Journal of Management, Economic, and Financial

Vol. 01, No. 02, July 2023 || e-ISSN 2986-6863
Published by Cyber Polytechnic Cerdika International

ANALYSIS OF THE RELATIONSHIP VOLUME DENSITY AND TRAFFIC SPEED ON STREET SRUNI BUDURAN SIDOARJO WITH GREENSHIELDS METHOD

Prastama Errian Apteda, Siti Zainab
Faculty of Engineering, Universitas Pembangunan Nasional "Veteran" East Java
Email: Prastama06@gmail.com

Abstract Sidoarjo Regency has several road sections that often have traffic problems such as congestion. The congestion is caused by economic improvement which also causes a person's mobility to increase so that there is a fairly high traffic movement. Likewise, what happened to the Sruni Buduran Highway, Tebel Buduran Highway, and Buduran Sidoarjo Highway East Java as study areas. By reaching a road length of 3 Km. The study in this study aims to analyze and map the mathematical relationship of Volume - Density - Traffic Speed, so that the value of free flow speed, maximum density, and maximum volume can be obtained on the Sruni Buduran Sidoarjo road section. With the method used is the Greenshields model, which is then compared with capacity using the Indonesian Road Capacity Guidelines method (2014), the survey was conducted at 08.00 – 18.00, with 4 survey days, Monday to Thursday in each segment to obtain primary data in calculating the Greenshields mathematical model. From this study, it shows that the highest free flow speed (Sff) value occurred on Wednesday, May 17, 2023 on segment 3 of the Buduran Sidoarjo Highway, (Sidoarjo - Surabaya) with a value of Sff = 70.888 km / hour, the highest capacity or maximum current (VM) occurred on Tuesday, May 2, 2023 on segment 1 of the Sruni Buduran Highway, (Surabaya - Sidoarjo) VM = 722.005 emp/hour, the highest speed in maximum traffic flow (SM) conditions occurred on Wednesday, May 17, 2023 on segment 3 of the Buduran Sidoarjo Highway, (Sidoarjo - Surabaya) SM = 37.444 km / hour, and the highest density in maximum traffic flow (DM) conditions occurred on Tuesday, May 2, 2023 on segment 1 of the Sruni Buduran Highway, (Surabaya - Sidoarjo) DM = 22.549 emp/km.

Keywords: Flooding, Traffic Density, Maximum Volume, Maximum Density, Free flow speed, GIS, Greenshields Method, PKJI 2014

Introduction

Sidoarjo is a regency in East Java known as the city of Delta, this is due to the location of Sidoarjo Regency which is flanked by two rivers, namely the Surabaya river and the Porong river. Administratively, Sidoarjo Regency consists of 18 sub-districts, 322 villages, and 31 sub-districts. Land use patterns in Sidoarjo Regency consist of 7 types of land use, namely settlements, rice fields and fisheries, mining, industry (warehouses, industrial zones and industrial estates), public facilities, trade and services,

and special military areas. At this time industrial growth in Sidoarjo Regency experienced rapid growth, where industry was one of the main economic sectors of Sidoarjo Regency.

The very rapid development in Sidoarjo Regency resulted in an increase in traffic volume which affected the density on a number of roads in Sidoarjo Regency, this was mainly due to the activities of industrial and trade zones. The traffic density points in Sidoarjo Regency include Sruni Buduran road. On Sruni Buduran road, there are several industrial areas and also cross the national road, so it is used as a route in and out of industrial vehicles and vehicles outside the Regency / City.

Transportation problems in the Sruni Buduran road area arise mainly due to the high population level in Sidoarjo Regency, the growth in the number of vehicles is not proportional to the growth of transportation infrastructure, and the population and movement are increasing rapidly every day. The density of vehicles that occur can be at risk of an increase in accidents, this is due to the free flow of vehicles that are hampered. Free-flow speed is defined as speed at the zero current level, which is the speed chosen by the driver if driving a motorized vehicle without being influenced by other vehicles on the road (PKJI, 2014).

For this reason, information about the movement of traffic flow is very important to know in the Sidoarjo Regency area, especially in research on the Sruni Buduran road. In planning and determining various transportation system policies, the theory of traffic flow movement plays a very important role. The ability to accommodate traffic flow depends largely on the physical condition of the road, both its quality and quantity as well as its traffic operational characteristics. This theory of traffic flow movement will explain the quality and quantity of traffic flow so that wisdom or selection of existing systems can be applied. To facilitate the application of traffic movement theory, a mathematical approach method is used to analyze the symptoms that occur in traffic flow.

(According to Suteja 1999), one approach to understanding traffic behavior is to describe it in the form of mathematical and graphical relationships, and can be used as a basis for implementing more appropriate traffic management. An increase in traffic volume will lead to a change in traffic behavior. Theoretically there is a fundamental relationship between volume (flow) with speed (speed) and density (density).

Therefore, efforts to overcome problems on the roads of Sidoarjo Regency, especially on the Sruni Buduran road, are to review traffic flow by taking into account the condition of vehicle volume, vehicle speed and density around the road area, this aims to understand traffic behavior so that it can know the right methods and systems in these problems, In order to later be able to provide solutions in every traffic problem that occurs on the road.

(According to Murniati et al 2013), the model of the relationship equation between the characteristics of effective traffic flow for industrial estates and shops is the Greenshields Model, therefore the Greenshields Model is expected to be an effective solution in overcoming the problem of congestion on Jalan Seruni Buduran whose density is influenced by industrial activities and shopping activities. The Greenshields

model is the earliest model to observe traffic behavior by formulating that the mathematical relationship between speed and density is a linear approach. Graphically the Greenshields Model also has better accuracy than the Greenbergs Model both for speed - density, current - density or current - speed (Wibisana, H., 2007).

Therefore, this study is intended to find a mathematical model between vehicle volume, and vehicle speed flow on a road section, using the Greenshield method and Mapping using Geographic Information System (GIS) tools. The road section studied is Jalan Seruni Buduran. This selection was based on initial observations where on this road section there is often congestion, which is caused by the increasing volume of vehicles at certain hours, this study models the correlation of flow and speed on this road section using the Greenshields Model.

These results are expected to be an alternative solution and can be applied to overcome traffic problems that occur in Sidoarjo Regency, especially on Jalan Seruni Buduran. The purpose of this study is to determine the value of free flow speed in vehicles, the value of traffic volume, travel speed, and traffic density passing on the Sruni Buduran Road section. To determine the mathematical relationship of volume, speed, density, and thematic map of free flow speed on the Sruni Buduran Road section using the Greenshields method.

Method

Volume is the number of vehicles passing through a road section during one unit of point time (kend/hour). Traffic volume is formed from the movement of individual motorists and vehicles interacting with each other on a road section and its environment. This type of traffic flow is divided into un-interupted flow and interupted flow.

According to PKJI'14, traffic flow is the number of motorized vehicles passing through a point on a section of road per unit of time expressed in units of kend/hour (Qkend), or skr/hour (Qskr), or skr/day Annual Average Daily Traffic (LHRT). The parameter commonly used to determine the tendency of daily traffic flow patterns is to use average daily traffic (LHR), LHR is obtained by observing traffic for 12 hours, in several days and the results are averaged, which is said in kend / day or emp / day. Vehicles, with correction factors for each vehicle, namely:

Total traffic flow in emp/hour:

Vemp = (ekrKR x KR+ ekrKB x KB+ ekrSM x SM)..... (1)

Information:

V: Vehicle Volume (emp/h)

Ekr KR: Light vehicle equivalence value (Light Vehicle)

Ekr KB :Value Light vehicle equivalence (Heavy Vehicles)

Ekr SM: Equivalence Value of light vehicles (Motorcycles)

KR : Light Vehicle Notation

KB : Heavy Vehicle Notation

BC : Motorcycle Vehicle Notation

Travel Speed (VT)

Speed is the rate of movement within a certain distance in one-unit time (km/h). In the movement of traffic flow, each vehicle travels at a different speed.

In the calculation, the average speed is divided into two, namely, Time Mean Speed (TMS), which is defined as the average speed of all vehicles passing a point from the road

during a certain period and Space Mean Speed (SMS), which is the average speed of all vehicles occupying a section of road over a certain period of time, Traveled speed is defined as the average speed of space mean speed (SMS) of light vehicles along a road segment:

$VT = L/T_T$

Information:

VT = Average space speed of vehicle (km/h)
L = Length Segment (KM)
TT = Time Average vehicle travel (hours).

Density is the number of vehicles occupying the observed road length divided by the observed road length. Density is difficult to measure with certainty. Density can be calculated based on speed and volume. The relationship between volume, speed, and density is:

D = V/S

Where:

D = Traffic Density (kend/km)
V = Traffic Volume (kend/hour)
S = Vehicle Speed (km/h)

The Relationship Between Volume, Speed and Density

Volume, speed and density are 3 (three) variables/parameters
main (macroscopic) in the traffic flow used to know
characteristics of traffic flow.

1. Volume (flow), is the number of vehicles that pass a certain point on a road section with a certain unit of time expressed in vehicles / hour.
2. Speed (speed), is the rate of movement where at a certain distance with a unit of time expressed by kilometers / hour.
3. Density, is the number of vehicles occupying a certain road section / segment expressed in vehicles / kilometers.

Such mathematical relationships can be expressed as follows:

V = D . S

Where:

V = current (volume)
D = Density
S = Speed

These three variables describe the flow of traffic (uninterrupted traffic stream) where these variables have a relationship with each other. The relationship between volume, velocity, and density can be graphically illustrated using mathematical equations (Nugroho Julianto, 2010).

Greenshields (Wohl and Martin, 1967; Pignataro, 1973; Salter,1978; and Hobbs, 1979), formulated that the mathematical relationship between velocity and density is assumed to be linear, as expressed in the following equation:

S = Sff - Sff/Dj . D ..... (2)

Furthermore, the mathematical relationship between current and velocity can be derived using the basic equation:

V = D x S ..... (3)

Information:

V = Volume Traffic Flow

D = Traffic Flow Density
S = Vehicle Speed (km/h)
And then put into the equation:
S=V/D..... (4)
V/D = Sff - Sff/Dj.. ..... (5)
V = D . Sff - Sff/Dj D2 ..... (6)
Equation (5) is an equation that expresses the mathematical relationship between current and density. Maximum current conditions (VM) can be obtained at the time of current
D = DM, The value of D = DM, can be obtained through the equation:
$\partial V/\partial D$ = Sff - (2 . sff)/dj d = 0 ..... (7)
DM = Dj/2 ..... (8)
By entering equation (7) into equation (5), the VM value can be obtained as shown in equation (7).
VM = (Dj. Sff)/4 .....(9)
Furthermore, the mathematical relationship between current and velocity can be derived using basic equation (3), and incorporating equation (9) into equation (3), then it can be derived through equation (9) – (10).
D = V/S .....(10)
S = Sff - Sff/Dj . V/S ..... (11)
sff/dj - v/s = sff -s ..... (12)
V = Dj . S - Dj/Sff . S2..... (13)
Equation (13) is an equation that expresses the mathematical relationship between current and velocity. The maximum current condition of the VM can be obtained when the current S = SM, the value of S = SM can be obtained through the equation (14) – (15).
$\partial V/\partial D$ = Dj - (2 . Dj)/Sff . SM = 0..... (14)
SM = Sff/2 ..... (15)
By entering equation (15) into equation (13), the VM value can be obtained as shown in equation (16).
VM = Dj - Sff/4 .....(16)
So it can be concluded that the VM can be reached at the condition of
S = SM and D = DM.

Results and Discussion

In data collection in the city of Sidoarjo, it is carried out using the method of taking measurements directly in the field, with a roll meter, or push meter, stop watch, and cheker as a tool to measure. In this study it is divided into 3 road segments, namely segment 1 is on Jalan Raya Seruni Buduran with a segment length of 0.85 km, segment 2 is on Jalan Raya Tebel Buduran with a segment length of 0.85 km, segment 3 is on Jalan Raya Buduran with a segment length of 1.3 km, so for the total length of the entire segment reaches 3 km. The following is the geometric data of the roads on Seruni Buduran Highway, Tebel Buduran Highway, and Buduran Highway:

1. Segment 1 Sruni Buduran Highway (0.85 km)
   a. From-to: Surabaya – Sidoarjo
      City/ District: Sidoarjo
      Wide Road Section: 14.4 meters
      Road Type: 4/2T (4 lanes 2 way divided)
      Wide Lane: 6.5 meters
   b. From-to: Sidoarjo – Surabaya

Wide Road Section: 14.4 meters
Road Type: 4/2T (4 divided 2-way lanes) Speed width: 6.5 meters

2. Segment 2 Jalan Raya Tebel Buduran (0.85 km)

a. From-to: Surabaya – Sidoarjo
City/ Regency : Sidoarjo
Wide Road Sections : 14,4 meter
Road Type: 4/2T (4 lanes 2 way divided)
Wide Lane: 6.5 meters

b. From-to: Sidoarjo – Surabaya
Wide Road Section: 14.4 meters
Road Type: 4/2T (4 lanes 2 way divided)
Wide Lane: 6.5 meters

3. Segment 3 Jalan Raya Buduran Sidoarjo (1.3 km)

a. From-to: Surabaya – Sidoarjo
City/ District: Sidoarjo
Wide Road Section: 14.4 meters
Road Type: 4/2T (4 lanes 2 way divided)
Wide Lane: 6.5 meters

b. From-to: Sidoarjo – Surabaya
Wide Road Section: 14.4 meters
Road Type: 4/2T (4 lanes 2 way divided)
Wide Lane: 6.5 meters.

Based on calculations on the Greenshields method, recapitulation results are obtained as in the following table:

Day	Sff (km/h)	Dj (emp/km)	Vm (emp/h)	Sm (km/h)	Dm (emp/km)
Monday	65,134	43,904	714,902	32,567	21,952
Tuesday	**65,358**	44,188	**722,005**	**32,679**	22,094
Wednesday	63,239	**45,098**	712,993	31,619	**22,549**
Thursday	64,567	43,031	694,598	32,283	21,516

From the results in table 4.17 recapitulation of the calculation of segment 1 of the Sruni Buduran Highway direction (Surabaya - Sidoarjo), on 01 – 04 May 2023, it is known:

1. Speed in very low traffic flow conditions or also called free flow speed Sff (km / h), getting the highest result on Tuesday with a value of Sff = 65.358 km / h
2. Congestion in traffic flow conditions experienced total congestion Dj (emp/km), getting the highest result on Wednesday with a value = 45,098 emp/km
3. VM maximum capacity or current (emp/hour), got the highest result on Tuesday with VM value = 722.005 emp/hour
4. Speed at maximum traffic flow conditions SM (km/h), got the highest result on Tuesday with a value of SM = 32.679 km/h
5. Density in maximum traffic flow conditions DM (emp/km), got the highest result on Wednesday with a value of DM = 22.549 emp/km

Day	Sff (km/h)	Dj (emp/km)	Vm (emp/h)	Sm (km/h)	Dm (emp/km)
Monday	64,606	42,399	684,801	32,303	21,199

Tuesday	62,784	**44,932**	**705,255**	31,392	**22,466**
Wednesday	63,102	44,349	699,628	31,551	22,175
Thursday	**65,872**	39,418	649,136	**32,936**	19,709

From the results in table 4.18 recapitulation of the calculation of segment 1 of the Sruni Buduran Highway direction (Sidoarjo - Surabaya), on 01 – 04 May 2023, it is known:

1. Speed in very low traffic flow conditions or also called free flow speed Sff (km / h), getting the highest result on Thursday with a value of Sff = 65.872 km / h
2. Congestion in traffic flow conditions experienced total congestion Dj (emp/km), getting the highest result on Tuesday with a value = 44,932 emp/km
3. VM maximum capacity or current (emp/hour), got the highest result on Tuesday with VM value = 705.255 emp/hour
4. Speed at maximum traffic flow conditions SM (km/h), got the highest result on Thursday with a value of SM = 32.936 km/h
5. Density in maximum traffic flow conditions DM (emp/km), got the highest result on Tuesday with a value of DM = 22.466 emp/km

Based on calculations on the Greenshields method, recapitulation results are obtained as in the following table:

Day	**Sff (km/h)**	**Dj (emp/km)**	**Vm (emp/h)**	**Sm (km/h)**	**Dm (emp/km)**
Monday	58,855	**43,416**	**638,816**	29,427	**21,708**
Tuesday	61,939	38,276	592,691	30,969	19,138
Wednesday	60,636	41,293	625,961	30,318	20,647
Thursday	**65,267**	34,344	560,397	**32,634**	17,172

From the results in table 4.35 recapitulation of the calculation of segment 2 of the Tebel Buduran Highway direction (Surabaya - Sidoarjo), on May 8 – 11, 2023, it is known:

1. Speed in very low traffic flow conditions or also called free flow speed Sff (km / h), getting the highest result on Thursday with a value of Sff = 65.267 km / h
2. Congestion in traffic flow conditions experienced total congestion Dj (emp/km), getting the highest result on Monday with a value = 43.416 emp/km
3. VM maximum capacity or current (emp/hour), got the highest result on Monday with VM value = 638.816 emp/hour
4. Speed at maximum traffic flow conditions BC (km/h), got the highest result on Thursday with a value of SM = 32.634 km/h
5. Density under maximum traffic flow conditions DM (emp/km), got the highest result on Monday with DM value = 21.708 emp/km

Day	**Sff (km/h)**	**Dj (emp/km)**	**Vm (emp/h)**	**Sm (km/h)**	**Dm (emp/km)**
Monday	58,364	**44,460**	**648,712**	29,182	**22,230**
Tuesday	60,896	37,486	570,680	30,448	18,743
Wednesday	67,066	32,989	553,101	33,533	16,494
Thursday	**67,570**	32,492	565,106	**34,784**	16,246

From the results in table 4.36 recapitulation of the calculation of segment 2 of the Tebel Buduran Highway direction (Sidoarjo - Surabaya), on May 8 – 11, 2023, it is known:

1. Speed in very low traffic flow conditions or also called free flow speed Sff (km / h), getting the highest result on Thursday with a value of Sff = 67.570 km / h
2. Congestion in traffic flow conditions experienced total congestion Dj (emp/km), getting the highest result on Monday with a value = 44,460 emp/km
3. VM maximum capacity or current (emp/hour), gets the highest result on Monday with VM value = 648.712 emp/hour
4. Speed at maximum traffic flow conditions SM (km/h), got the highest result on Thursday with a value of SM = 34.785 km/h
5. Density in maximum traffic flow conditions DM (emp/km), gets the highest result on Monday with DM value = 22,230 emp/km

Based on calculations on the Greenshields method, recapitulation results are obtained as in the following table:

Day	Sff (km/h)	Dj (emp/km)	Vm (emp/h)	Sm (km/h)	Dm (emp/km)
Monday	70,568	30,832	543,946	35,284	15,416
Tuesday	**70,604**	29,577	544,247	**36,802**	14,788
Wednesday	68,937	32,860	**566,310**	34,468	16,430
Thursday	67,368	**32,981**	555,462	33,684	**16,490**

From the results in table 4.53 recapitulation of the calculation of segment 3 of the Buduran Sidoarjo Highway direction (Surabaya - Sidoarjo), on May 15 – 18, 2023, it is known:

1. Speed in very low traffic flow conditions or also called free flow speed Sff (km / h), getting the highest result on Tuesday with a value of Sff = 70.604 km / h
2. Congestion in traffic flow conditions experienced total congestion Dj (emp/km), getting the highest result on Thursday with a value = 32.981 emp/km
3. VM maximum capacity or current (emp/hour), got the highest result on Wednesday with VM value = 566.310 emp/hour
4. Speed at maximum traffic flow conditions SM (km/h), got the highest result on Tuesday with a value of SM = 36.802 km/h
5. Density in maximum traffic flow conditions DM (emp/km), got the highest result on Thursday with a value of DM = 16,490 emp/km

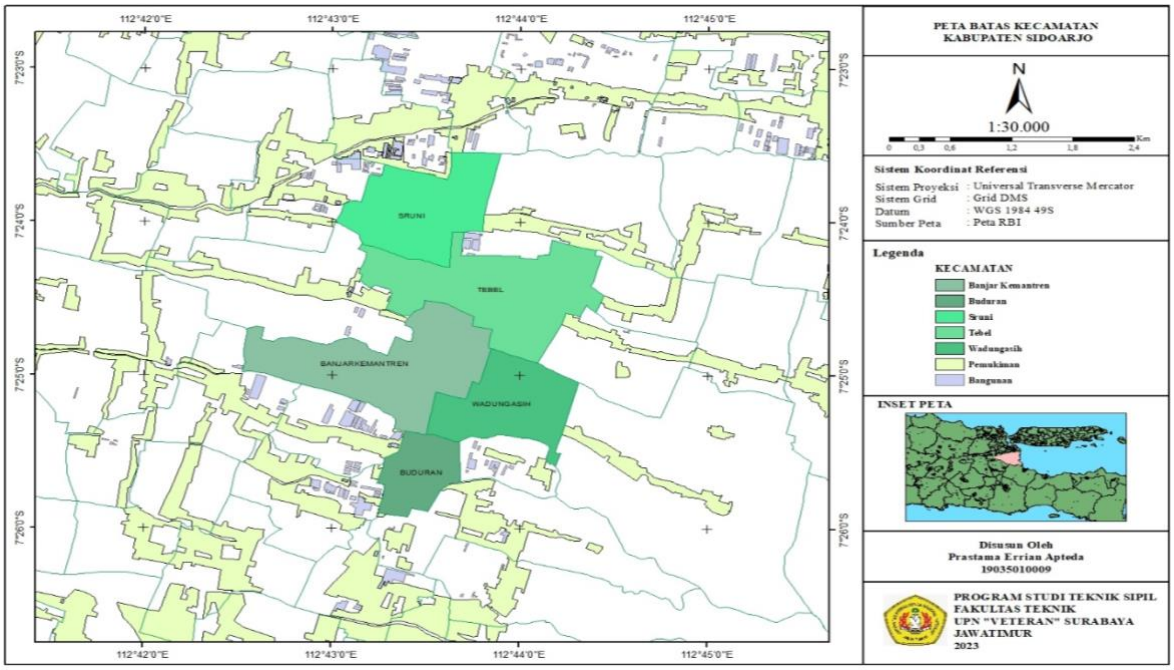
Day	Sff (km/h)	Dj (emp/km)	Vm (emp/h)	Sm (km/h)	Dm (emp/km)
Monday	62,757	**36,640**	**574,853**	31,379	**18,320**
Tuesday	65,918	34,372	566,436	32,959	17,186
Wednesday	**70,887**	29,912	560,013	**37,444**	14,956
Thursday	64,313	35,895	573,118	32,156	17,947

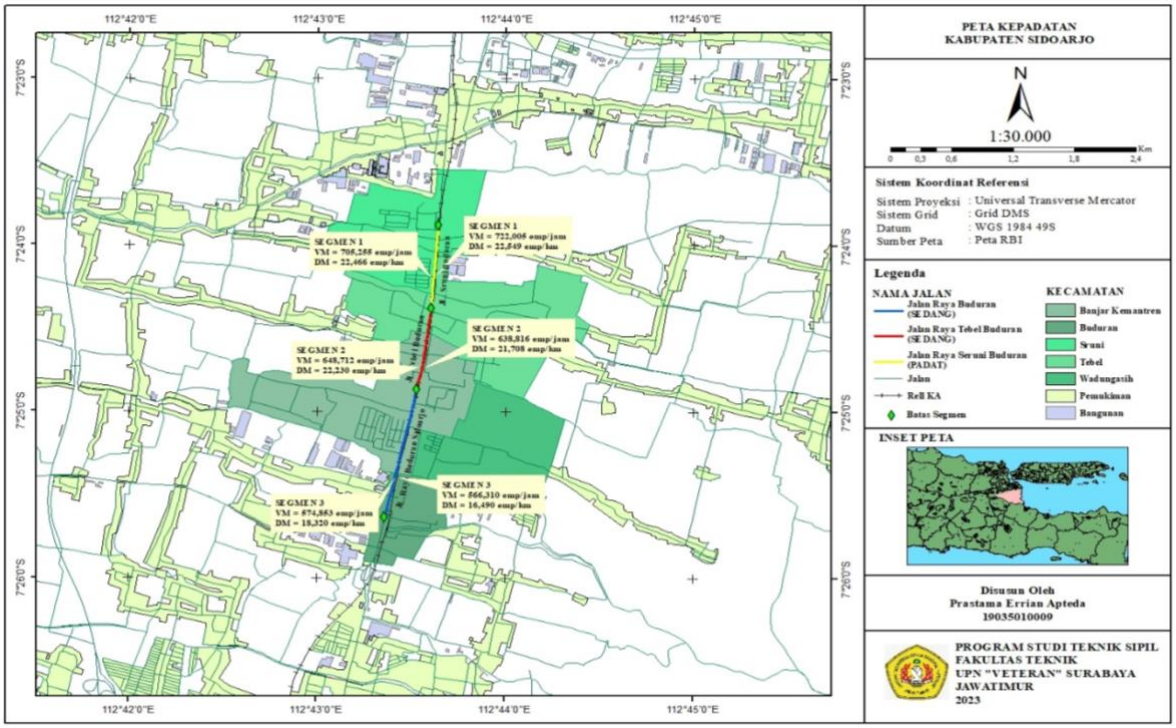
From the results in table 4.54 recapitulation of the calculation of segment 3 of the Buduran Sidoarjo Highway direction (Sidoarjo - Surabaya), on May 15 – 18, 2023, it is known:

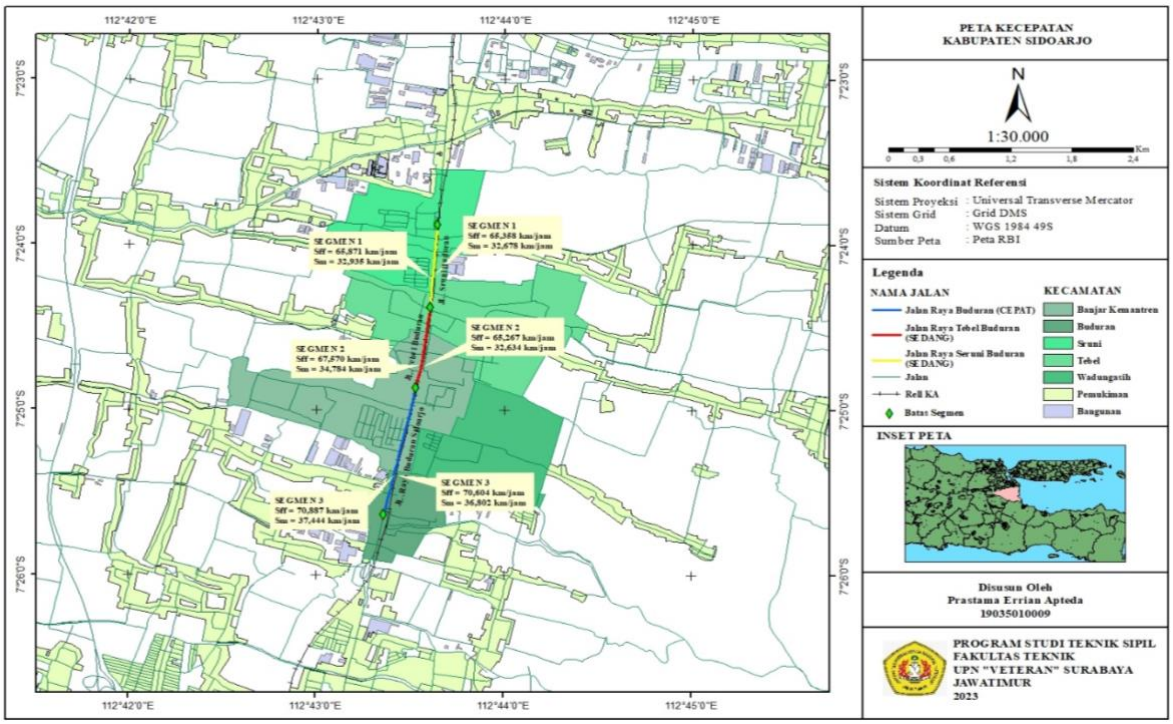
1. Speed in very low traffic flow conditions or also called free flow speed Sff (km / h), getting the highest result on Wednesday with a value of Sff = 70.887 km / h

2. Congestion in traffic flow conditions experienced total congestion Dj (emp/km), getting the highest result on Monday with a value = 36,640 emp/km
3. VM maximum capacity or current (emp/hour), gets the highest result on Monday with VM value = 574.853 emp/hour
4. Speed at maximum traffic flow conditions SM (km/h), got the highest result on Wednesday with a value of SM = 37.444 km/h
5. Density in maximum traffic flow conditions DM (emp/km), got the highest result on Monday with DM value = 18,320 emp/km

Thematic Map of Traffic Characteristics of Sruni Buduran Road, Sidoarjo Regency with Greenshields Method.


112°42'0"E
112°43'0"E
112°44'0"E
112°45'0"E
7°23'0"S
7°24'0"S
7°25'0"S
7°26'0"S
SRUNI
TEBEL
BANJARKEMANTREN
WADUNGASIH
BUDURAN
PETA BATAS KECAMATAN
KABUPATEN SIDOARJO
N
1:30.000
0 0,3 0,6 1,2 1,8 2,4 Km
Sistem Koordinat Referensi
Sistem Proyeksi : Universal Transverse Mercator
Sistem Grid : Grid DMS
Datum : WGS 1984 49S
Sumber Peta : Peta RBI
Legenda
KECAMATAN
Banjar Kemantren
Buduran
Sruni
Tebel
Wadungasih
Pemukiman
Bangunan
INSET PETA
Disusun Oleh
Prastama Errian Apteda
19035010009
PROGRAM STUDI TEKNIK SIPIL
FAKULTAS TEKNIK
UPN "VETERAN" SURABAYA
JAWATIMUR
2023


112°42'0"E
112°43'0"E
112°44'0"E
112°45'0"E
7°23'0"S
7°24'0"S
7°25'0"S
7°26'0"S
SEGMEN 1
VM = 708,588 emp/jam
DM = 22,466 emp/km
SEGMEN 1
VM = 722,006 emp/jam
DM = 22,849 emp/km
SEGMEN 2
VM = 648,712 emp/jam
DM = 22,230 emp/km
SEGMEN 2
VM = 638,816 emp/jam
DM = 21,708 emp/km
SEGMEN 3
VM = 874,863 emp/jam
DM = 18,320 emp/km
SEGMEN 3
VM = 866,310 emp/jam
DM = 16,490 emp/km
PETA KEPADATAN
KABUPATEN SIDOARJO
N
1:30.000
0 0,3 0,6 1,2 1,8 2,4 Km
Sistem Koordinat Referensi
Sistem Proyeksi : Universal Transverse Mercator
Sistem Grid : Grid DMS
Datum : WGS 1984 49S
Sumber Peta : Peta RBI
Legenda
NAMA JALAN
Jalan Raya Buduran (SEDANG)
Jalan Raya Tebel Buduran (SEDANG)
Jalan Raya Sruni Buduran (PADAT)
Jalan
Rel KA
Batas Segmen
KECAMATAN
Banjar Kemantren
Buduran
Sruni
Tebel
Wadungasih
Pemukiman
Bangunan
INSET PETA
Disusun Oleh
Prastama Errian Apteda
19035010009
PROGRAM STUDI TEKNIK SIPIL
FAKULTAS TEKNIK
UPN "VETERAN" SURABAYA
JAWATIMUR
2023



Conclusion

1. The volume of vehicles on the Pantura Highway section on the Babat – Pucuk District section in 2023 with research time during the morning rush hour 06.00 – 08.00 and the afternoon rush hour 16.00 – 18.00 is:
   Segment 1 initial coordinates 637721.55 m E and 9215083.07 m S final coordinates 638508.19 m E and 9215168.06 m S direction Tripe – Gresik Total Q = 3016.5 emp/hour. As for the direction Gresik – Tripe Q total = 3159.2 emp / hour.
   Segment 2 initial coordinates 638508.19 m E and 9215168.06 m S final coordinates 638900.84 m E and 9215198.63 m S direction Tripe – Gresik Total Q = 3348.9 emp/hour. As for the direction Gresik – Tripe Q total = 2937.6 emp / hour.
   Segment 3 initial coordinates 638900.84 m E and 9215198.63 m S final coordinates 639834.56 m E and 9215272.35 m S direction Tripe – Gresik Q total = 3343.9 emp/hour. As for the direction Gresik – Tripe Q total = 2917.3 emp / hour.
   Segment 4 initial coordinates 637721.55 m E and 9215083.07 m S final coordinates 640246.01 m E and 9215307.15 m S direction Tripe – Gresik Total Q = 3027.8 emp/hour. While the direction Gresik – Tripe Q total = 3299.9 emp / hour.
   Segment 5 initial coordinates 640246.01 m E and 9215307.15 m S final coordinates 640577.47 m E and 9215338.28 m S direction Tripe – Gresik Q total = 3060.1 emp/hour. While the direction Gresik - Tripe Q total = 3208.3 emp / hour.
2. The noise level on Jalan Raya Pantura section of Babat District – Pucuk District in 2023 with research time in the morning rush hour 06.00 – 08.00 and afternoon rush hour 16.00 – 18.00 is:
   Segment 1 way Tripe – Gresik highest noise value = 85.6 dBA. While the direction Gresik – Tripe the highest noise value = 87 dBA.
   2-way segment Tripe – Gresik highest noise value = 85.6 dBA. While the direction Gresik – Tripe the highest noise value = 84.8 dBA.
   3-way segment Tripe – Gresik highest noise value = 87.5 dBA. While the direction Gresik – Tripe the highest noise value = 87 dBA.

4-way segment Tripe – Gresik highest noise value = 86.1 dBA. While the direction Gresik – Tripe highest noise value = 87.8 dBA.
5-way segment Tripe – Gresik highest noise value = 86.5 dBA. While the direction Gresik – Tripe the highest noise value = 86 dBA.

3. From the results of data analysis and discussion, it can be concluded that the volume of vehicles does not have a steady increase in noise. The increase in vehicle volume is not always directly proportional to the increase in noise value, this happens because there are differences in capacity between segments and noise generated from the surrounding environment such as markets, train stations, factories, shops. Noise is also generated from the sound of blown tires, exhaust leaks, modif exhaust, horns, etc.
   The hypothesis used is: H0 is accepted if there is no significant difference between the noise value (Y) and the calculation result Ha is accepted if there is a significant difference between the noise value (Y) and the calculation result.
   In the linear regression method = value of t stat = 0.007474 < t critical = 2.262157 then H 0 is accepted which means there is no significant difference between the value of insitu noise (Y) and the results of linear regression calculations.
   p value = $0.9 > \alpha = 0.05$ *then H 0* is accepted which means that there is no significant difference between the insitu noise value (Y) and the results of linear regression calculations.
   In the lagrange polynomial method = stat t value = 2.303102485 critical t > = 2.262157163, H a is accepted, which means that there is a significant difference between the insitu noise value (Y) and the results of the lagrange polynomial calculation.
   p *value* = $0.046 < \alpha = 0.05$ *then H*a is accepted which means that there is no significant difference between the insitu noise value (Y) and the results of the lagrange polynomial calculation.

   So it can be concluded that in the calculation of the correlation between vehicle volume and noise value, the linear regression method is more feasible to use because in the t-test results there is no significant difference between the insitu noise variable (Y) and the calculation results of the linear regression function formula, while for the lagrange polynomial method, there is a significant difference between the insitu noise variable (Y) and the calculation results of the lagrange polynomial function formula.

BIBLIOGRAPHY

Aronoff, Geographic information systems: a management perspective. (1989).

Balirante, Meylinda, Lucia IR Lefrandt, and Meike Kumaat. "Analysis of traffic noise levels on the highway in terms of permissible noise quality standards." Journal of Civil Static 8.2 (2020).

Ferial, Linardita, Endro Susanto, and Mawar DS Silalahi. "Noise Level Analysis at Pakupatan Terminal (Serang Regency, Banten Province)." Indonesian Journal of Urban and Environmental Technology 8.1 (2016): 81-96.

Indratmo, Dunat. "Study of Road Capacity and Degree of Traffic Saturation on Jalan Ahmad Yani Surabaya." Journal of Civil Engineering Applications 1.1 (2017): 25-31.

Decree of the minister of environment No. 48 on noise (1996).

Khairina, Khairina, Deasy Arisanty, and Sidharta Adyatma. "Motor vehicle traffic noise on roads in Central Banjarmasin District." JPG (Journal of Geography Education) 1.1 (2016).

Lewis, R.W., & Sukirman, Y. Finite element modeling to simulate surface subsidence over a compaction hydrocarbon reservoir (1994).

Marisdayana, R., Suhartono, S., &; Nurjazuli, N. Relationship between noise exposure intensity and working period with hearing loss in employees of PT. X. Indonesian Journal of Environmental Health, 15(1), 22-27. (2016).

Indonesian Road Capacity Guide (PKJI) (2014).

Pristianto, Hendrik. "Analysis of noise due to transportation activities on Jalan Ahmad Yani in Sorong City." (2018).

Rahayu, Setiya, and Trapsilo Prihandono. "The Effect of Traffic Noise Level on Student Comfort Level During Learning in Bangil Sub-District School, Pasuruan Regency (Case Study at SMP Negeri 3 Bangil and MTs Negeri Bangil)." Journal of Physics Learning 5.1 (2017): 10-16.

Setiawan, Agung. "Prediction of heterogeneous traffic noise levels based on geographic information systems." Makassar: Department of Environmental Engineering, Faculty of Engineering UNHAS (2017).

Sugiyanto, G., Munawar, A., Malkhamah, S., & Sutomo, H. Development of a congestion cost model for private car users in the central urban area of Yogyakarta. Journal of Transportation, 11(2). (2011).

Sya'bani, Nyanyu Lutfia, and Budi Hartanto Susilo. "Traffic Noise Modeling on Kopo Bandung Canal Road." Journal of Civil Engineering 8.2 (2012): 91-111.

Syaiful, Syaiful, and Zainal Abidin. "The effect of traffic volume on the noise generated by motor vehicles." UNIID Symposium II 2017 2.1 (2017): 229-234.

Geometric planning procedures for intercity roads (Bina Marga, 1997).

Law of the Republic of Indonesia No. 22 of 2009 concerning road traffic and transportation (2009).

Wardika, I. K., I. G. P. Suparsa, and D. M. W. Priyantha. "Traffic Noise Analysis on Arterial Roads (Case Study: Prof. Dr. IB. Spells at Km 15 to Km 16." Scientific Journal of Electronic Civil Engineering Infrastructure, Udayana University, Denpasar. XV-1–XV-8 (2012).

Wibisana, H1., Utomo, N2., Mapping the speed and density of traffic on arterial roads in Surabaya. Journal of Civil Engineering (2016)