SPEED FLOW DENSITY STUDY AND COMPARISON BETWEEN TWO DIFFERENT ROADS

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Abstract: The flow of traffic depends on the movement of the driver and the interactions that vehicles make between two points. We cannot predict the flow of traffic just because of the driver's movement, which is more difficult to analyze. The basic parameters of traffic flow are speed, density and flow, which are the most essential to know before understanding the flow of the vehicle. With the three parameters above, we can design, plan and operate the road installation.
Keywords: Flow of Traffic, Speed, Density And Flow

I. INTRODUCTION

Speed
In traffic engineering, speed is defined as the distance traveled by a vehicle during a certain period of time. It is almost impossible to calculate the speed of each individual vehicle and, due to this, the average speed is taken into account. The average speed can be calculated in two ways. They are, the average speed of time and the average speed of space. The average speed of time is defined as the average speed of vehicles crossing a particular section. The average speed of space is defined as follows. First, the time it takes for a vehicle to cross a particular section is calculated and then averaged for all vehicles that cross the section at a given time. Now the average space velocity is defined as the ratio of the distance (length) of a particular section and the average time of the vehicles crossing that particular section. Units: S.I unit is m/sec and C.G.S unit is cm/sec.

Flow
It is defined as the ratio between the number of vehicles crossing a particular section and the time it takes the vehicle to cross that particular section. Units: vehicles/time

Density After a particular time, the number of vehicles occupying the particular region is defined as

density. The density is generally averaged over a certain period of time. Units: vehicles/distance The flow parameters mentioned above are related to a basic equation

$q = u*k$ (1)

From the above equation it can be seen that speed, density and flow are related to each other. Relationships can occur as follows

$u = f1(k)$, $q = f2(k)$ and $u = f3(q)$ and the frames of the previous relationships are considered fundamental diagrams. With just the above equations, it is more sufficient to describe the fundamental properties of any vehicle stream.

II. FUNDAMENTAL DIAGRAMS OF TRAFFIC FLOW

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

Speed-density relation
According to the diagram, it is very clear that the speed will be maximum when the density is zero or the vehicles flow with the velocity of free flow. When the velocity is zero, it is clear from the diagram that the density is maximum. From the figure it is clear that the variation of velocity with density is linear, which can be represented as a solid line in figure 1. When the density becomes the density of the traffic jam, the speed of the vehicles is clearly zero.

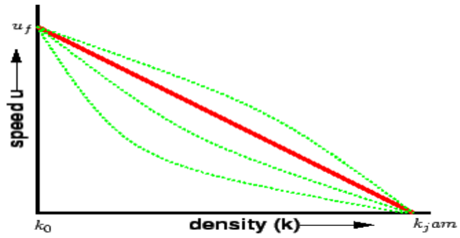

Fig 1: Speed Flow Density

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

Speed-flow relation
The relationship between velocity and flow can be explained in the following way. If there are no vehicles or so many vehicles in such a position that they cannot move, then the flow is considered zero. The flow becomes maximum when the velocity is zero or the velocity of free flow. This relationship can be clearly seen in Figure 2.

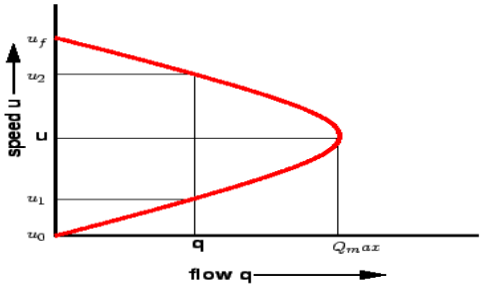

Fig 2: Speed Flow Diagram

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

Flow-density relation

Time and location are the factors for the variation of flow and density. From the figure we can find the relationship between 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 in the road section.
3. If the vehicles continue to increase, the vehicles cannot move, which is known as maximum density or density of traffic jams. The flow is zero in the stuck density position because the vehicles are not moving.
4. When the flow is maximum, the density is the stuck density or the maximum density. From the figure, it is clear that the relationship is in parabolic form, as shown in figure 3.

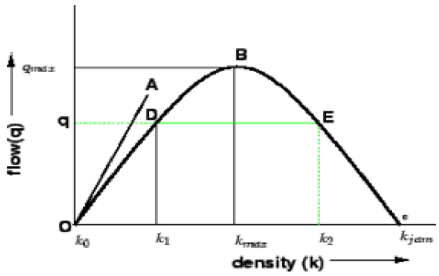

Fig 3: Speed Flow Density Curve

From the figure it can be seen that point O refers to zero density and zero flow. The maximum flow occurs at point B, where the corresponding density is considered as the stuck density. At point C, the flow is zero and the density is considered maximum jam density. An OA tangent to the parabola is drawn and the slope can be discovered, which provides the speed with which a vehicle passes the stretch of the road when the flow is zero. For the same flow there may be two different densities that can be seen from the figure and the respective points are D and E. The average velocity at the density k1 can be calculated from the slope of the line OD and 6 similarly the velocity Average density in the center can be discovered from the slope of the line. It is very clear that the speed in the density k1 is higher due to the lower number of vehicles in the stretch of the road.

III. LITERATURE REVIEW

The three parameters flow, speed and density help determine the flow of traffic. The relationships between speed, flow and density are known as fundamental diagrams that gained more attention since Greenshields found a numerical model in 1935. There is a linear relationship between velocity and density. Recent studies mainly involve the relationships between the density of flow velocity, the definition of traffic flow parameters and the nature of the fundamental diagrams. Among the previous three, the definition of traffic parameters plays a vital role because it is the basic analysis of the traffic phenomenon. Traffic conditions are particularly divided into three different categories, that is, they are not congested, queued and congested. In previous studies, the flow density relationship is used to examine the qualitative signature.

Greenberg (1959) discovered a logarithmic relationship between flow parameters.

$U=c\ lnk/k_j$

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 velocity.

Duncan (1976, 1979) showed three-step procedures

1) The density can be calculated from the flow and speed data
2) A speed density function fits that information
3) Now transforming the velocity density function into a velocity flow function that results in a curve and does not adapt to the original slow velocity data.

IV. PRESENT STUDY

Data Collection and Extraction

Nit srinager data was collected with the help of a video camera that was placed at the entrance and exit of the road in the NIT corridor, srinager city on January /12/ 2018. The distance between the entry point and the exit point is 1KM. The video started at 11.50 AM and continues until 14.29 PM. The video was run on a computer and the vehicle numbers are counted for every minute at the entry and exit points. The initial density is 75/1000 vehicles / m.

IUST anantnag data was collected with the help of a video camera that was placed in an inclined position for the flow of traffic in sector 2, IUST on February /16/ 2018. A particular road section was considered to count the vehicles and 4 posts were maintained around the section of the road (2 poles on the left side and 2 poles remaining 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 started at 11.30 a.m. and continues until 12.30 p.m. The section that was considered to count the vehicles has a rectangular shape and the video was decoded in the computer. The poles that were kept along the sides of the road are considered as 4 landmarks on the computer. The flow data is calculated at the entry and exit points in such a way that vehicles pass through the rectangular section at every minute. The output flow data is considered in the project. The density data is calculated after every 10 seconds, that is, the number of vehicles that remain in the rectangular section after every 10 seconds and then the density data are averaged. The speed data is made by calculating the time the vehicle enters and leaves the rectangular section. With the help of the initial density, the density is calculated in each minute using the procedure as follows:

$k_{t} = k_{t-1} + N_{entry-} N_{exit}$

Where, kt is the density at time t,

Nentry is the number of vehicles entered in the section during the time from t-1 to t,

And next it is the number of vehicles that leave the stretch during the time from t-1 to t.

It should be mentioned here that the flow at time t is the result of density during the time period t a t-1. Then, the flow at time t is plotted with an average density between t and t-1.

Data Analysis and Methodology

NIT srinager data: a graph is drawn between the average density (vehicle / m) on the X axis and the outflow (vehicle / s) on the Y axis. But the graph is not for pointing due to the lack of points of insufficient data. The data collected for that particular type of road stretch is of limited density domain (as shown in Figure 4). The figure also shows a second order polynomial fitted to the data (which is expected to explain the nature of any flow density diagram). The maximum of the adjusted curve, that is, the highest flow value, indicates the capacity of the road section. Due to limited domain data, that point is not promising (as you can see from the figure that some data points are well above the maximum). Therefore, we want to design a new methodology to estimate the capacity from the limited domain data.

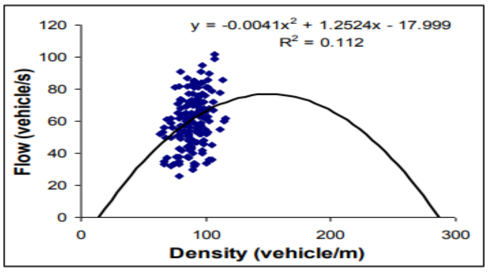

Fig 4: Fitted flow-density diagram for the collected data

V. 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.

$Z=\mu(m)-\mu(r)/(s^2(m)+s2(r))^{1/2}$

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

m=Madras data, r =Rourkela data

Table 1: data collected

Data collection	Means of flow	Means of density	Standard deviation of flow	Standard deviation of density	Numbers of points of flow	Numbers of points of average density
NIT Srinager	1.0048955833	.0890400881	.2724837003	.010518213	160	159
IUST Awantipora anantnag	.180246914	.004345912	.62785912	.002811349	54	53

Table 2: flow vs. density

	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.

VI. CONCLUSION

The data collected comes from a limited number of domains, so it cannot predict the volume. Both weight and flow data are followed by conventional distribution, that is, in terms of natural mass flow and flow. If the data arrives in the market then it is possible to predict the relationship between vehicle restrictions as shown by the basic drawings. Both data are compared to one another and they are found to be different from each other.

REFERENCES

[1] http://en.wikibooks.org/wiki/Fundamentals_of_Transportation/Traffic_Flow(last accessed on 07/05/2011).
[2] http://www.civil.iitb.ac.in/tvm/1100_LnTse/117_lntse/plain/plain.html(last accessed on 07/05/2011)
[3] http://www.stat.stanford.edu/~naras/jsm/NormalDensity/NormalDensity.html(last accessed on 07/05/2011).
[4] http://www.netmba.com/statistics/distribution/normal/(last accessed on 07/05/2011).
[5] http://www.ehow.com/how_5627529_z_score-using-microsoft-excel.html(last accessed on 07/05/2011).
[6] Xia, J and Chen, M. "Defining Traffic Flow Phases Using Intelligent Transportation Systems-Generated Data," Journal of Intelligent Transportation Systems, 11(1), (2007), pp.15-24.
[7] http://www.docstoc.com/docs/62143231/Greenshield--Traffic-and-TransportationEngineering--yee-pin(last accessed on 07/05/2011).
[8] https://secure.wikimedia.org/wikipedia/en/wiki/Normal_distribution(last accessed on 07/05/2011).

