CASE STUDY OF SPEED-FLOW-DENSITY OF TWO DIFFERENT ROADS: A REVIEW

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ABSTRACT

In this work speed –flow- density study of an Indian street has been led. Data has been gathered utilizing video cameras and later decoded in PC. This data is extremely useful to assess speed, density and flow of street. Data's been collected from two unique sites. One of the data is gathered in ganderbal and another data is from Srinagar both the two sites lies in J and K state. Both the data's were compared statistically.

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

INTRODUCTION AND LITERATURE REVIEW

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 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.

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.

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.

The above mentioned flow parameters are related to a basic equation

q = u*k

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 = f1 (k), q = f2 (k) and u = f3 (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.

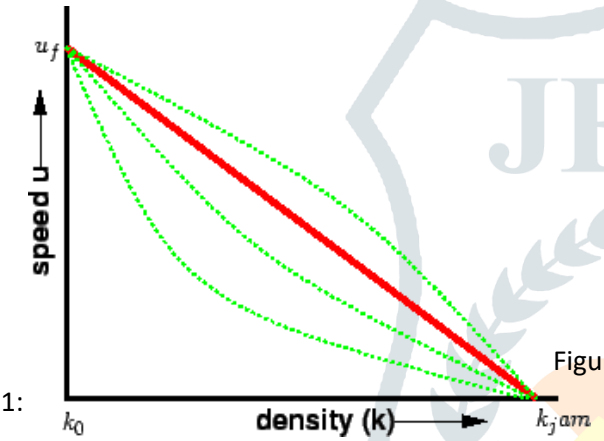

Figure 1:

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.

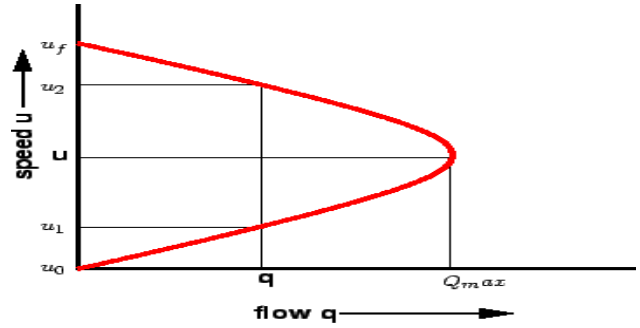

Figure 2: Speed- flow diagram

At speed u the maximum flow qmax 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.

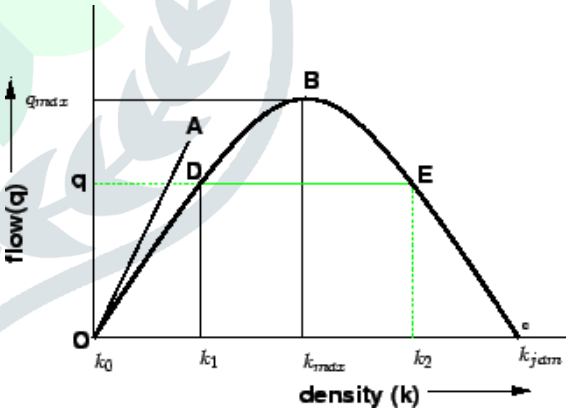

Figure 3: Flow density curve

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 k1 can be calculated from the slope of the line OD and similarly the mean speed at density k2 can be found out from the slope of the line.

2. 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 than the normal distributions are also different. For any value of x the height of the density is shown below

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

3: 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.

4: Data analysis, Data extraction and Methodology

The data was collected with the help of video camera which were placed at the entry and exit of road at ganderbal site. The distance between the entry and exit point is 50M. The video was started at 9.00 AM and it is continued till 4.00 PM. The video was run in computer and after playing and freezing the video the numbers of vehicles i.e. flow and spot speed are counted for 5 minute interval. Then by using fundamental formula density is calculated.

The same procedure was used to take the data at Srinagar site. The speed and flow data is extracted from the video recording and then density is calculated by standard formulas. The length of the section was 100 meters and the width of the road section was 7 meters. The video was started at 10.00 am and it is continued till 2.00 pm. In this section 5 minute data interval is calculated. The exit flow data is considered in the project.

Various graphs like speed flow, speed density, and speed frequency graphs are made and then the analysis is done by these graphs.

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