20-30	25	0	0	0
30-40	35	2	70	0.057
40-50	45	15	675	0.333
50-60	55	21	1155	0.381
60-70	65	10	650	0.153
70-80	75	2	150	0.026
80-90	85	0	0	0.000
		∑f=50	∑qv =2700	∑ q/v = 0.95

Space mean speed (Vs) $= \sum \frac{q}{v} / \sum f =$ (0.95) / (50) = 0.019 kmph

Time mean speed (Vt) $= \sum qv / \sum f$ = (2700)/ 50 = 54 kmph

Standard deviation (S2) = Vs (Vt -Vs) = 0.019 (54 - 0.019) = 1.025

TABLE 7. Frequency Distribution of Two Wheelers

LOCATION: CHAHERU				**DATE: 2/10/16**	
WEATHER: SUNNY DAY				**TIME: 10 A.M. TO 2P.M.**	
TYPE OF ROAD : NH1				**BASE LENGTH: 50m**	
MEASUREMENT TECHNIQUE: MANUALLY				**VEHICLE: Two wheelers (50)**	
SPEED RANGE Kmph	**MID SPEED (x)**	**FREQUENCY (f)**	**%FREQUENCY (%f)**	**%CUMMULATIVE FREQUENCY (%c .f)**	**(fx)**
30-40	35	0	0	0	0
40-50	45	1	2	2	45
50-60	55	12	24	26	660
60-70	65	16	32	58	1040
70-80	75	16	32	90	1200
80-90	85	4	8	98	340
90-100	95	1	2	100	95
		∑f=50			∑fx =3380

AVERAGE SPEED FOR TWO WHEELER $= \sum fx / \sum f$ = (3380/50) = 67.6 kmph

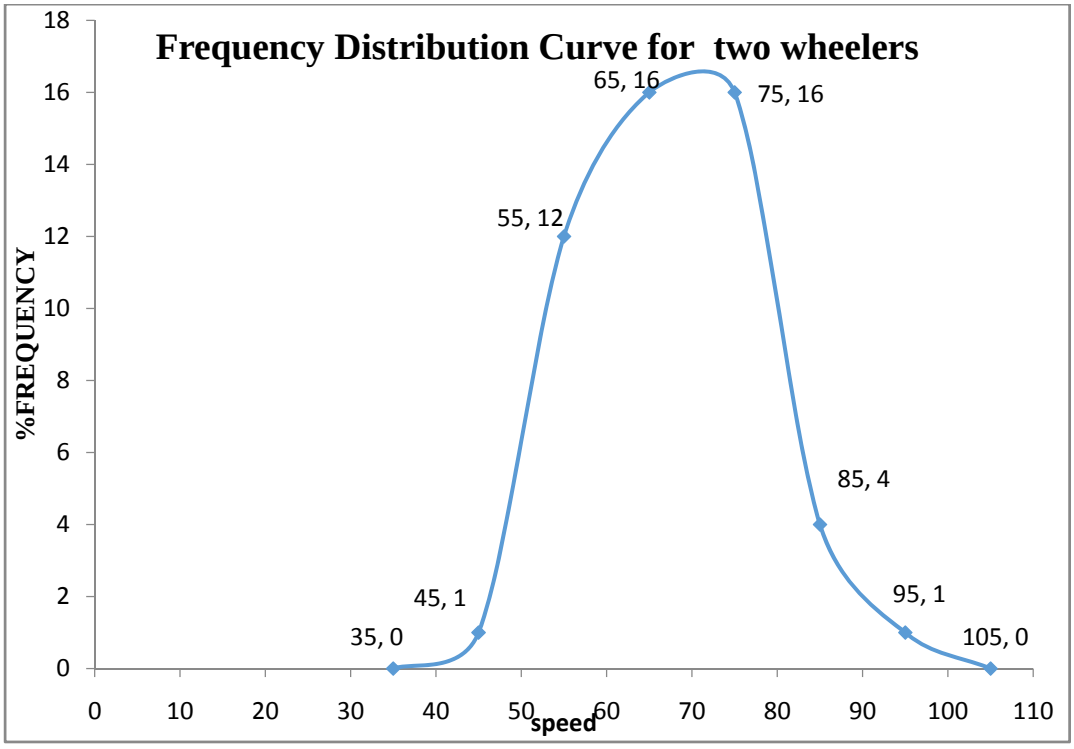

Fig. 8 Frequency Distribution Curve of Two Wheelers

From frequencyDistribution curveModal speed = 65 kmph

Therefore the most preferred speed at which maximumProportion of trucks travel is the MODAL SPEED = 65KMPH

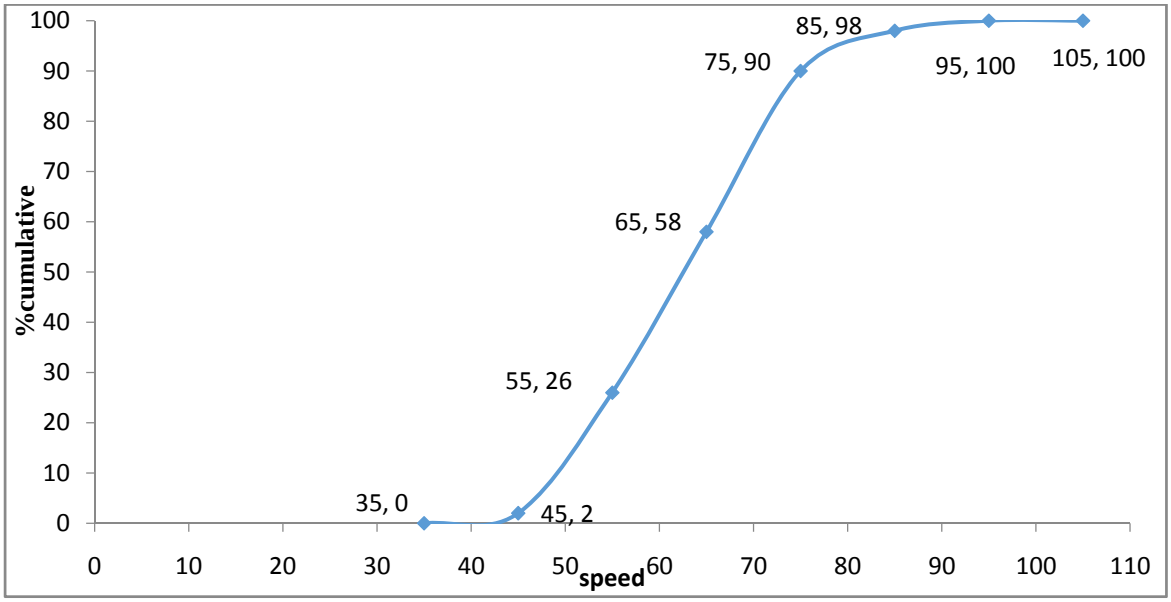

Fig. 9 Cumulative Frequency Distribution Curve for Two Wheelers

FOR NH1 CHAHERU FOR TWO WHEELERS

1. UPPER SPEED = 85^{th} percentile speed = 70 kmph
2. LOWER SPEED = 15^{th}percentile speed = 45 kmph
3. DESIGN SPEED = 98^{th}percentile speed = 85 kmph
4. MEDIAN SPEED = 50^{th} percentile speed = 60 kmph

TABLE 8. Data Analysis of Two Wheelers

SPEED RANGE Kmph	MID SPEED (v)	(q)	(q.v.)	(q/v)
20-30	25	0	0	0.0
30-40	35	0	0	0.0
40-50	45	1	45	0.0222
50-60	55	12	660	0.2181
60-70	65	16	1040	0.2461
70-80	75	16	1200	0.2133
80-90	85	4	340	0.0470
90-100	95	1	95	0.0105
		∑f=50	∑qv =3380	∑ q/v = 0.7572

Space mean speed (Vs) $= \sum \frac{q}{v} / \sum f$ = (0.7572) / (50) = 0.01514 kmph

Time mean speed (Vt) $= \sum qv / \sum f$ = (3380)/ 50 = 67.6 kmph

Standard deviation (S2) = Vs (Vt -Vs) = 0.01514(67.6 - 0.01514) = 1.023

TABLE 9. Frequency Distribution of Two Wheelers Maheru Road

LOCATION: CHAHERU			**DATE: 2/10/16**		
WEATHER: SUNNY DAY			**TIME: 10 A.M. TO 2P.M.**		
TYPE OF ROAD : MAHERU ROAD			**BASE LENGTH: 50m**		
MEASUREMENT TECHNIQUE: MANUALLY			**VEHICLE: Two wheelers (50)**		
SPEED RANGE Kmph	**MID SPEED (x)**	**FREQUENCY (f)**	**%FREQUENCY (%f)**	**%CUMMULATIVE FREQUENCY (%c .f)**	**(fx)**
10-20	15	0	0	0	0
20-30	25	15	30	30	375
30-40	35	26	52	82	910
40-50	45	6	12	94	270
50-60	55	2	4	98	110
60-70	65	1	2	100	65
		∑f=50			∑fx =1730

AVERAGE SPEED FOR TWO WHEELER $= \sum fx / \sum f$ = (1730/50)= 34.6 kmph

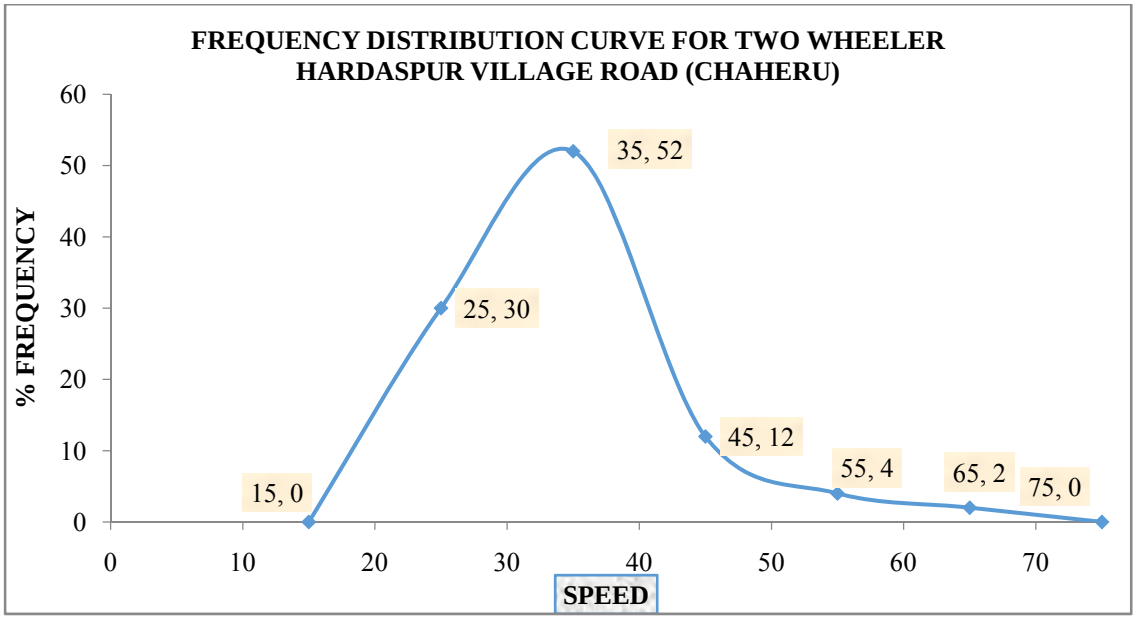

Fig. 10 Frequency Distribution Curve of Two Wheelers Maheru Road

From frequencyDistribution curveModal speed = 52 kmph

Therefore the most preferred speed at which maximumProportion of trucks travel is the MODAL SPEED = 52 KMPH

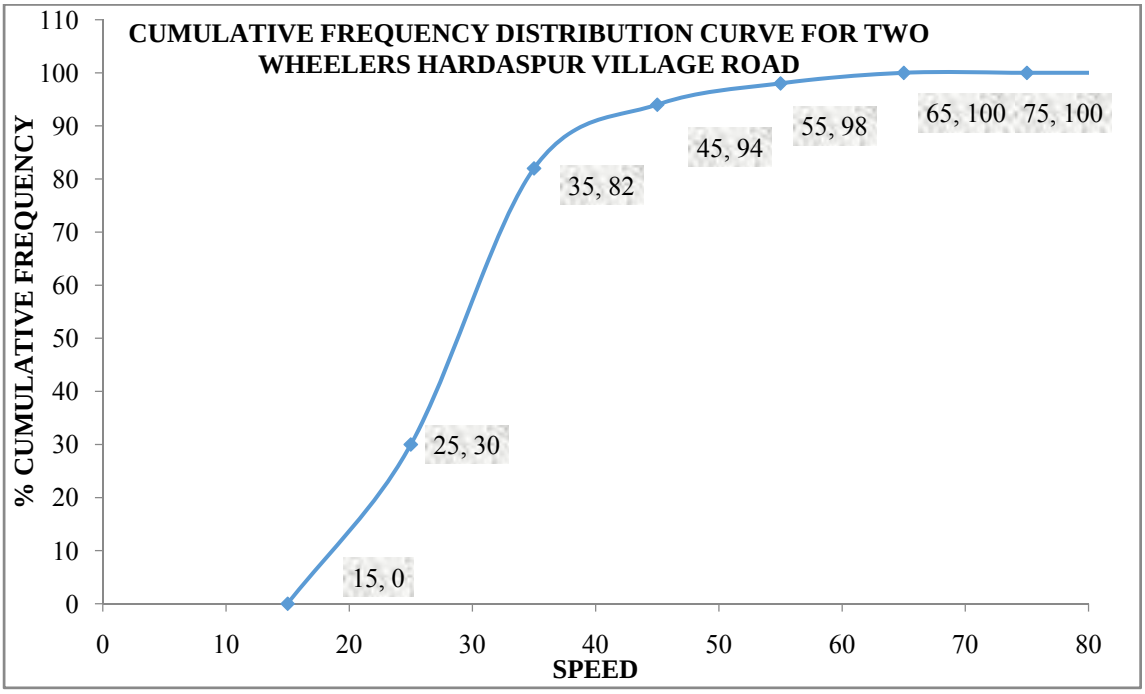

Fig. 11 Cumulative Frequency Distribution Curve for Two Wheelers Maheru Road

FOR VR CHAHERU FOR TWO WHEELERS

1. UPPER SPEED = 85^{th} percentile speed=40 kmph
2. LOWER SPEED = 15^{th}percentilespeed=20 kmph
3. DESIGN SPEED = 98^{th}percentile speed= 55 kmph
4. MEDIAN SPEED = 50^{th}percentile speed =30 kmph

TABLE 10. Data Analysis of Two Wheelers Maheru Road

SPEED RANGE Kmph	MID SPEED (v)	(q)	(q.v.)	(q/v)
10-20	15	0	0	0.000
20-30	25	15	375	0.600
30-40	35	26	910	0.7428
40-50	45	6	270	0.1333
50-60	55	2	110	0.03636
60-70	65	1	65	0.01538
		∑f=50	∑qv =1730	∑ q/v = 1.90682

Space mean speed (Vs) $= \sum \frac{q}{v} / \sum f$ = (1.9068)/ (50) =0.0381 kmph

Time mean speed (Vt) $= \sum qv / \sum f$ = (1730)/ 50 = 34.6 kmph

Standard deviation(S2) = Vs. (Vt -Vs)= 0.0381(34.6 -0.0381) = 1.31

VI. CONCLUSION

A. For NH-1 Chaheru

1.) Modal Speed:

BUS = 65 kmph

CAR = 75 kmph

TRUCK = 55 kmph

TWO WHEELER = 70 kmph

B. For Village Road Chaheru

1.) Modal Speed:

TWO WHEELER = 35 kmph

SPEED TO CHECK DESIGN ELEMENT = 98^{TH} PERCENTILE SPEED

Speed is one of the development operational parts that should be considered in the layout of the road geometrics. The safe acceptable speed most remote indicate will make vehicles go in a sorted out and safe way. The effects of road geometrical design on the speed of the vehicles exhibit that the differences in road geometrical framework would particularly impact the speed of the vehicles. The design speed should be made depending upon the shielded speed limit of the road. The vehicles found in the lower 15 percent are considered to be travelling unreasonably direct and those saw over the 85th percentile are thought to outperform a secured and reasonable speed. 85th percentile could be a govern in setting up the speed limit as this speed is seen as protected and reasonable under conditions states of the road.

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