CHAPTER I

INTRODUCTION

As volume of vehicular traffic in the past several years has rapidly outstripped the capacities of the nation's highways, and as roads and highways are required to carry ever higher traffic volumes, it becomes increasingly necessary for traffic engineers to understand the dynamics of traffic flow and obtain a mathematical description of the process. This is especially true for extremely heavy traffic when the roadway must perform at its peaks and has been found to be necessary due to the rising cost of land, especially in metropolitan areas, which make construction of new highway expensive. With an insight into the complex structure of road traffic, it may be possible to increase the present capacities of highways to accomodate present and future demand.

Traffic flow, which involves the combination of a variety of vehicles controlled by different driver moving in a random fashion, is affected by many factors. Some of the significant factors are: land use and activities of the area, weather conditions, geometric arrangements of the roadway and its ancillary facilities, the personal nature of individual drivers and their moods and attitudes during driving, and the characteristics of the vehicles. The combination of these factors make the phenomenon of traffic flow a rather complex one, the analysis of which is difficult.

Traffic flow in a road network consists of many cars that are driven more or less under the seperate wills of the individual drivers, and movement of individual cars should be regarded as probabilistic phenomenon. However, as we often see in a large city or on an arterial highway, when many vehicles are moving in a group, it can be considered a continuous and deterministic flow. When we discuss conditions affecting safety on a freeway, or starting characteristics of vehicles from a signalized intersection, etc., we should take the former probabilistic position, and use a so-called "microscopic model" that represents the movement of individual vehicles. On the other hand, when we deal with traffic flow in an urban network which includes many signalized intersections, we can benefit from a "macroscopic model" which deals with traffic as a steady flow and represents it by overall mean speed, traffic density, and traffic volume, because the microscopic model is too detailed to apply to such a traffic flow at high densities or in a large system such as a major city. In this research, since we intend to systematize traffic control in a large scale network, the macroscopic model is used.

"A macroscopic traffic model" is defined as a model representing the average characteristics of traffic flow which consists of vehicles each of which has stochastic(random) characteristics. Parameters of a macroscopic model, the three most important characteristics of traffic, are flow, speed, and density.

Probably the most useful result of traffic flow theory is the development of the relationships among the macroscopic variables of traffic stream flow (flow, speed, and density). An understanding of these relationships, is of prime important to the practicing traffic engineer, has carried over into most traffic engineering work and has led to the development of the level of service concept. It has led also to the development of an understanding of shock wave development and propagation and this has had important applications. The traffic stream model is one of the basic equations used by traffic engineer in the economic appraisal of new schemes and assignments to proposed networks. From the standpoint of design, a knowledge of high-flow-rate characteristics is required for the prediction of highway capacity. These concerned with traffic operations are faced with the problem of providing an adequate level of service; this calls for an understanding of the entire range of relationships. Development of flow control and ramp metering techniques must be based on these functional interrelationships under high-density conditions. Finally, any effort toward developing new roadway and vehicular technologies for the purpose of improving flow characteristics will necessarily stem from an understanding of the present relation.

Definitions of Traffic Stream Model

The relationship among the three variables, flow, speed and density, is of paramount important in any theory of traffic flow, is called a "traffic stream model". Flow is defined as the time rate of traffic flow and is evaluated by counting the number of vehicles that pass a point in a unit of time. It is the easiest of all characteristics to obtain and generally denotes the degree of serviceability of a highway or street. This quantity varies with time; the maximum value obtainable for a particular portion of a road is called the "capacity", denoted by q_m. The flow, at any level below maximum, may be increased by adding more vehicles to a given length of highway or by increasing the speed of travel. Speed is indicative of the "quality" of traffic movement and is described as the distance that a vehicle travels in a given interval of time. There are two principal average speeds, the time mean speed and the space mean speed.* In this research, we will use the space mean speed, which defines as average of speeds of vehicles within a given space or section of roadway at a given instant. Vehicular speed is an important consideration in highway transportation because the rate of vehicle movement has significant economic, safety, time, and service (comfort and convenience) implications to both the motoring and the general public. The concentration of vehicles on a highway or street is defined as density, which is the number of vehicles in a unit length of highway at any instant of time. Density is a better speed predictor than flow inasmuch as flow decrease after reaching the critical density whereas density continues to increase.

Purpose and Scope of the Research

The purposes of this research has been to establish traffic stream models for different types of urban streets at mid-block in Bangkok that satistfy preselected statistical and traffic flow criteria and only single-regime traffic flow models are considered. This research is primarily concerned with macroscopic models which assume a homogeneous movement of traffic or steady-state condition and describe the overall properties of the traffic stream.

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* See Appendix A.

The main requirements of any model could be stated as follow.

1) It must fit with a high degree of accuracy all available data.

2) It should be capable of extrapolation over the full range of values normally found in practice.

3) Its limitation, if any, should be known.

4) It should lend itself readily to mathematical analysis.

Assumptions Used in the Research.

The assumptions used in this research are as follows.

1) Movement of traffic is homogeneous, i.e. steady-state condition.

2) Geometric design of roadway and composition of the traffic stream are the same in each direction of two-way street, i.e. traffic stream characteristics are the same in each direction.

3) Various days of weak, hours of day, and intervals of an hour are minor effect on driver behavior, i.e. traffic stream characteristics are the same for various time, except between daytime and nighttime.

4) Characteristics of the study section at mid-block of each street are assumed to be the same as other sections of that street.

Uses of the Research

The uses of this research and its applications are as follows:

1) The model is useful in defining the maximum traffic flow, capacity, of a facility. To improve traffic efficiency, traffic should

somehow be forced to move at a density (and speed) corresponding to maximum traffic flow.

2) The model describes operational efficiency and safety of traffic flow.

3) The flow-density relationship is most helpful in design of freeway surveillance and control system.

4) The flow-density curve is an essential part of any traffic wave analysis.

5) Use flow-density curves for describing behavior of traffic flow at bottleneck.

6) Use of speed-flow curves for establishing levels of service for traffic flow.

7) Queue length at a traffic signal can be computed by using flow-density curve,-quantitative analysis.

8) Evaluation of models by procedure used in this research form the basis for consideration of other data sets.

9) By this research, method of collecting data for obtaining traffic stream models is suitable to organization of developing country that could not effort expensive instrument.

10) The model can be applied to relate with quantities of air pollution, which is produced by traffic on each location.

11) Models of streets of the same characteristics with streets in each category can be approximately obtained from these models in each category of streets.