Mathematical Model of Traffic Speed and Capacity in the Archipelago Base

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Abstract. The transportation engineering developing who the application of the principal use planning, analysis and design to the disciplines comprising transportation: its vehicles, physical infrastructure, safety in travel, environment impacts and energy usage. The mathematical model in base archipelago was not much enough to research by transportation practiced. It had been of characteristic which different mainland. This paper using greenshields and greenberg models for approach real condition of the base archipelago. In the transportation involves working with the businessman, with industry, with citizen group, with elected officials, and with employees to the joint each segment of the public strip depended on at least one constructed facility. In this time there three components that included the discussion of the traffic of a microscop scale were flow, density and speed. At the greenshields model, the speed-density relationship show whose the value of speed higher than value of density lower with determination value 0,9755 where the curve of flow-density relationship show the value determination 0,8634 and for curva of flow-speed relationship showing whose maximum value of flow 1807 vehicles/hour at the value traffic speed 46 km/hour, traffic speed which at the lower or it the higher, so it condition given impact that the value of flow will going to low. on the other hand for greenberg model at speed-density relationship’s determination 0,9463, density-flow relationship show that the value minimum of density is 25 vehicles/km while value of flow is 1400 vehicles/hour and the relationship between flow-speed curve show that value maximum flow 1750 vehicles/hour with value speed 37. Base the value of each condition, so the greenshields model was better than greenberg model for this research. The mathematical model of the traffic flow which approach the real condition for the base archipelago was greenshields model.

Keywords: Greenshields model, greenberg model, transportation

1. Introduction
Transport infrastructure is provided and means of transportation which are operated will shape transport services, which all everything must be regulated, organized, managed, nurtured, and developed with implementing policy and legislation in the field of transport, in order to achieve the integration of sustainability of transport services in order to realize a transportation system (national) are effective and efeisien [5,6]. Follow-the leader models of traffic flow found from extensive correlecalation studies that more data are needed establish the unequivocal superiority of one particular model [1]. Modal transportation in the public primitives are simple, using the animal like: horses, buffalow and the etc to taken and bring who want be their need. Then developed using human of power.
On the next found the wheel. With the wheel opening then of the new advances, successfully created a wheeled cart, wagon, and bicycle. The model of transition from free flow to congested flow occurs spontaneously by the collective motion of vehicles, which obey to the same dynamical equation. The observation of specific discrepancy of traffic flow vs. car density graph is well understood in terms of the phase transition [2]. In the develop a numerical code, which solves the corresponding system balance laws. Applying code to a wide variety of initial data, it find the observed invers shape of the fundamentals diagram of traffic flow [3]. Further developed after the industrial revolution have successfully created a variety of types and sizes of vehicles (station wagon), followed by trains, and plane.

The problem of highway traffic is a complex issue in the world of transportation, especially for urban transportation. Each solved a problem will there are next issue, and did not rule out the possibility that the problem was successfully solved in the future will lead to new problems. Transportation problems in the city mainly due to higher urbanization, growth in the number of vehicles is not comparable with the growth of the transport infrastructure. As well as increase population and movement with rapidly every day. Therefore, information regarding the movement of the traffic flow is very important to urban areas.

2. Research Methods
2.1. Transportation System
The transportation system consists from fixed facilities, the current magnitude, and control systems that allow people and goods to move from one place to another efficiently in terms of timely for the desired activity.

ITE (institute of transportation engineers), defined that transportation engineering as an application of the principle of technology and pure science in the planning, design, operation, and management of facilities for each mode of transportation, so as to provide safety, speed, convenience, accuracy, economical, and environmentally friendly for movement of people and goods. It also defined such definitions that traffic engineering transport engineering related to the design, geometric design and traffic operations of roads, highways, terminals, and the connectivity with the other transportation modes.

2.2. Traffic System
Traffic system can be said to consist of three components, namely roads, people and vehicles. As structural engineers cannot design a structure without knowing the location of the load and the behavior of structural elements under load, then the traffic experts also requires knowledge of load (traffic flow) and elements (people and vehicles). To operate without fail, all three components, namely the street, people, and vehicles should be very appropriate. In the daily reality this never happens, the consequences of road traffic systems often fail. Road accidents, congestion and traffic disruption is an example: for (a) system failure, and nearly all cases result from mismatches between the three components, or between the component and the environment in which the system operates. The next example for (b) The components of the Way, that the road has four functions, including: Serve moving vehicle, serve vehicle parking, Serve pedestrians and vehicle not motorized and enable development with access to area ownership.

A road allows only serve one function freeway just moving vehicles, almost all the way to serve two or three of the above functions. Often, these functions are not consistent, for example, roads that serve high traffic flow is not suitable for pedestrians, or unsafe to access. Nevertheless it possible to assign the main function, and if a ban or not recommended for use tailored to that function, or make special arrangements to cater to all. For example, a congested road traffic need no parking restrictions and necessary signals for pedestrians, should be regulated in such a way that the road network traffic is constantly not to use it.
2.3. Traffic Characteristics

Characteristics due to the interaction between the driver and the road in the environment vehicles. At this time the discussion about traffic flow for concentration the variables flow traffic were flow, speed, and density. There are three components that included discussion of the traffic flow on a macroscopic scale. The discussion has evolved from the original concept that the main element of the traffic flow is ingredients or flow characteristics, origin destination, quality, and cost. Such shifts occur because the current traffic flow and the basically just illustration how many types of vehicles that move.

Flow
Traffic flow is the number of vehicles passing a given point on a piece of road, at a certain time period, measured in units of vehicles per unit of time. While the flow is the number of vehicles passing through a flow path for a time period measured in units of vehicles per unit time.

Speed
Speed is the second main parameter that describes the state of traffic flow on the road, the speed can be defined as the movement of vehicles within the distance per unit time. In the movement of traffic, each vehicle running at different speeds. This the traffic flow is not known a single speed characteristics but more as distribution of a single vehicle speed. The distribution, the number average or typical value buffer is used to determine the characteristics of the traffic flow. In the calculations the average of speed can be divided into two, namely: mean time speed, which is defined as average speed of all vehicles that pass through something point from Street for period time and space mean speed, which is average speed of all vehicles that occupy fragment street for period time particular [6].

Density
The density can be defined as the number of vehicles that occupy a long road or track, can generally be expressed in vehicles per mile (vmp) or per mile per lane [4,6].

The Fundamentals of Flow-Speed-Density Relationship
The traffic flow in the road there are three point variables used to determine of traffic flow characteristics, namely: Flow is the number of vehicles that pass a certain point review on a road section per unit of time, Speed defened the distance that can be traveled a vehicle on a road flow per unit time and density, the number of vehicles per unit length of certain roads. These variables have a relationship with one another. The relationship between from Flow, velocity and density, among others:

Flow–Speed Relationship
The fundamental relationship between flow and speed is by increasing the flow of traffic the average speed of its space will be reduced until the critical density (maximum flow) is reached. However, as yo will find out when doing some research problems, intuition may not match what the traffic and the showing between of fundamental relationship.

Speed-Density Relationship
The speed will decrease if the density increases. Free flow speed will occur if the density is equal to zero, and when the speed is equal to zero there will be congestion (density). In the density will show curve the relationship with value of flow.

Flow-Density Relationship:
Maximum flow (Vm) occurs when the density reaches a point Dm (capacity lane road has been reached). After this point get flow will decline as the density increases until there is congestion.
4. Results and Discussion

Type of research is a combination of direct field survey and study of literature (literature) associated / related to traffic impact analysis. The data in one day taken for 10 hours at 07.00 am until 05.00 pm.

4.1. Step Data Collection
Based on previous observations on the preliminary survey, here are the steps of data collection in the field:

a. Geometric survey, the survey to determine the geometric road with of the road. Survey road geometric done by measuring the width of the road straight and wide using rollers meter.

b. Flow ago traffic, in collecting data on the flow of traffic prior classification of types of vehicles are divided into four categories, namely: heavy vehicle (HV) namely trucks and buses, light vehicle (LV), namely (passenger cars, minivans, pick-ups, small truck, jeep), motor cycle (MC), namely (motorcycles), and the General (bicycles and wagons). Period/field data collection interval was every 15 minutes.

4.2. Data Retrieval Techniques
Priority the implemented data collection is complete, the necessary preliminary surveys. Activities performed at a preliminary survey are: Set locations research, set selection method are based to be used, estimate circumstances or the quality of data to be taken, determine size samples to be taken and determine division period observations/observations considered important.

4.3. Research Data
The data required for further analysis include: primary data, Data traffic speed and geometric roads that in the review for 200 m and 11 m wide road The Traffic flow there are four (4) groups: light vehicle, heavy vehicles, motorcycles and the public transport (bicycles and carts) and the traffic speed in the roadway for 200 m. Secondary Data, Secondary data obtained from these studies, both from the village office or agency other agencies, namely population growth, traffic growth and vehicle ownership data.

4.4. Discussion
The Figure 1 show curve speed-density-flow relationship of greenshields model.

(a) speed - density relationship

(b) flow- density relationship
Figure 1. The greenshield model of speed - density - flow relationship

Figure 1(a) show that density is higher when value of speed slowly. Can be resembles the straight-line greenshields is the best linear fit may give good intercept values for $S_f$ and $D_j$, but be sure to check the results for reasonableness. However the traffic data seem to show about the relationship between traffic stream characteristic. Can be saw that the figure 1 show the linear with the value of density from the first to the last value of speed in the research the value density very lower. Figure 1(b) the curve show that the value of flow 1300 veh/hour while value of density 23 vehicle/km. The figure 1 (c) show that the value at maximum flow is 1807 veh/hour while the speed is 46 km/hour.

The next for the relationship curve of speed, density and flow in the greenberg model can be saw at figure 2, figure 5 and figure 6. Figure 4. Speed-density relationship show value of density lower than value of speed higher. We saw that the graph of this relation was not the best linear. This is probably lower than values you may be accustomed to seeing in the laboratory experiments involving the behavior of materials, but here we are examining the behavior of people or driver in the roadways. Fig 5. Curve show that value minimum of density is 25 vehicles/km than value of flow is 1400 veh/hour. Figure 6. Curve show that maximum flow occur in value 1750 veh/hour with speed value 37 km/hr.
Table 1. The Greenshiels and the Greenberg Models of Speed-Flow-Density Relationship

| Model   | The Fundamental Relationships | Equation                  | Result             |
|---------|-------------------------------|---------------------------|--------------------|
| Greenshields | Speed-Density | S = 80,282-0.892D | S = 19,961 km/H |
|         | S-D                           |                           |                    |
|         | Flow-Density                  | V = 80,282 D-0.892 D     | V = 1350,110 veh/H |
|         | V-D                           |                           |                    |
|         | Flow-Speed                    | V = 90,002S-1,121S       | V = 1262,872 smp/H |
|         | V-S                           |                           |                    |
| Greenberg | Speed-Density                | S = 178,065D-36,791Ln(D) | S = 23,029 km/H |
|         | S-D                           |                           |                    |
|         | Flow-Density                  | S = 178,065-36,791Ln(D)  | V = 1557,319veh/H |
|         | V-D                           |                           |                    |
|         | Flow-Speed                    | V = 126,458S.exp(-0.0272S) | V = 1339,847 veh/H |
|         | V-S                           |                           |                    |

Table 1 showing equation traffic flow at two mathematical model in base archipelago was greenshields and greenberg models. In the greenshield model we can be saw that fundamental relationship of flow-speed show linear graph, which on the one line show straiagh line. On the other hand at the greenberg model saw flow-speed relationship not linear due to using logaritma function. The result in this table I. that the traffic model approach the real condition was greenshields model.

5. Conclusions

At the greenshields model, the speed-density relationship show whose the value of speed higher than value of density lower with determination value 0.9755 where the curve of flow-density relationship show the value determination 0.8634 and for curva of flow-speed relationship showing whose maximum value of flow 1807 veh/hour at the value traffic speed 46 km/hour, traffic speed which at the lower or it the higher, so it condition given impact that the value of flow will going to low. On the other hand for greenberg model at speed-density relationship’s determination 0.9463, density-flow relationship show that the value minimum of density is 25 vehicles/km while value of flow is 1400 veh/hour and the relationship between flow-speed curve show that value maximum flow 1750 veh/hour with value speed 37. Base the value of each condition, so can be conclude that the
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