

**Development of Traffic Flow Model for a Collector Road (Case Study)***Imad Said¹, Zawar Husain khan², Hassan Shehzad³*^{1&3}Undergraduate Student, University of Engineering & Technology, Peshawar Pakistan.²Assistant Professor, University of Engineering & Technology, Peshawar Pakistan

ABSTRACT: Traffic on roads and major highways are getting bigger with time and its characterization is a challenging task. For channelizing traffic flow and decision making regarding the traffic, traffic flow models are very efficient. The objective of this research study was to develop a traffic flow relationship. Therefore the data regarding the speed (u), density (v) and flow rate (q) was collected at a section on Dir-Chitral road. The traffic flow data was collected during week days from Tuesday till Thursday. Samples were collected at different flow times of the day using automated traffic counters fitted at the study section. Statistical test was set as a criteria for data analysis. The collected traffic data, traffic flow models were obtained.

Key words: Traffic flow models, Traffic parameters, Flow rate, Traffic density, Flow speed

1. INTRODUCTION

The characteristics that is Flow, speed, and density are the major macroscopic traffic flow characteristics. Flow rate (q) is a variable that quantifies demand on the road section. It usually is, the number of vehicles (n) that desire to use a given road section during a given time interval. Speed (u) is also an important measure of effectiveness in defining levels of service for many types of road way facilities [2]. The density (k) is also a crucial parameter for uninterrupted (that flow on a road section which is not affected by traffic signals) flow facilities because it qualifies the quality of traffic operations [2]. So, the relationships between these three variables are called traffic flow-models.

The traffic flow models gives us the basic relationships of the major macroscopic traffic flow characteristics for uninterrupted flow situations and for free flow and congested flow conditions [1]. The traffic flow models are mostly used in nearly all fields in transportation related studies. These fields involve economic studies, transportation planning and management, and other. Literature review showed that there are no traffic flow characteristics models in Khall (district lower dir kpk). Therefore, the objective of this study is to device a traffic flow model for Khall main road call is Dir Chitral road.

The methodology followed in the development of this model models was carried through four steps: data collection, data processing, data analysis, and finally devising of appropriate mathematical model. A representative road section is considered for the data collection. I have taken 30m section of the road. Data are collected by using video-camera for traffic data collection. The data samples were collected during typical weekdays that are Monday and Thursday in addition to Friday where the traffic is heavier than any normal week day. The traffic flow is measured on at the middle section of road. The speeds were measured between two specific lines in that section. And finally the density (k) was calculated from flow and speed results as $q=k*u$. Now we know that the relationship between the density, the speed, and the flow rate was developed through a related traffic flow model.

2. Methodology

The methodology followed in this study consist of four steps that are data collection and correction, data processing, data analyzing and finally device an appropriate traffic flow model.

2.1 Data collection

The aim of this section is to explain the data collection procedure and preparation of the data for analysis. The data we recollected by using by using video camera placed at an appropriate spot so that all the vehicle travelling on the road section is visible and no vehicle to be left without counting. During this stage, a practice study was performed by using mobile camera to check the validity of the technique and for checking of the selected road way sections.

The first step in data collection was to select road way section that could be easily monitored through video-tap camera and no issue of visibility could interrupt the data collection. And after the selection of road section we tried our best to mark a study section which was taken as 30m straight portion.

The data were collected using video-taped traffic data collection method. After selecting the method of data collection, we first checked the materials in practice work. so before actual field data collection took place, it was necessary to make a site investigation and practice study for many reasons: for pointing out the best camera position, to have familiar with the using

of camera, and to do the necessary modifications. As resulted from site investigation, the best location was to locate the camera sidewise and fortunately there were one and we tried that camera for collecting the count data. I have selected a distance of 30m, within that range we have collected data regarding the number of vehicle and there travel time between the marks.

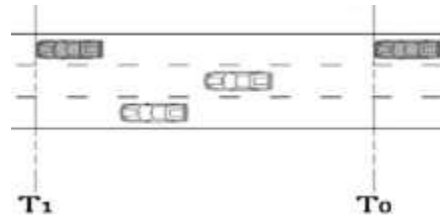


Figure 1: Study section illustration

For data collection, we focused on peak flow hours which are morning rush hours 7:30am to 9:30 am and moderate rush hours like 1:00 pm to 2:00 pm, and is done on normal week days as given in following table;

Table 1: time of data collection in a day

Week day	Time of day	Length of the section (m)
Monday	7:30 to 8:30 am	30
Monday	8:30 to 9:30 am	30
Monday	1:00 to 2:00 pm	30

The same day time schedule was followed for the other week days for collection of data like for Tuesday, Wednesday and Thursday.

Also we focused on only morning and noon peaks but we assume that this peak in the after-noon is to be repeated again so, no need to collect that data too.

2.2 Data processing

Vehicle by vehicle movements were processed as the vehicle crossed the section first line until it has crossed the next line. In simple words, each and every vehicle was traced in terms of time and space as the vehicle crossed the section. Most importantly, the Time at which vehicle enters section(T_0) and Time at which vehicle leaves the section (T_1) were collected while processing the videotapes.

Then the data from the camcorder were transferred into Excel, and then processed in order to obtain the three macroscopic traffic flow characteristics: flow rate, speed, and density by using equations.

2.2.1 Flow rate (q) calculation

The traffic volume also called as the traffic flow rate when traffic flow is counted for one hour, was measured by counting the number of vehicles that had crossed a pre-draw line in the mid of the section during time interval A-B and that A-B interval may be from 5 to 15 minutes. But we have taken that interval to be 15 minutes[3]. The hourly flow rate was calculated by using the following equation (1) [4].

$$q = \frac{[\sum(v_i * PCEFi)] * 4}{No\ of\ lanes} \quad \text{Equation (1)}$$

Where,

q = is hourly flow rate, in (pcu/h/lane),

v_i = is Number of vehicles of type i which pass the study section in the time interval,

PCEFi = is the passenger car equivalency factor of vehicles of type i.

2.2.2 Speed calculation

As we know that traffic on the road has all types of vehicles, so for each vehicle type, the speed was calculated by knowing the length of the section and the time of vehicle taken by the vehicle to cover the study section. The length of the study section was about 30m and the travel time is noted from the video-tape. The equation (2) used for speed calculation is given as;

$$\bar{u}_s = \frac{L}{T} \quad \text{Equation (2)}$$

Where,

L= is the length of the study section, and
 T= is the average travel time of the selected vehicles to traverse the study section.
 u_s = space mean speed of vehicle.

2.2.3 Density calculation

The density of the road way section was calculated by using the relationship between flow rate speed and density as given;

$$q = k \cdot u \quad \text{Equation (3)}$$

$$k = q/u \quad \text{Equation (4)}$$

Where,

q = flow rate in vehicle per time

u = space mean speed in distance per time

k = is density in vehicle per distance

2.3 Data analysis

Now we have data of speed, flow rate and density, so we can now relate any of two from the given data sample and plot in excel and we will find out the equation from that scatter in excel that will be our model for the road section regarding this traffic flow conditions. The following is the scatter diagrams of different relation used.

2.4 Scatter diagram/ plotting of the data

The Scatter diagrams were plotted using the processed data between the speed–density, flow–density, and flow–speed, as shown in Fig 2.

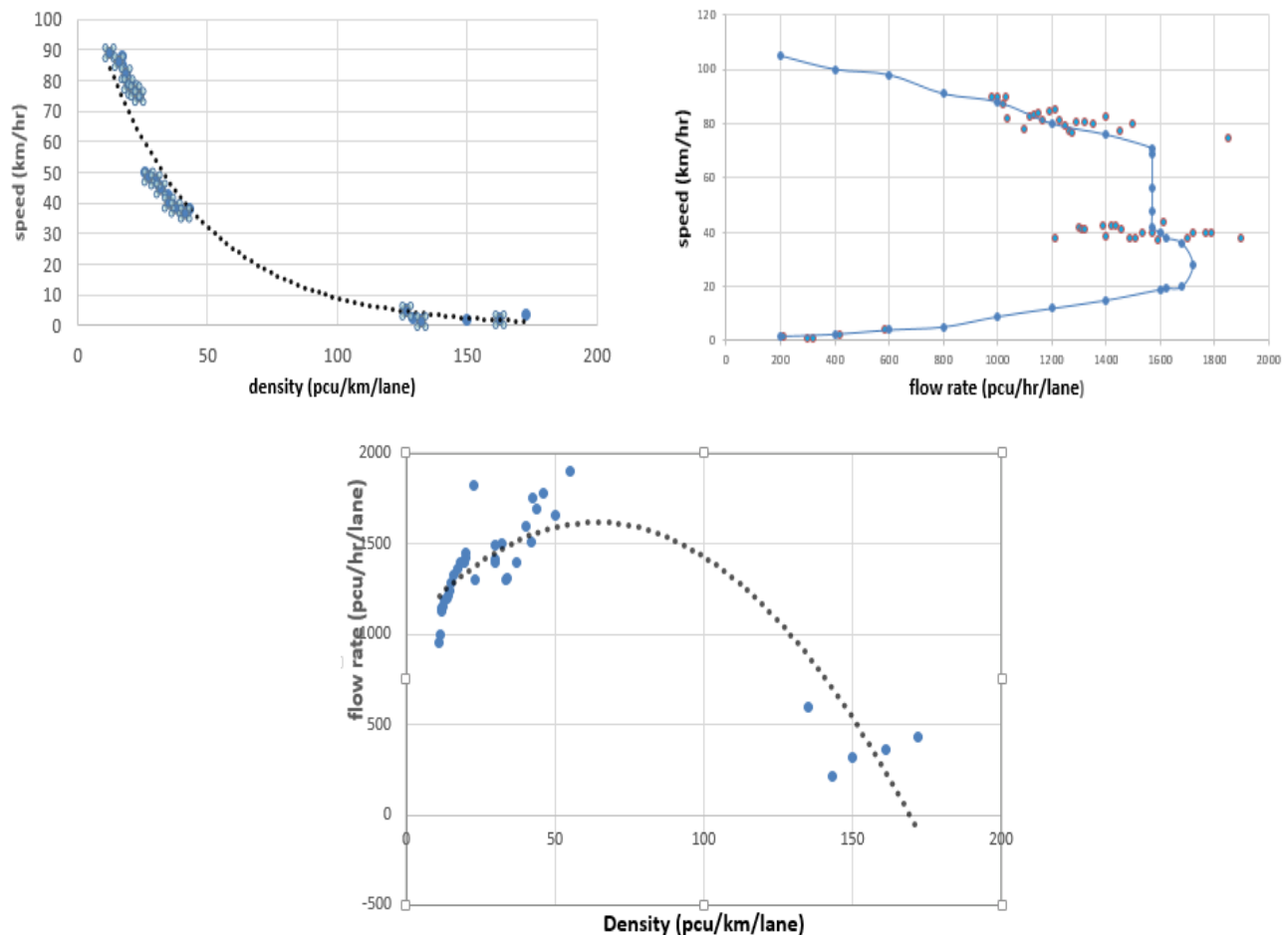


Figure 2: Scatter obtained from plotting

From the above plots we have find out the equations which are actually the models are given as below.

Speed-density model:

From plotting of speed and density data we will obtain the following model.

$$u = 1342.17 * k^{-1} \quad \text{Equation (5)}$$

Flow density model:

By plotting flow and density data we will have the given model.

$$q = -1.735 * k^2 + 102.65 * k \quad \text{Equation (6)}$$

Flow speed model:

By plotting flow and speed data the following model is obtained.

$$q = -0.6135 * u^2 + 49.123 * u \quad \text{Equation (7)}$$

3. Conclusion:

The traffic flow models are actually the relationship of traffic flow parameters that is speed, flow rate and density.

In this work I compare these with each other to obtain a relationship in excel and plotted them and got the above.

The data is taken through video based camera and seem good representation of the actual field manual count.

References

1. A.D. May, Traffic Flow Fundamentals, Traffic Engineering Handbook, Prentice-Hall, Englewood Cliffs, New Jersey, 1990.
2. TRB, Highway Capacity Manual 2000, National Research Council Washington D.C., 2000.
3. Rui Song, Xingjian Xue, Analysis of the traffic stream characteristics of urban expressway, in: ICTE 2011, ASCE, 2011.
4. Development Research and Technological Planning Center (DRTPC) at Cairo University, Development of Traffic Stream Relationships for Rural Roads in Egypt, Academy of Scientific Research and Technology, Transportation Research Council, 1998.