A

Project Report

On

SPEED-FLOW-DENSITY STUDY OF TWO DIFFERENT INDIAN ROADS AND THEIR COMPARISONS

Submitted by

Sonu Agarwal

(Roll No: 107CE037)

In partial fulfillment of the requirements for the degree in

Bachelor of Technology in Civil Engineering

Under the guidance of

Prof. Ujjal Chattaraj

Department of Civil Engineering

National Institute of Technology Rourkela

May, 2011

CERTIFICATE

It is certified that the work contained in the thesis entitled "*Speed-flow-density study of two different Indian roads and their comparisons*" submitted by Mr. Sonu Agarwal, has been carried out under my supervision and this work has not been submitted elsewhere for a degree.

Date: 11.05.2011

(Ujjal Chattaraj, Ph.D.)
Assistant Professor
Dept. of Civil Engineering
NIT Rourkela

Acknowledgements

First and foremost we take this opportunity to express our deepest sense of gratitude to our guide *Prof. Ujjal Chattaraj* for his able guidance during our project work. This project would not have been possible without his help and the valuable time that he has given us amidst his busy schedule.

I sincerely thank Dr. Lelitha Devi Vanajakshi, Assistant Professor, Transportation Division, and IITM for providing traffic data for my B.Tech project.

I thank to Ms. Asha Anand, Ms. Harshitha M.S., Mr.Vasanth, Mr.Samraj and Mr. Siva, Transportation Engineering from Indian Institute of Technology, Madras for their valuable help in collecting the data at IT corridor, Chennai city on 30th June, 2010.

I thank to Mr. B.B. Sutradhar, Mr. S. Purohit, Mr. D. Kar and Mr. S. S. Mohapatra, Transportation Engineering from National Institute of Technology, Rourkela for their valuable help in collecting the data at sector-2, Rourkela on 16th Feb, 2011.

Sonu Agarwal

Roll No. 107CE037

B.Tech. Final Year,

Dept. of Civil Engineering,

N.I.T Rourkela.

ABSTRACT

In this work speed -flow-density study of an Indian road has been conducted. Data has been collected using video camera and later decoded in computer. This data is very essential to estimate capacity of an Indian road. Since the collected data is of a narrow density domain, capacity prediction from this data is not promising. One of the data is collected in Chennai and another data is from Rourkela .Both the data's were compared statistically. For both the data's

Z-value is calculated and it is compared with Z-critical to define whether both the data's are same or different.

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CHAPTER 1

Introduction

Traffic Flow depends upon the driver's movement and the interactions done by the vehicles in between two points. We cannot predict the traffic flow only by the driver's movement which is more difficult to analyze. The basic parameters of traffic flow are speed, density and flow which are most essential to know before to understand the vehicle flow. With the above three parameters we can design, plan and operate the roadway facility [1].

1.1 Speed

In traffic engineering speed is defined as the distance travelled by a vehicle over a certain period of time. It's quite impossible to calculate the speed of every individual vehicle and due to this the average speed is taken in to account. Average speed can be calculated in two ways. They are time mean speed and space mean speed.

Time mean speed is defined as the average of speed of vehicles crossing a particular section.

Space mean speed is defined in the following manners. First of all the time taken by a vehicle to cross a particular section is calculated and later on it is averaged for all the vehicles which cross the section in a particular time. Now space mean speed is defined as the ratio of distance (length) of particular section and the average time of vehicles crossing that particular section.

Units: S.I unit is m/sec and C.G.S unit is cm/sec.

1.2 Flow

It is defined as the ratio of number of vehicles crossing a particular section and the time taken by the vehicle to cross that particular section.

Units: vehicles/time

1.3 Density

After a particular time the number of vehicles which occupy the particular region is defined as density. The density is generally averaged over certain duration of time.

Units: vehicles/distance

The above mentioned flow parameters are related to a basic equation

$$q = u*k \tag{1}$$

From the above equation it can be noted that the speed, density and flow are related to one another. The relations can be produced in the following way

$u = f_1$ (k), $q = f_2$ (k) and $u = f_3$ (q) and plots of the above relations are considered to be as fundamental diagrams. Just by the above equations it is more sufficient to describe the fundamental properties of any vehicle stream.

1.4 Fundamental diagrams of traffic flow

By the following curves we can know the relation in between the density and speed, speed and flow, flow and density. These can be explained one by one in detail.

1.4.1 Speed-density relation

From the diagram it is very clear that the speed will be maximum when the density is zero or the vehicles flowing with the free flow speed. When the speed is zero then from the diagram it is clear that the density is maximum. From the figure it is clear that the variation of speed with the density is linear in shape which can be represented in solid line in figure 1.When the density becomes jam density then the speed of vehicles is clearly zero.

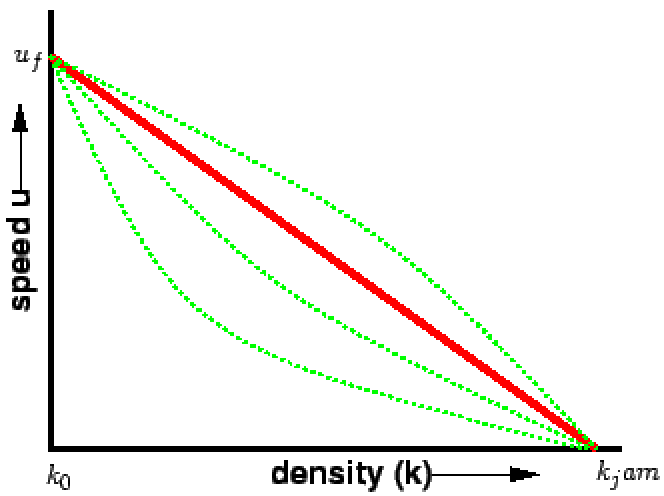

Figure 1: Speed-density diagram

Non-linear relationships can be obtained from the figure which is represented separately in dotted lines.

1.4.2 Speed-flow relation

The relation in between speed and flow can be explained as follows. If there are no vehicles or there are so many vehicles in such a position that they cannot move then the flow is considered to be zero. The flow becomes maximum when the speed is either zero or free flow speed. This relationship can be seen clearly from the figure 2.

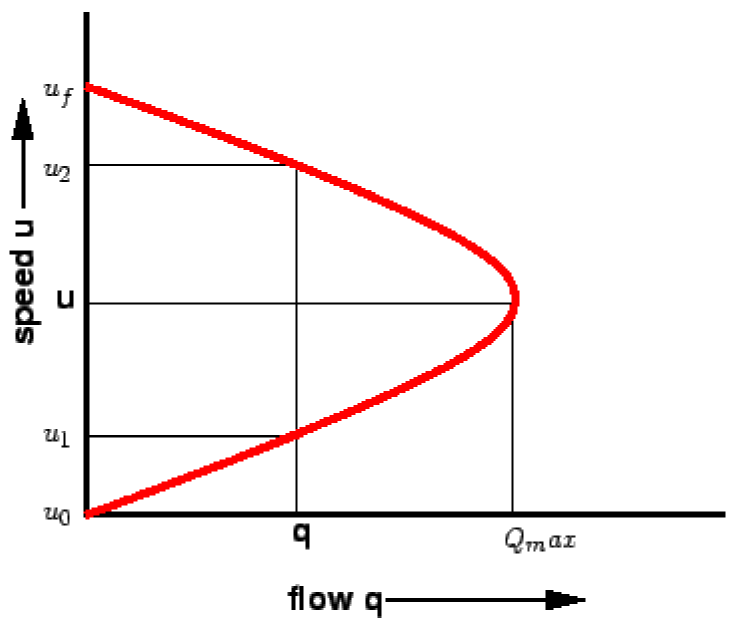

Figure 2: Speed-flow diagram

At speed u the maximum flow q_{max} occurs. For a given flow there can be two different speeds.

1.4.3 Flow-density relation

Time and location are the factors for the variation of flow and density. From the figure we can find the relation in between the flow and density and some of the characteristics are mentioned below.

1. When there are no vehicles on the road then the density is zero and automatically the flow is zero.
2. The density and flow will increase when the number of vehicles increases on the road stretch.
3. If vehicles go on increasing then the vehicles can't move which is known as maximum density or jam density. The flow is zero at the position of jam density because vehicles are not moving.
4. When the flow is maximum then the density is jam density or maximum density. From the figure it is clear that the relation is in parabolic shape as shown in figure 3.

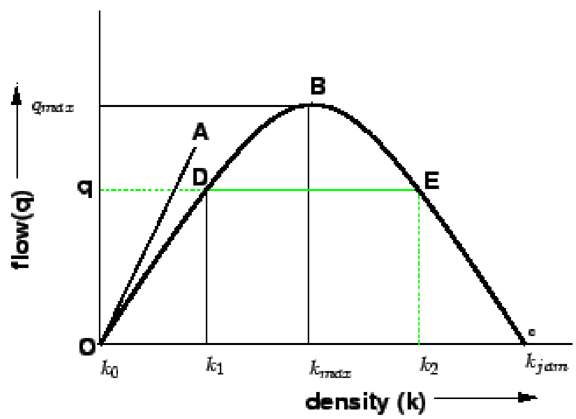

Figure 3: Flow density curve

From the figure it can be seen that the point O refers as zero density and zero flow. The maximum flow occurs at point B where the corresponding density is considered to be jam density .At point C the flow is zero and the density is considered to be jam density or maximum density. A tangent OA is drawn to the parabola and the slope can be found out which gives the speed with which a vehicle passes on the road stretch when the flow is zero. For the same flow there can be two different densities which can be seen from figure and the respective points are D and E. The mean speed at density k_1 can be calculated from the slope of the line OD and similarly the mean speed at density k_2 can be found out from the slope of the line .It is very clear that the speed at density k_1 is higher due to less number of vehicles on the road stretch [2].

1.5 Normal distribution

In statistical distributions the normal distribution plays an important role. Generally the normal distributions curves are symmetrical in shape .It contains only one single peak with bell shaped density curves. To define the normal distribution curve we must be well known with two parameters .They are mean and standard deviation. Mean determines the peak's location and standard deviation determines the spread of the bell curve. When the values of mean and standard deviation are different then the normal distributions are also different. For any value of x the height of the density is shown below [3].

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2} \qquad (2)$$

The characteristics of bell curve are described as follows

1. Symmetrical in shape

2. It is unimodal

3. It can be extended to +/- infinity

4. The value of the area which is under curve=1[4].

1.6 Z-Score

A Z-score which is used normally in statics is defined as the calculation of the number of standard deviations which may be above or below to the mean. Sometimes Z-scores are referred as standard scores or Z-values. It can be measured by deducting the mean from raw score and dividing it by standard deviation. From the Microsoft Excel also we can calculate the Z-score which is a function in Microsoft Excel [5].

CHAPTER 2

Literature Review

The three parameters flow, speed and density help in determining the traffic flow. The relations in between speed, flow and density are known as fundamental diagrams which gained more attention since Greenshields found a numeric model in 1935. A linear relationship exists in between speed and density. Recent studies involve mainly the relationships in between the speed- flow – density, definition of traffic flow parameters and nature of fundamental diagrams. Among the above three definition of traffic parameters plays a vital role because it is the basic analysis of traffic phenomenon. The traffic conditions are particularly divided in to three different categories, namely uncongested, queue discharge and congested. In previous studies the flow density relation is used for examining the qualitative signature [6].

Greenberg (1959) found out a logarithmic relation in between the flow parameters.

$$U = c \ln (K / K_j) \qquad (3)$$

Where u=velocity at any time

C=a constant (optimum speed)

K=density at that instant

K_j=jam density

At maximum flow the value c is the speed.

Duncan (1976, 1979) showed three step procedures

1) The density can be calculated from the data of flow and speed
2) A speed-density function is fitted to that data
3) Now by transforming the speed-density function in to a speed-flow function which results in a curve and it doesn't suit the original data of speed-slow [7].

CHAPTER 3

Present Study

3.1 Data Collection and Extraction

The IIT Madras data was collected with the help of video camera which were placed at the entry and exit of road at IT corridor, Chennai city on 30^{th} June, 2010.The distance between the entry and exit point is 1KM. The video was started at 11.50 AM and it is continued till 14.29 PM. The video was run in computer and the numbers of vehicles are counted for every minute at entry and exit points. The initial density is 75/1000 vehicles/m.

The NIT Rourkela data was collected with the help of video camera which was placed in inclined position to the flow of traffic at sector-2, Rourkela on 16 February, 2011.A particular road section was considered for counting the vehicles and 4 poles were kept around the road section (2 poles on the left side and remaining 2 poles on the right side of the road).The length of the section was 5 meters and the width of the section was 7 meters. The video was started at 11.30 am and it is continued till 12.30 pm. The section which was considered for counting the vehicles is in rectangular in shape and the video was decoded in the computer. The poles which were kept along the sides of the road are considered as 4 reference points in the computer. The flow data is calculated at entry and exit points such a way that the vehicles which are passing through the rectangular section in every minute. The exit flow data is considered in the project. The density data is calculated after every 10 sec i.e. the number of vehicles staying in the rectangular section after every 10 sec and then the density data is averaged. The speed data is done by calculating the time the vehicle which enters and exit the rectangular section. With the help of initial density the density is calculated at every minute using the procedure as follows:

$$k_t = k_{t-1} + N_{entry} - N_{exit} \quad (4)$$

Where, k_t is the density at time t,

N_{entry} is the number of vehicles entered the stretch during the time from t-1 to t , and

N_{exit} is the number of vehicles going out the stretch during the time from t-1 to t.

It must be mentioned here that flow at time t is the outcome of density during the time period t to t-1. So, flow at time t is plotted with average density between t and t-1.

3.2 Data Analysis and Methodology

IIT Madras data: A graph is drawn in between the average density (vehicle/m) in X-axis and exit flow (vehicle/s) in Y-axis. But the graph is not to point due to lack of insufficient data points. The collected data for that particular kind of road stretch is of a limited density domain (as shown in Figure 4). The figure also shows a fitted second order polynomial to the data (which is expected to explain the nature of any flow-density diagram). The maximum of the fitted curve, i.e., the highest flow value indicates capacity of the road stretch. Due to limited domain data that point is not promising (as can be seen from the figure that some data points are quite above the maximum). So, it is desired to devise a new methodology to estimate capacity from the limited domain data.

Average Density(vehicle/m)	Flow(vehicle/s)
86	52

102	60
93	70
98.5	46
98	72
87.5	49
87.5	63
85.5	51
90	64
78.5	62
100	34
96.5	91
85.5	38
86	77
78.5	35
95	68
83.5	69
86.5	44
80	73
90	32
103	90
84	58
98	48
90.5	81

92	33
94	75
86.5	51
97.5	63
98.5	68
93	74
82.5	54
97	42
93.5	81
96	52
97.5	84
87	61
102.5	68
90.5	85
92	47
80	91
68.5	37
77	71
73	56
83	57
80.5	64
92	54
79	82

74	33
90.5	72
78.5	54
95	53
105.5	72
101	63
97.5	77
99	62
90	81
80.5	53
72	59
76	38
96.5	59
105	79
115	60
97.5	95
93.5	55
89.5	77
71.5	50
93	47
101.5	81
81	73
87.5	49

75.5	81
66.5	33
100	52
91	83
65.5	53
80.5	42
89	70
104.5	45
106.5	102
68.5	61
78.5	26
90	85
66.5	56
79	38
89.5	71
89.5	48
79.5	68
91	34
95.5	84
86	48
93	65
92.5	56
106	67

85	82
89	30
100	81
87.5	60
95	67
95	63
92	64
90.5	59
99	66
94	65
94.5	52
95	71
87	56
87	62
78.5	51
105	36
113.5	86
111	55
101	86
85.5	44
91	64
77	51
102	36

111.5	78
99	55
96.5	72
94.5	58
115.5	62
106.5	99
101.5	53
85	87
74.5	33
77.5	65
72.5	32
96.5	57
89	83
88.5	44
80	74
78.5	33
88.5	73
79.5	49
83.5	60
78.5	55
87	45
84	62
86	48

85	70
78.5	43
87	59
80	57
97	40
91	84
87.5	42
93.5	76
86.5	54
84	65
67.5	50
86.5	37
88	65
88.5	43
86.5	72
89	40
99.5	76
71.5	62
66.5	35
63.5	52

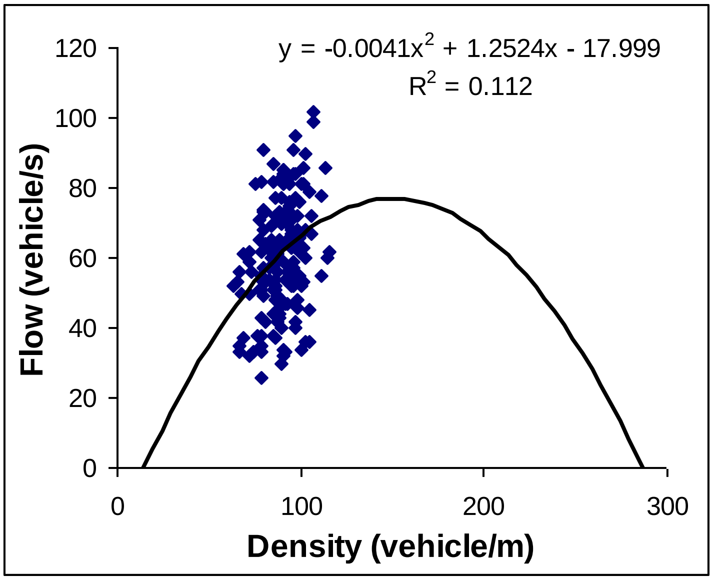

Figure 4: Fitted flow-density diagram for the collected data

Further, relative frequency distribution of density and flow are plotted (shown in Figures 5 and 6). From those figures it can be observed that both the density and flow data are nearly normally distributed [8].

Average density (v/m)	Sorting
0.086	0.0635
0.102	0.0655
0.093	0.0665
0.0985	0.0665
0.098	0.0665
0.0875	0.0675
0.0875	0.0685
0.0855	0.0685

0.09	0.0715
0.0785	0.0715
0.1	0.072
0.0965	0.0725
0.0855	0.073
0.086	0.074
0.0785	0.0745
0.095	0.0755
0.0835	0.076
0.0865	0.077
0.08	0.077
0.09	0.0775
0.103	0.0785
0.084	0.0785
0.098	0.0785
0.0905	0.0785
0.092	0.0785
0.094	0.0785
0.0865	0.0785
0.0975	0.0785
0.0985	0.079
0.093	0.079
0.0825	0.0795

0.097	0.0795
0.0935	0.08
0.096	0.08
0.0975	0.08
0.087	0.08
0.1025	0.0805
0.0905	0.0805
0.092	0.0805
0.08	0.081
0.0685	0.0825
0.077	0.083
0.073	0.0835
0.083	0.0835
0.0805	0.084
0.092	0.084
0.079	0.084
0.074	0.085
0.0905	0.085
0.0785	0.085
0.095	0.0855
0.1055	0.0855
0.101	0.0855
0.0975	0.086

0.099	0.086
0.09	0.086
0.0805	0.086
0.072	0.0865
0.076	0.0865
0.0965	0.0865
0.105	0.0865
0.115	0.0865
0.0975	0.087
0.0935	0.087
0.0895	0.087
0.0715	0.087
0.093	0.087
0.1015	0.0875
0.081	0.0875
0.0875	0.0875
0.0755	0.0875
0.0665	0.0875
0.1	0.088
0.091	0.0885
0.0655	0.0885
0.0805	0.0885
0.089	0.089

0.1045	0.089
0.1065	0.089
0.0685	0.089
0.0785	0.0895
0.09	0.0895
0.0665	0.0895
0.079	0.09
0.0895	0.09
0.0895	0.09
0.0795	0.09
0.091	0.0905
0.0955	0.0905
0.086	0.0905
0.093	0.0905
0.0925	0.091
0.106	0.091
0.085	0.091
0.089	0.091
0.1	0.092
0.0875	0.092
0.095	0.092
0.095	0.092
0.092	0.0925

0.0905	0.093
0.099	0.093
0.094	0.093
0.0945	0.093
0.095	0.0935
0.087	0.0935
0.087	0.0935
0.0785	0.094
0.105	0.094
0.1135	0.0945
0.111	0.0945
0.101	0.095
0.0855	0.095
0.091	0.095
0.077	0.095
0.102	0.095
0.1115	0.0955
0.099	0.096
0.0965	0.0965
0.0945	0.0965
0.1155	0.0965
0.1065	0.0965
0.1015	0.097

0.085	0.097
0.0745	0.0975
0.0775	0.0975
0.0725	0.0975
0.0965	0.0975
0.089	0.098
0.0885	0.098
0.08	0.0985
0.0785	0.0985
0.0885	0.099
0.0795	0.099
0.0835	0.099
0.0785	0.0995
0.087	0.1
0.084	0.1
0.086	0.1
0.085	0.101
0.0785	0.101
0.087	0.1015
0.08	0.1015
0.097	0.102
0.091	0.102
0.0875	0.1025

0.0935	0.103
0.0865	0.1045
0.084	0.105
0.0675	0.105
0.0865	0.1055
0.088	0.106
0.0885	0.1065
0.0865	0.1065
0.089	0.111
0.0995	0.1115
0.0715	0.1135
0.0665	0.115
0.0635	0.1155

Grouping	Frequency	Relative frequency
<0.064	1	0.006289308
<0.068	5	0.031446541
<0.072	4	0.025157233
<0.076	6	0.037735849
<0.08	16	0.100628931
<0.084	12	0.075471698
<0.088	28	0.176100629
<0.092	23	0.144654088
<0.096	22	0.13836478

<0.1	19	0.119496855
<0.104	11	0.06918239
<0.108	7	0.044025157
<0.112	2	0.012578616
<0.116	3	0.018867925

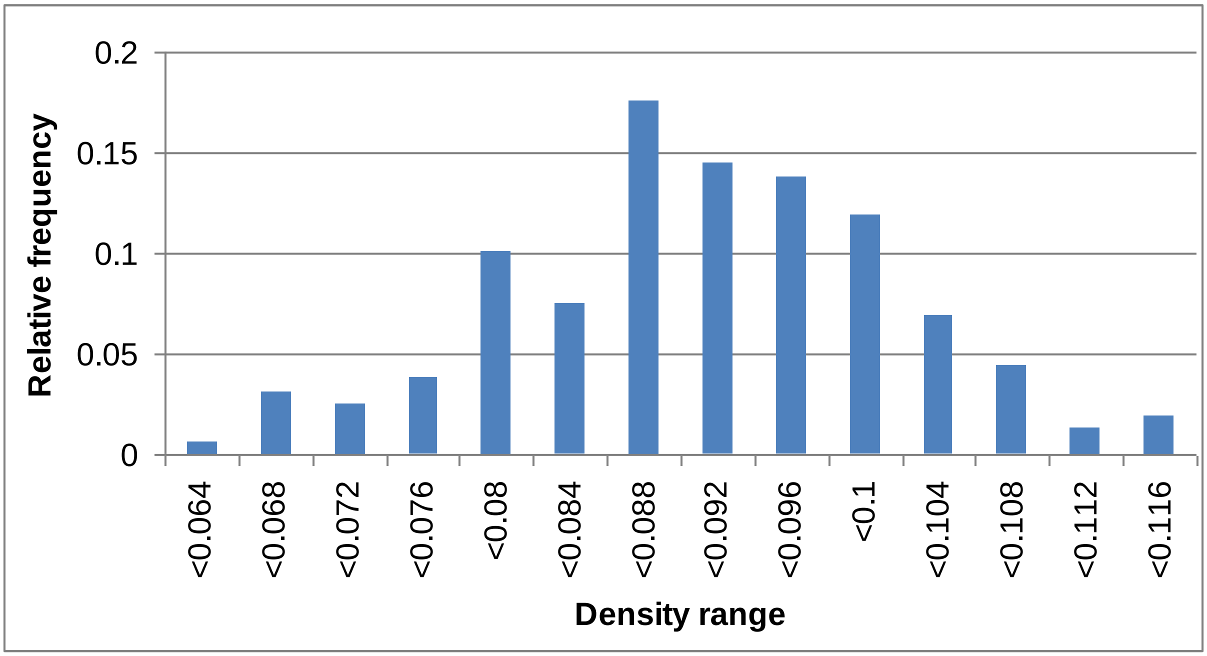

Figure 5: Relative frequency distribution of collected density data

Exit flow (v/s)	Sorting
1.233333333	0.433333
0.866666667	0.5
1	0.533333
1.166666667	0.533333

0.766666667	0.55
1.2	0.55
0.816666667	0.55
1.05	0.55
0.85	0.55
1.066666667	0.566667
1.033333333	0.566667
0.566666667	0.583333
1.516666667	0.583333
0.633333333	0.6
1.283333333	0.6
0.583333333	0.616667
1.133333333	0.616667
1.15	0.633333
0.733333333	0.633333
1.216666667	0.633333
0.533333333	0.666667
1.5	0.666667
0.966666667	0.7
0.8	0.7
1.35	0.7
0.55	0.716667
1.25	0.716667

0.85	0.733333
1.05	0.733333
1.133333333	0.733333
1.233333333	0.75
0.9	0.75
0.7	0.766667
1.35	0.783333
0.866666667	0.783333
1.4	0.8
1.016666667	0.8
1.133333333	0.8
1.416666667	0.8
0.783333333	0.816667
1.516666667	0.816667
0.616666667	0.816667
1.183333333	0.833333
0.933333333	0.833333
0.95	0.85
1.066666667	0.85
0.9	0.85
1.366666667	0.85
0.55	0.866667
1.2	0.866667

0.9	0.866667
0.883333333	0.866667
1.2	0.866667
1.05	0.883333
1.283333333	0.883333
1.033333333	0.883333
1.35	0.883333
0.883333333	0.9
0.983333333	0.9
0.633333333	0.9
0.983333333	0.9
1.316666667	0.916667
1	0.916667
1.583333333	0.916667
0.916666667	0.916667
1.283333333	0.933333
0.833333333	0.933333
0.783333333	0.933333
1.35	0.933333
1.216666667	0.95
0.816666667	0.95
1.35	0.95
0.55	0.966667

0.866666667	0.966667
1.383333333	0.983333
0.883333333	0.983333
0.7	0.983333
1.166666667	0.983333
0.75	1
1.7	1
1.016666667	1
0.433333333	1
1.416666667	1.016667
0.933333333	1.016667
0.633333333	1.033333
1.183333333	1.033333
0.8	1.033333
1.133333333	1.033333
0.566666667	1.033333
1.4	1.033333
0.8	1.05
1.083333333	1.05
0.933333333	1.05
1.116666667	1.05
1.366666667	1.066667
0.5	1.066667

1.35	1.066667
1	1.066667
1.116666667	1.083333
1.05	1.083333
1.066666667	1.083333
0.983333333	1.083333
1.1	1.083333
1.083333333	1.1
0.866666667	1.116667
1.183333333	1.116667
0.933333333	1.133333
1.033333333	1.133333
0.85	1.133333
0.6	1.133333
1.433333333	1.15
0.916666667	1.166667
1.433333333	1.166667
0.733333333	1.166667
1.066666667	1.183333
0.85	1.183333
0.6	1.183333
1.3	1.2
0.916666667	1.2

1.2	1.2
0.966666667	1.2
1.033333333	1.2
1.65	1.216667
0.883333333	1.216667
1.45	1.216667
0.55	1.233333
1.083333333	1.233333
0.533333333	1.233333
0.95	1.25
1.383333333	1.266667
0.733333333	1.266667
1.233333333	1.283333
0.55	1.283333
1.216666667	1.283333
0.816666667	1.3
1	1.316667
0.916666667	1.35
0.75	1.35
1.033333333	1.35
0.8	1.35
1.166666667	1.35
0.716666667	1.35

<table>
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<tr><td><0.6</td><td>12</td><td>0.075</td></tr>
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<0.9	22	0.1375
<0.10	21	0.13125
<0.11	25	0.15625
<0.12	14	0.0875
<0.13	17	0.10625
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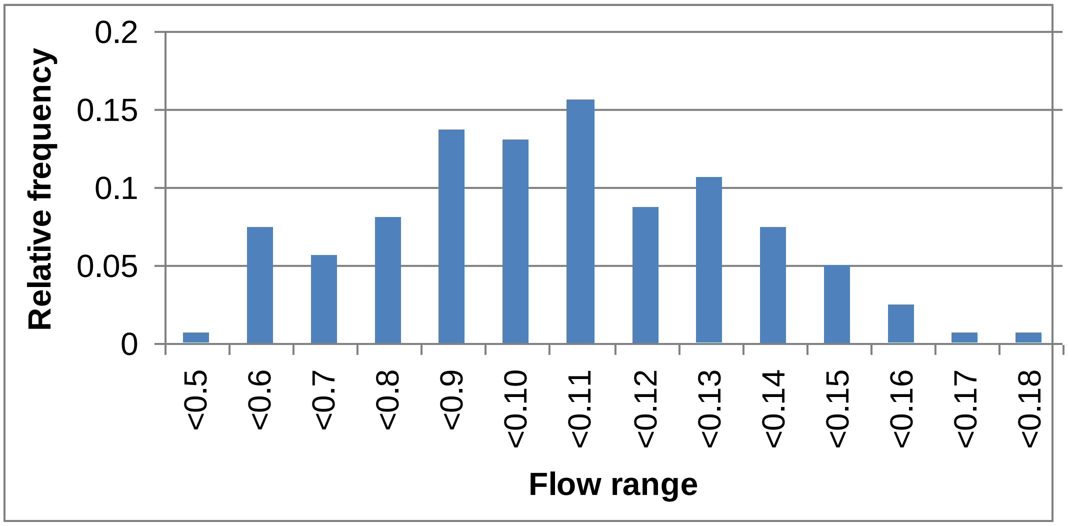

Figure 6: Relative frequency distribution of collected flow data

NIT Rourkela data: A graph is drawn in between the average density in X-axis and exit flow in Y-axis. But the graph is not as expected as shown in fundamental diagram due to lack of insufficient data points. The collected data for that particular kind of road stretch is of limited density domain (as shown in figure -7).

Average Density (v/km)	flow(v/hr)
3.333333333	480
0	660
0.166666667	840
1.833333333	540
3.333333333	780
5.666666667	840
5.333333333	540
3	600
5	600
5.833333333	540
6.333333333	900
5.666666667	420
2.5	780
3	960
2.333333333	600
0	600

1.666666667	780
2	480
0.5	420
8.5	900
9.166666667	780
3	960
4.666666667	900
6	1260
7.666666667	780
5.833333333	720
5	780
6.833333333	840
4.333333333	780
4.5	600
3.666666667	360
0	480
0.833333333	360
10.16666667	1320
11	660
1.666666667	420
0.833333333	420
3.333333333	660
5.833333333	360

6.666666667	840
5	720
8.333333333	720
8	540
3.166666667	480
8.166666667	480
8.833333333	420
4.166666667	360
4.5	660
4.5	180
1.666666667	420
0.333333333	540
2	540
4.666666667	960

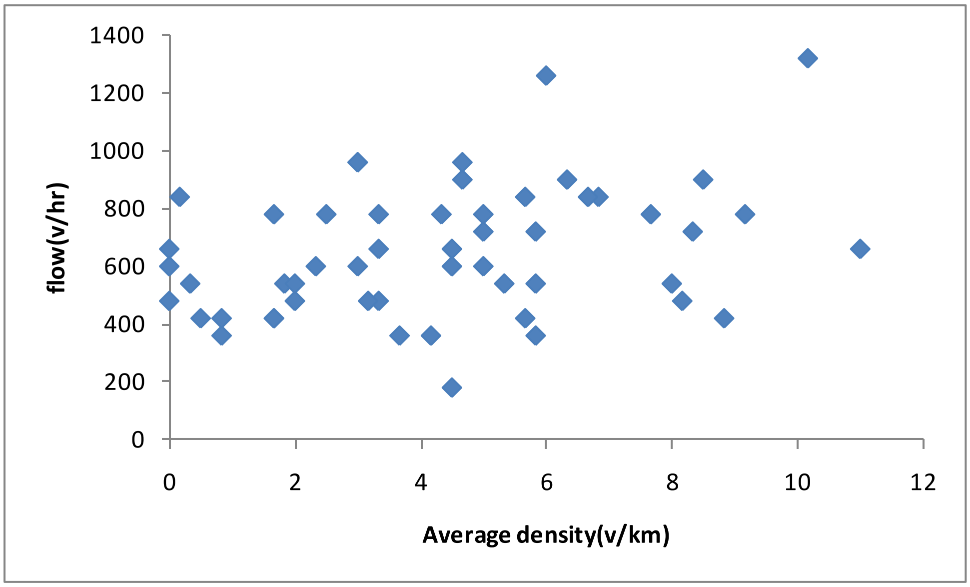

Figure 7: Flow-density diagram for the collected data

A graph is drawn in between the average density taken in x-axis and speed taken in Y-axis. But the graph doesn't resemble the figure as shown in fundamental diagram due to lack of insufficient data points. The collected data for that particular kind of road stretch is of limited density domain (as shown in figure -8).

Average den(v/km)	speed(km/hr)
3.333333333	15.42857143
0	13.5
0.166666667	13.5
1.833333333	10.8
3.333333333	10.8
5.666666667	13.5

5.333333333	15.42857143
3	13.5
5	13.5
5.833333333	13.5
6.333333333	12
5.666666667	13.5
2.5	18
3	15.42857143
2.333333333	15.42857143
0	18
1.666666667	15.42857143
2	18
0.5	18
8.5	18
9.166666667	18
3	18
4.666666667	18
6	15.42857143
7.666666667	18
5.833333333	15.42857143
5	18
6.833333333	18
4.333333333	18

4.5	21.6
3.666666667	21.6
0	21.6
0.833333333	21.6
10.16666667	13.5
11	10.8
1.666666667	15.42857143
0.833333333	18
3.333333333	13.5
5.833333333	18
6.666666667	10.8
5	12
8.333333333	10.8
8	13.5
3.166666667	18
8.166666667	21.6
8.833333333	18
4.166666667	18
4.5	10.8
4.5	36
1.666666667	15.42857143
0.333333333	15.42857143
2	13.5

4.666666667	18

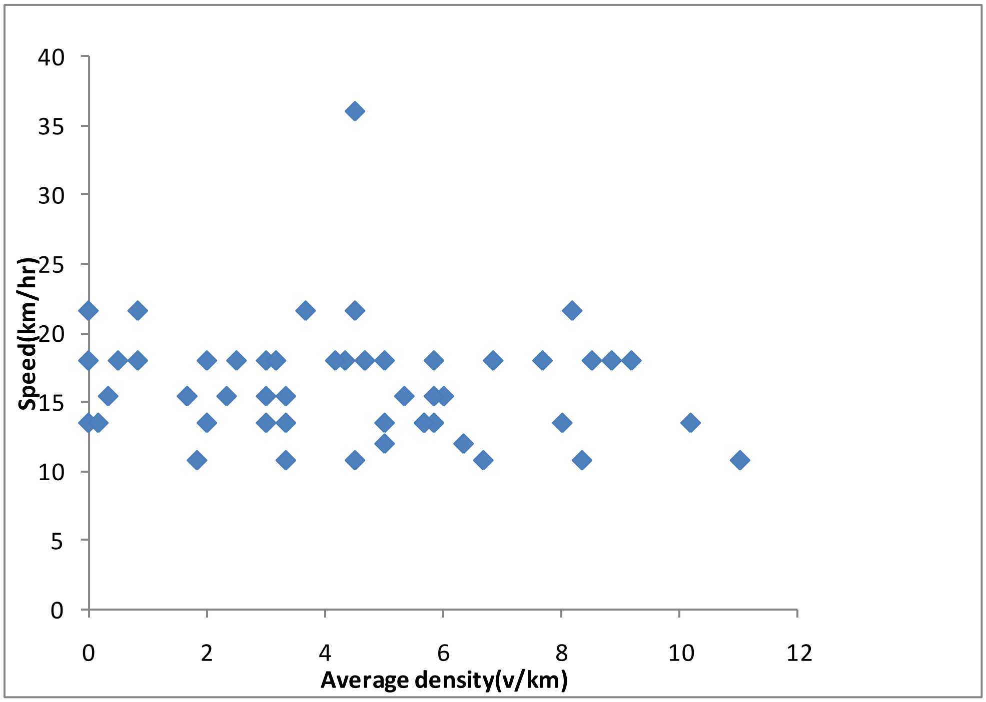

Figure 8: Speed-density diagram for the collected data

A graph is drawn in between the flow taken in X-axis and speed taken in Y-axis. But the graph doesn't resemble the figure as shown in fundamental diagram due to lack of insufficient data points. The collected data for that particular kind of road stretch is of limited flow domain (as shown in figure -9).

flow(v/hr)	speed(km/hr)
480	15.42857143
660	13.5

840	13.5
540	10.8
780	10.8
840	13.5
540	15.42857143
600	13.5
600	13.5
540	13.5
900	12
420	13.5
780	18
960	15.42857143
600	15.42857143
600	18
780	15.42857143
480	18
420	18
900	18
780	18
960	18
900	18
1260	15.42857143
780	18

720	15.42857143
780	18
840	18
780	18
600	21.6
360	21.6
480	21.6
360	21.6
1320	13.5
660	10.8
420	15.42857143
420	18
660	13.5
360	18
840	10.8
720	12
720	10.8
540	13.5
480	18
480	21.6
420	18
360	18
660	10.8

180	36
420	15.42857143
540	15.42857143
540	13.5
960	18

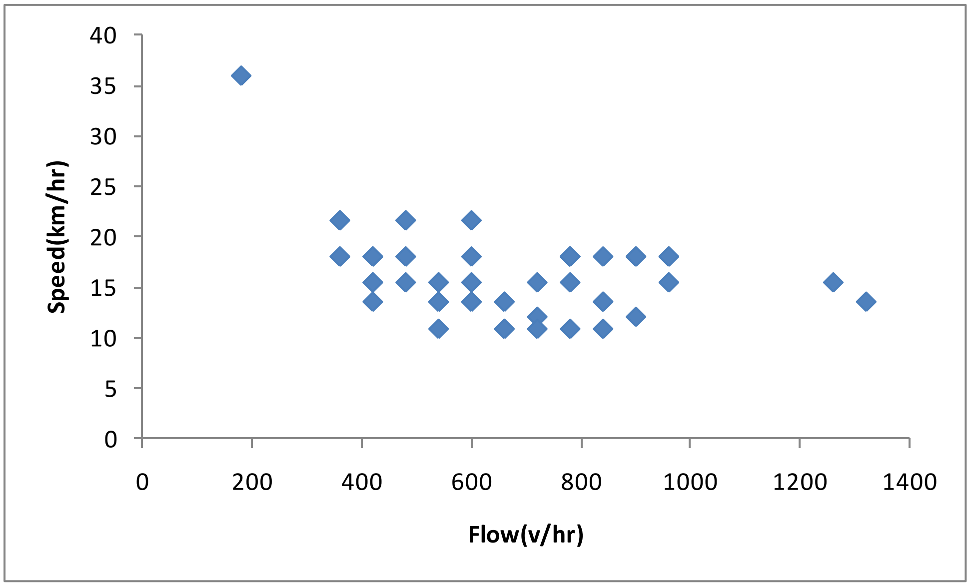

Figure 9: Speed-flow diagram for the collected data

Further, relative frequency distribution of density, flow and speed are plotted (shown in figures - 10, 11 and 12).From those figures it can be observed that both the density and flow data are nearly normally distributed.

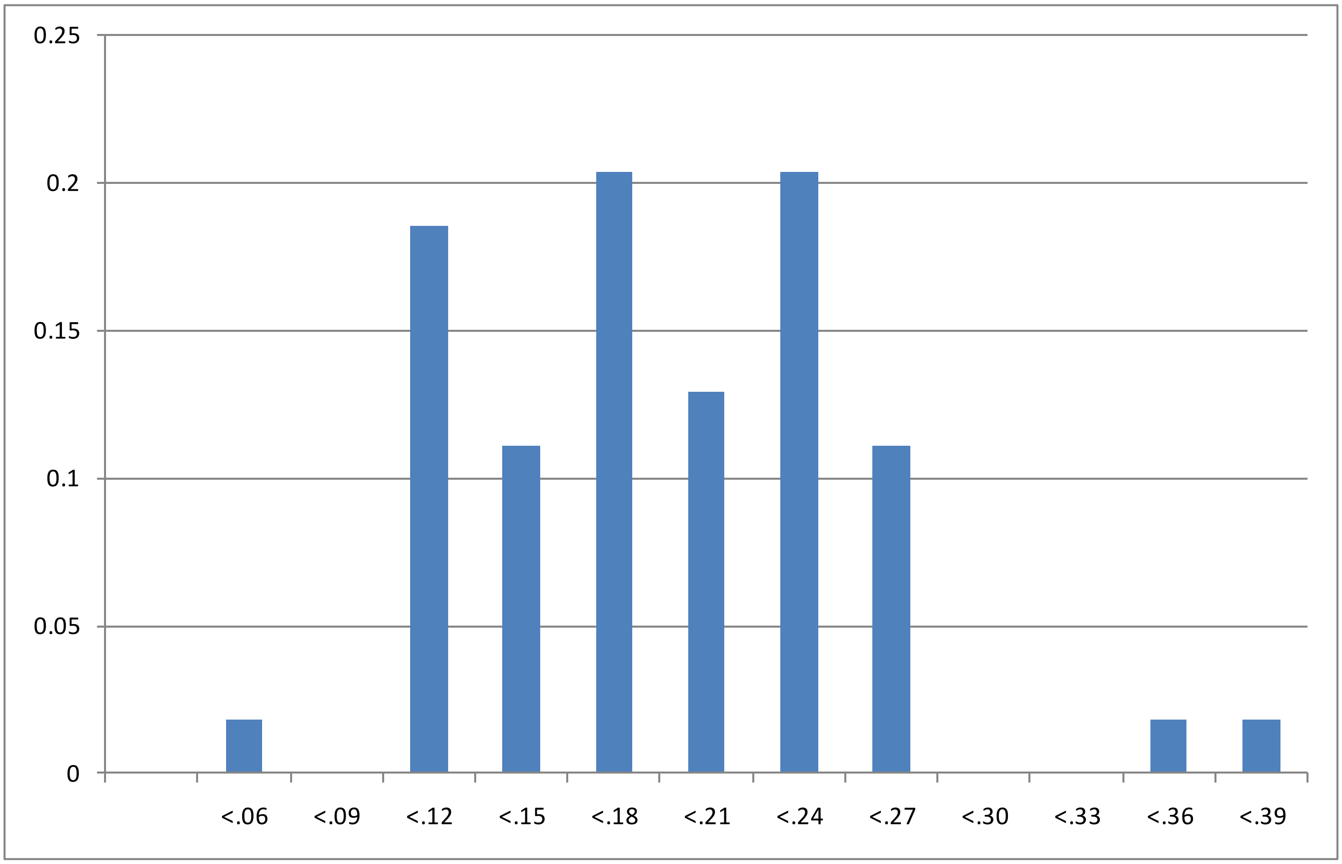

Figure 10: Relative frequency distribution of collected flow data

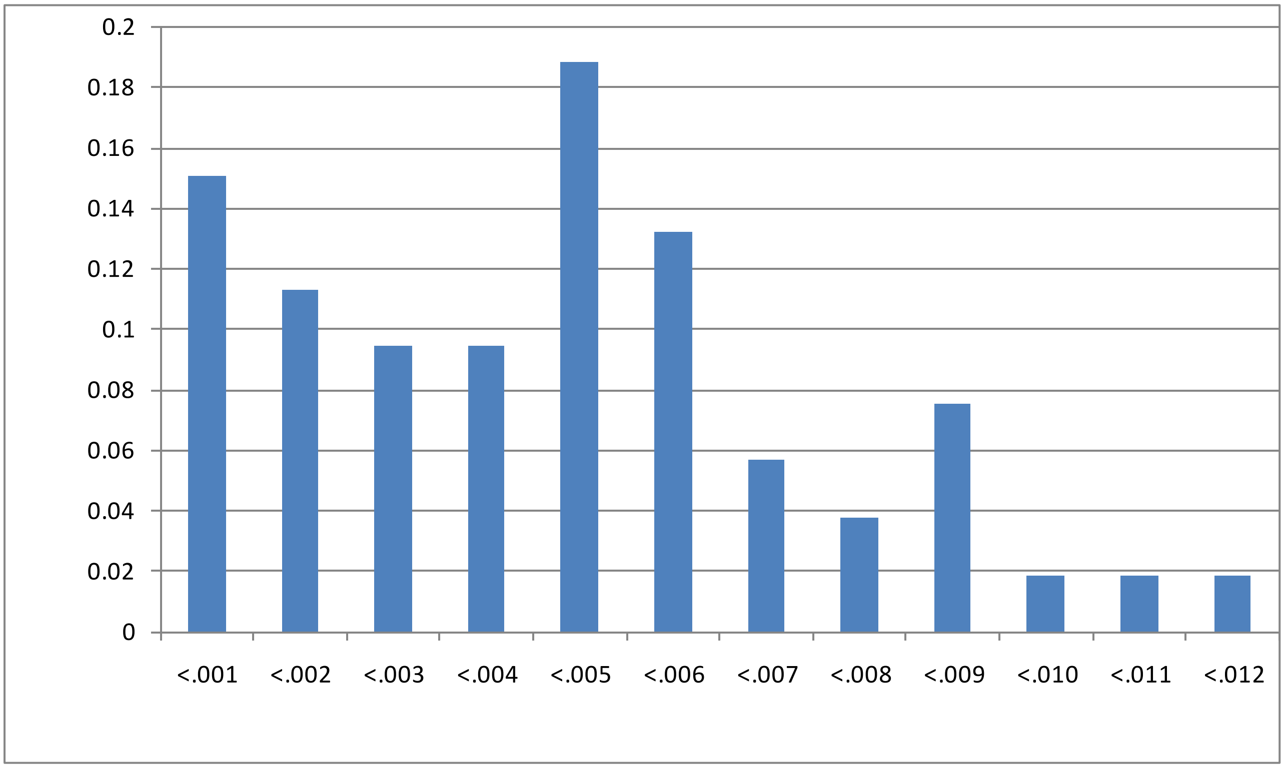

Figure 11: Relative frequency distribution of collected density data

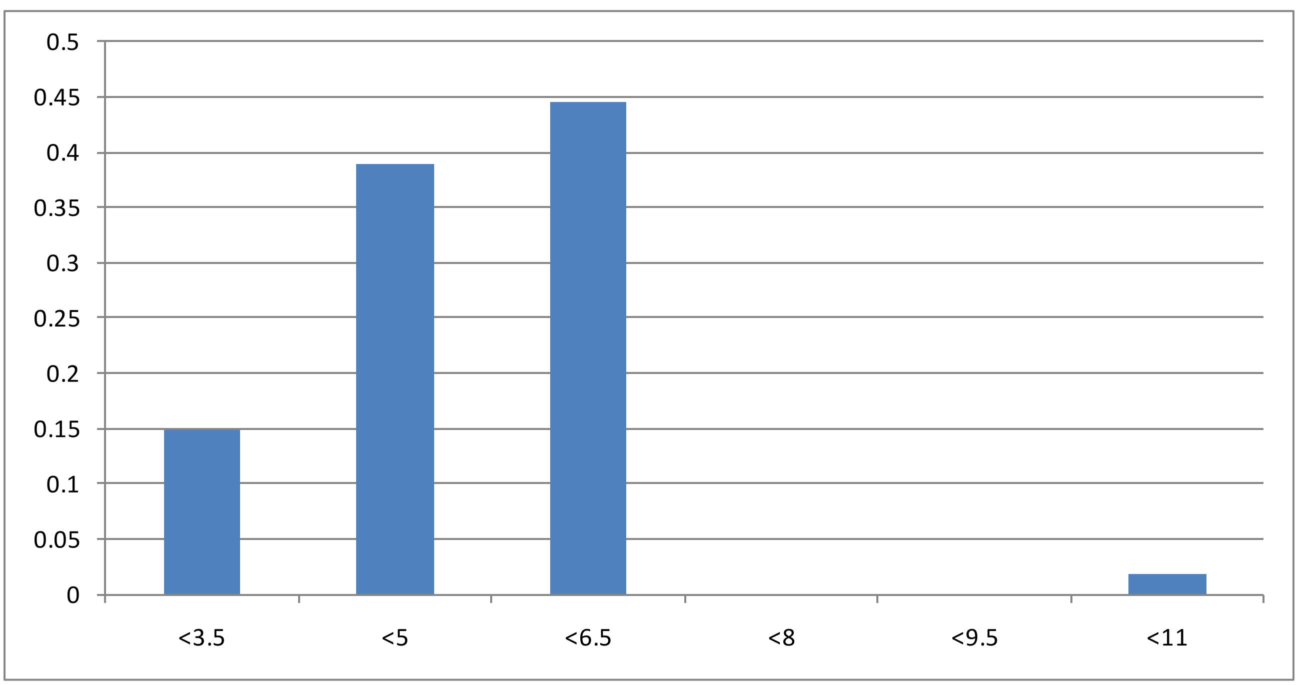

Figure 12: Relative frequency distribution of collected speed data

3.3 Comparison of data

Both the data's are compared to one another and the Z-score value is calculated for both data's and then it is compared with Z critical. If Z is less than Z critical then we can say that both the data's are equal. If Z is greater than Z critical then both the data's are different.

$$Z=\frac{\mu(m)-\mu(r)}{(S^2(m)+S^2(r))^{1/2}} \qquad (5)$$

Where μ=mean, S= (standard deviation) ²/number of data points,

m=Madras data, r =Rourkela data

TABLE-7

Data collected	Mean of flow	Mean of density	Standard deviation of flow	Standard deviation of density	Number of points of flow	Number of points of average density
IIT Madras	1.004895833	.089040881	.272483703	.010518213	160	159
NIT Rourkela	.180246914	.004345912	.062785956	.002811349	54	53

TABLE-8

	Flow	Density
Z-value	35.58465493	92.13979708

It is clear from the above table that the Z-value is greater than Z-critical. So both the data's are different.

CHAPTER 4

Conclusion

The collected data is from a limited domain of density, so unable to predict capacity properly. Both the density and flow data follow normal distribution, i.e., as per the natural phenomena of density and flow. If the data is up to the mark then there is a possibility of predicting the relation in between traffic parameters as shown in fundamental diagrams. Both the data's are compared to one another and it was found that they are different to each other.

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