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ANALYSIS OF CITY ROAD NETWORK SYSTEM IN SUPPORTING REGIONAL DEVELOPMENT SIDIKALANG CITY, DAIRI REGENCY

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ABSTRACT
Sidikalang City's development and expansion are inseparable from the road network accessible. The study aims to analyze the availability and performance of road systems using quantitative and descriptive studies. The approach used to measure the road network's reliability is to compare connectivity and mobility values with the 2001 SPM Road Value while the MKJI 1997 is used to calculate the road network's Service Level Index (ITP). The results showed that the road accessibility index in Sidikalang City is 1.5 km / km2, with an SPM value of 0.5 km / km2 (meeting the minimum requirements), the SPM road mobility index of 1.94 km/1 000 people (down from the minimum requirements) is 5 km/1000, and road performance in the primary road collection system has decreased substantially, in the 5 m wide road segment where ITP Category F is the highest degradation in performance occurred at Jalan Pahlawan.
KEYWORDS: *Availability, Accessibility, Mobility, Capacity, Service Level Index*

1. INTRODUCTION

Concerning the development along with the time, both physical and non-physical development of the Dairi Regency increased each year. Among other things, since 2012, the rate of economic growth has grown by an average of 5.03 percent annually and the number of GDP in 2017 has increased to IDR 5,968,770,000,000, based on constant 2010 prices, population growth in 2017 amounted to about 0.64 percent annually with a population of 281.876 people. The total population of Sidikalang is 70,67 km2 and 50,434 people so that population density amounts to 713,66 people. The total population density is 2140,66 people / km2, if the region is reduced by woodland, cropland and rice fields (totals 47,11 square kilometers) then this is already classified as a very dense population according to law 56/PRP/1960 (density exceeding 401 people / km2).

The overall annual growth rate in the Community's HDI (Human Development Index) is 1.17%, where the HDI is 67.15% from 2013 to 2017, 67.91%, 69.00%, 69.6%, 70.36% and so on. As Dairi Regency GRDP increased, per capita income also grew 8.11 percent annually, based on current prices, to IDR 28,539,613,-per capita GRDP in 2017. Consequently, the Community's ability to meet its needs (primary, secondary and tertiary needs) has increased, including building permanent houses, buying four- or two-wheelers and also increasing purchasing power, with an average increase from 2012, in local vehicles of 1,599

two-wheeled cars per year, four-wheel pick up and oplet busses of 194 units per year, and a minimum of 194 units per year.

Increased Community income, and high growth in vehicles (23.91%, when the total LHR in 2017 is 40.296 pcu per day on five main highways in Sidikalang), without any further increase in transport infrastructure services, whether in the form of extra highways and/or roads. Apart from a large number of vehicles parking on the streets, it is still possible to develop government offices, public, and other social infrastructures so that the traffic flow can lead to the town center which causes a downward trend in the network of urban center (Sidikalang and Batang Beruh village).

Objectives of the Study

To analyze the effect of the availability and performance of the city road network in supporting the development of the Sidikalang city.

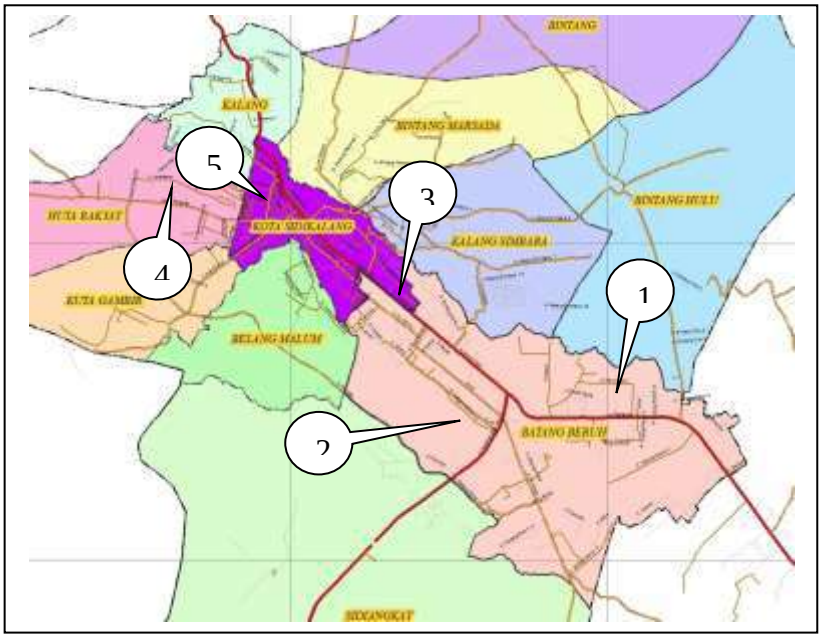
2. RESEARCH METHODOLOGY

This is a study of a descriptive quantitative survey method with primary data in the form of data about the distribution of community centers, data about traffic volume 2019, traffic speed (travel times and time), side barriers, geometrical path. Secondary data in the form of Sidikalang City map, city population, GRDP per capita, total functional road frequency, location, regional potential data LHR (daily traffic) for the last 5 years, road data and road maps, RTRW (Regional Spatial Planning))/RUTR (Spatial General Plan)/RDTR (Spatial Detailed Plan), data center of community activity concentration (if any).

Several roads function as primary roads as described in Table 1 and Figure 1, below, where study areas/locations are important to study:

Table 1 Roads of study sites

No.	Route/Type of Road	Service area
1.	Pahlawan street/national roads -primary collector	• Sidikalang city–Tanah Karo regency, Medan and connecting 5 sub-district capitals.
2.	Runding street/ national roads -primary collector	• Sidikalang – Pakpak Bharat regency, Sumbul Salam city (Aceh Province),. South Aceh (Aceh Province).
3.	Ahmad Yani street & Sisingamangaraja street/ national roads - primary collector	• Cities in Sidikalang – Tanah Karo regency, Southeast Aceh (Aceh province) and connecting 4 sub-district capital
4.	Sitellu Nempu street & Persada street/ Regency road – primary local	• Sidikalang (City center) –5 sub-district capital.
5.	Sulang Silima street / Regency road – primary local	• Cities



Gambar 1. Sket lokasi penelitian

In this survey, the tools and materials used are:

a. Map of the road network of the district of Sidikalang city used to determine the connection between the community centers and their locations;
b. GPS used to identify geographically mapped positions of the activity centers,
c. Tape measurement used to measure the distance and width of the road sections observed;
d. Stopwatch to determine how long a vehicle will have to travel such distance
e. Counter, which is used to count traffic through the point of the observation area
f. Survey car, a vehicle for travel time measurement,
g. The camera is used to record what is considered necessary, and
h. Stationery.

It's rush hour observation time. Observation time is two hours in the morning starting at 06:30-08:30, three hours from 11.00 am-02.00 pm and three hours starting from 04.00 pm-07.00 pm for six days (Monday to Saturday) for each road section.

In order to facilitate the accessibility and mobility of the movement of people, goods, and services, data analysis was done by measuring the total length of accessible road networks in the total area, population and income of the per capita population, and then compared them with the Indonesian road sector service quality standards, in accordance with the minimum service standards (SPM) 2001. The Dairi District RDTR / RTRW and Community Activity Centre, based on GIS-based mapping results, shall be evaluated for land use (development) in the city's shape. Road performance analysis consists of calculating traffic speed, saturation level (VCR), the density of traffic, and then the road level index (ITP) following the 1997 MKJI road plan.

3. LITERATURE REVIEW

Regional Development

Regional development in an environment adapted to the physical and social potential of the community and obey related laws and regulations is according to Sandy (1992). In this way, regional development is applied. According to Alkadri et.al (2001), three regional components are to be considered in the area of regional development; the following are the pillars of regional development: natural resources, human resources, and technology. Therefore, regional development can be interpreted as an increase in the activities of the factors in the area which includes: institutions, politics, social and ecological aspects to increase people's living standards and quality of life (Sirojuzilam, 2015: 34).

Transportasi dalam Pengembangan Wilayah

Transport benefits can lead to the place and time utility, which can lead to more use for persons and goods and to greater time and benefits for them in economic, social and political aspects (Adisasmita, 2014; 1.4) The benefits of transportation can be achieved. M.N. Nasution, said two main transport roles: first, as a service facility and, secondly, as a promoter of the facility (Adisasmita & Sakti 2011: 11).

Jaringan Jalan Sebagai Penunjang Pertumbuhan Ekonomi

Transport problems are one of the main issues that must be addressed by Miraza in regional planning (2006). The development of the inter-regional transportation routes means that the economic potentials between the regions are related to ongoing economic activities, both as regards natural resources, labor, and services, etc. (Sirojuzilam, 2015: 7). According to Tarmin (2000:7), the infrastructure system has two principal roles essentially, that is to say: as an instrument for direct urban development and infrastructure for the movement of persons and/or goods arising out of urban activities.

Access to roads

The network capacity is a ratio of the total length of the road to the area according to Santoso and Joewono (2005). Accessibility is increased due to the availability of the street network, so the more accessibility the city will surely increase the number and length of the road network in an urban area. According to Tamin (2000:40) it can be combined as the four-stage transport planning model with the basic relationship between the activity system, network system, and the movement system, where components for the three systems are accommodated at the accessibility and mobility stages, traffic generation, population distribution, transport modes, and routes selection.

Roads Network As A Determinant Of Urban Design

According to Smailes (1995) there are three elements that shape city morphology, namely (1) land use (2) street plan / layout (3) architectural style of buildings and their design, whereas according to Johnson (1981) the three elements of morphology are (1) street plan, (2) buildings, (3) the functions of buildings Both of these views show that the road element (Yunus, 2014: 108) is the most important in the formation of urban space (morphology).

Indicators and measures of Network Availability

The requirements set in the minimum service standards consisting of minimum service standards for the road network and minimum service standards for the road sections were set in Article 112 of Government Regulation No. 34/2006. Minimum road network service standards include connectivity, flexibility, and safety, minimum roadway service standards covering road requirements and speed.

The availability of the road network can be calculated based on the importance of the accessibility index and its mobility index by comparing it with the minimum service standards set by the government. According to Decree no. 534/KPTS / M/2001 of the Minister of Settlement or Regional Infrastructure the

following minimum service standards shall be shown in Table 2 as to the availability of road infrastructure.

Table 2 The Indonesian road's minimum service standards

Availability of Road Infrastructure	**Accessibility Index (km/km^2)**		
	Total Road Network	Population density (person / km^2)	Minimum Accessibility Index Value (km / km^2)
		Very High > 5000	> 5,00
		High > 1000	> 1,50
		Medium > 500	> 0,50
		Low > 100	> 0,15
		Very low < 100	> 0,05
	Mobility Index (km/1000 people)		
	Total Road Network	Per capita GRDP (million IDR / cap. / yr)	Minimum Accessibility Index Value (km/1000 people)
		Very High > 10	> 5,00
		High > 5	> 2,00
		Medium > 2	> 1,00
		Low > 1	> 0,50
		Very low < 1	> 0,20

Source: Department of Settlement and Regional Infrastructure (Depkimpraswil)

Road Performance Measurement

Road performance is a standard indicator of service level (LOS), which reflects the drivers ' perception of vehicle driving quality. LOS is related to measures such as density or time delay in quantitative approaches. A road section determines its quality to what degree the road is capable of performing its functions (Morlok, 1978). In Indonesia, the speed and degree of saturation is the traffic behavior indicator according to the MKJI (1997: 5-19). The road service level is expressed in the ITP (Index of Service Level). The following is the mathematical correlation between these variables:

Speed (S) = Length of the road (L) / Observation time (T)

Low density flow speed (FV) = (FV_O + FV_W) x FFV_{SF} x FFV_{CS}

where: FV = Free flow speed (Km/jam)

FV_0 = Base of low density flow speed (Km/jam)

FV_W = Speed adjustment factor due to road width (Km/jam)

FFV_{SF} = Factor of adjustment due to side barriers and roadside width

FFV_{CS} = Factor to city size adjustment

The degree of saturation (DS = NVK = VCR) = volume (V) / capacity (C)

Volume (V) = Q = Q_{LV} + Q_{HV} x emp_{HV} + Q_{MC} x emp_{MC}

Capacity (C) = C_O x FC_W x FC_{SP} x FC_{SF} x FC_{CS}

Where: LV = light vehicle

HV = heavy vehicle

MC = motorcycle

emp = the equivalent of a passenger car

C = Capacity (smp/jam)

C_O = Base of capacity (smp/jam)

FC_W = adjustment factor due to road width

FC_{SP} = adjustment factor due to road direction (hanya untuk jalan tak terbagi)

FC_{SF} = adjustment due to side barriers and roadside width

FC_{CS} = city size adjustment

MKJI (1997: 5-25) states that if the saturation value is less than 0.75 the NVK value for the traffic is still stable, 0.8-1 is unstable traffic conditions, and if the traffic conditions are more than 1.0 are critical and the conditions are less than 0.8 (Tamin 2000: 541).

Table 3 ITP based on free flow speed and saturation level

Service Level	% from free flow	Traffic saturation level
A	≥ 90	≤ 0,35
B	≥ 70	≤ 0,54
C	≥ 50	≤ 0,77
D	≥ 40	≤ 0,93
E	≥ 33	≤ 1,0
F	< 33	> 1,0

Source: Tamin, 2000: 543

4. RESULT

Table 4 District of Sidikalang area and population distribution

No	Village	Population					Area (km^2)
		2010	2017	2018	i (%)	Density	
1	Sidikalang village	10.472	10.605	11.432	1,15	2.858,00	4,00
2	Batang Beruh village	10.423	10.812	11.586	1,39	1.787,96	6,48
3	Sidiangkat village	4.372	4.575	5.184	2,32	324,00	16,00
4	Kuta Gambir village	2.835	2.937	3.226	1,72	1.240,77	2,60
5	Bintang Hulu village	1.958	2.044	2.440	3,08	375,38	6,50
6	Kalang village	3.003	3.127	2.987	(0,07)	497,83	6,00
7	Huta Rakyat village	6.225	6.453	7.217	1,99	1.621,80	4,45
8	Kalang Simbara village	3.221	3.517	3.398	0,69	647,24	5,25
9	Bintang Mersada village	2.052	2.115	2.476	2,58	396,16	6,25
10	Bintang village	1.953	2.013	2.444	3,14	279,31	8,75
11	Belang Malum village	2.132	2.236	2.394	1,54	545,33	4,39
	Total	48.646	50.434	54.784	1,58	775,21	70,67

Source: Sidikalang District (2018) Statistics Indonesia.

The above statistics show that the population is still centered in four villages-Sidikalang, Batang Beruh, Kuta Gambir and Huta Rakyat-this can be caused by the planning and construction of public facilities, social facilities, public offices, road transport support and/or distance from CBD. This can also be attributed to a large population.

Table 5 GRDP per capita population of Dairi Regency (IDR), 2013-2017

Year	Based on current price	Increasing percentage	Based on constant price 2010	Increasing percentage
2013	20.891.305,00		17.947.940,00	
2014	22.581.579,00	8,09%	18.567.329,00	3,45%
2015	24.447.890,00	8,26%	19.397.860,00	4,47%
2016	26.490.918,00	8,36%	20.271.733,00	4,50%
2017	28.539.613,00	7,73%	21.175.177,00	4,46%

Source: Statistical Center for Dairi Regency 2018

As a city, state, social and economic center, Sidikalang Subdistrict is the regional center for activities (PKW), but the majority of the area is still built for wet and dry agriculture, although some of it remains a forest area. Industrial (special) areas have not yet been developed in Sidikalang, because the industries currently in existence tend to be home industries. Sidikalang district land allotment for farmland represents 57.90% and 42.10% for non-agricultural land allotments.

Table 6 Condition and length of roads in Sidikalang

No	Village	Hierarchy	2000	2010	2018	i (7 years	Total
1	Sidikalang	National	2,67	2,67	2,67	-	17,79
		Regency	14,30	15,12	15,12	5,73%	
2	Batang Beruh	National	5,14	5,14	5,14	-	25,37
		Province	-	-	1,80	100,0%	
		Regency	15,27	17,27	18,43	20,69%	
3	Sidiangkat	National	4,74	4,74	4,74	-	17,23
		Regency	10,98	12,19	12,49	13,75%	
4	Kuta Gambir	Regency	2,95	3,30	3,80	28,8%	3,80
5	Bintang Hulu	Regency	4,20	8,05	8,05	91,7%	8,05
6	Kalang	Regency	1,70	2,62	2,62	54,1%	2,62
7	Huta Rakyat	Regency	7,23	8,96	9,86	36,38%	9,86
8	Kalang Simbara	Regency	2,60	3,80	3,80	46,15%	3,80
9	Bintang Mersada	Regency	6,20	6,50	7,50	20,97%	7,50
10	Bintang	Regency	5,90	7,73	7,73	31,02%	7,73
11	Belang Malum	Regency	2,20	2,38	2,38	8,18%	2,38
	Total		86,08	100,47	106,13	23,29%	106,13

Source: Public Works and Public Housing Agency (PUPR) and Dairi Regency Housing and Settlement Area (PKP) Office

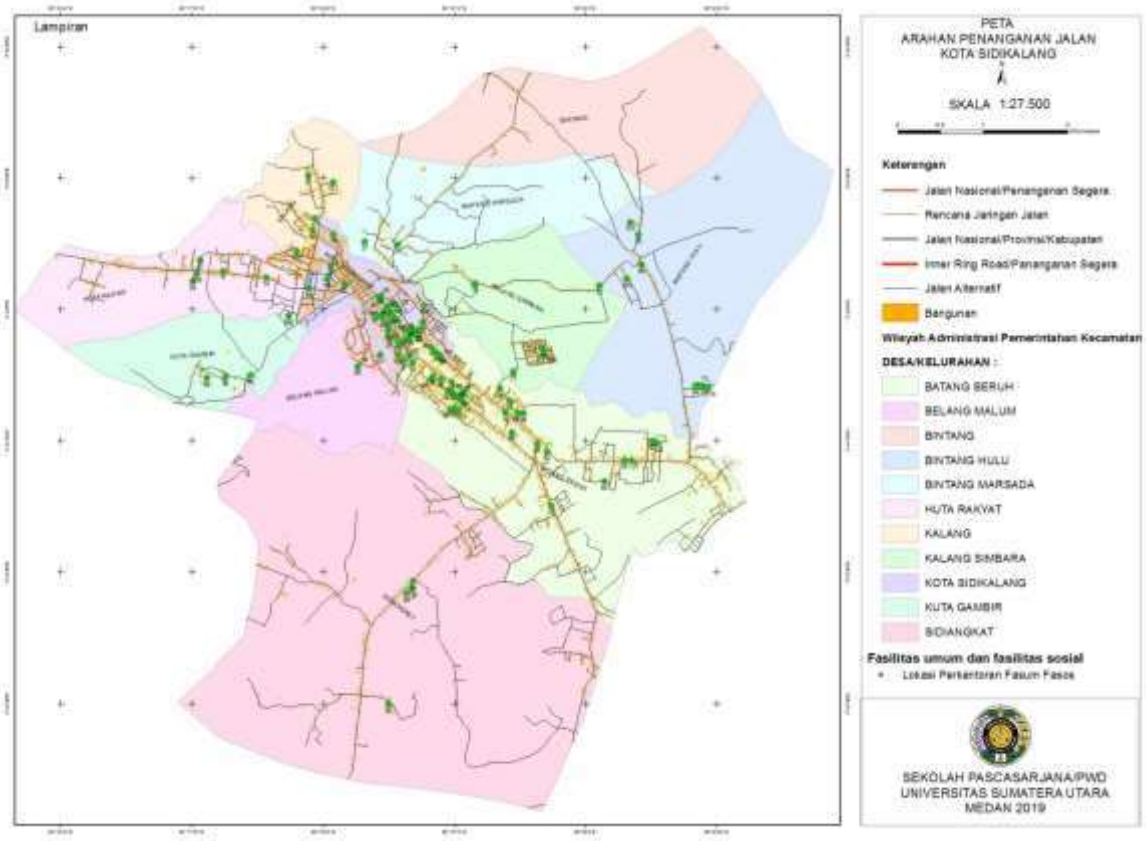


Figure 2. Map of the road network in Sidikalang

Calculation of Road Accessibility and Mobility Index in Sidikalang City

1. Road network accessibility index $= \frac{\text{Length of the road}}{\text{area}} = \frac{106{,}13 \text{ km}}{70{,}67 \text{ km}^2}$

   $= 1{,}50 \text{ km/km}^2$

2. "> 0.5" means "meets the minimum requirements" for the Sidikalang City road network's accessibility indexes with a density of 775 people / km2.

3. According to the above calculations, if the accessibility of Kuta Gambir roads is checked for every village, the minimum requirements are not met, so that the priority of this area is to add road networks.

4. Road network mobility index = $\frac{\text{Length of the road}}{\text{Total of people/1.000}} = \frac{106{,}13 \text{ km}}{54.784 \text{ people}/ 1.000}$

$$= \underline{1{,}94 \text{ km}/1.000 \text{ people}}$$

5. According to the above calculations, if the accessibility of Kuta Gambir roads is checked for every village, the minimum requirements are not met, so that the priority of this area is to add road networks.
6. The network of roads must be more than 54.78 x 5 km or more to meet Minimum Service Standards.

Calculation of Free Flow Speed

Table 7 Calculation of Free Flow Speed

No	Road section	Tipe of road	Side barriers	FV_O	FV_W	Roadside	Gutter curb	FFV_{CS}	FV (km/j)
						FFV_{SF}	FFV_{SF}		
1	Pahlawan (l = 7)	2/2 UD	M	42	0	0,96		0,90	36,29
	Pahlawan (l = 5)	2/2 UD	L	42	-9,5	0,99		0,90	28,96
2	Runding	2/2 UD	M	42	-3		0,89	0,90	31,24
3	Ahmad Yani (ki)	4/2 D	VH	55	-4		0,81	0,90	37,18
	Ahmad Yani (ka)	4/2 D	VH	55	-4		0,81	0,90	37,18
4	Sisingamangaraja (ki)	4/2 D	VH	55	-4		0,81	0,90	37,18
	Sisingamangaraja (ka)	4/2 D	VH	55	-4		0,81	0,90	37,18
	(tanpa median)	4/2 UD	H	51	-4		0,84	0,90	35,53
5	Sitellu Nempu	2/1 D	H	55	-4		0,84	0,90	38,56
		2/2 UD	H	42	-3		0,81	0,90	28,43
6	Persada	2/2 UD	L	42	-9,5	0,98		0,90	28,67
7	Sulang Silima	2/1 D	H	55	-4		0,84	0,90	38,56

Source: Researcher calculation

Calculation of Capacity and Degree of Saturation

As described in table 8, results of the capacity (C) calculation and saturation degree (DS) of road sections.

Table 8 Volume, capacity and degree of saturation of each road section

NO	Road section	Peak time	V = Q (smp/j)	C_O (smp/j)	FC_W	FC_{SP}	FC_{SF}		FC_{CS}	C (smp/j)	Degree of Saturation
							Roadside	curb			
1	Pahlawan (l = 7m)	Morning	1.377	2900	1	1	0,95		0,86	2.369	0,58
		Noon	1.630	2900	1	1	0,95		0,86	2.369	0,69
		Afternoon	1.407	2900	1	1	0,95		0,86	2.369	0,59
		Evening	1.390	2900	1	1	0,95		0,86	2.369	0,59
	Pahlawan (l = 5m)	Morning	1.283	2900	0,56	1	0,97		0,86	1.355	0,95
		Noon	1.546	2900	0,56	1	0,97		0,86	1.355	1,14
		Afternoon	1.311	2900	0,56	1	0,97		0,86	1.355	0,97
		Evening	1.287	2900	0,56	1	0,97		0,86	1.355	0,95
2	Runding	Morning	963	2900	0,87	1		0,88	0,86	1.909	0,50
		Noon	1.036	2900	0,87	1		0,88	0,86	1.909	0,54
		Afternoon	888	2900	0,87	1		0,88	0,86	1.909	0,47
3	Ahmad Yani (ki)	Morning	1.196	3300	0,92	1		0,81	0,86	2.115	0,57
		Noon	974	3300	0,92	1		0,81	0,86	2.115	0,46
		Afternoon	970	3300	0,92	1		0,81	0,86	2.115	0,46
	Ahmad Yani (ka)	Morning	928	3300	0,92	1		0,81	0,86	2.115	0,44
		Noon	914	3300	0,92	1		0,81	0,86	2.115	0,43
		Afternoon	1.031	3300	0,92	1		0,81	0,86	2.115	0,49
4	Sisingamangaraja (ki)	Morning	1.048	3300	0,92	1		0,81	0,86	2.115	0,50
		Noon	1.084	3300	0,92	1		0,81	0,86	2.115	0,51
		Afternoon	990	3300	0,92	1		0,81	0,86	2.115	0,47
	Sisingamangaraja (ka)	Morning	1.241	3300	0,92	1		0,81	0,86	2.115	0,59
		Noon	1.147	3300	0,92	1		0,81	0,86	2.115	0,54
		Afternoon	1.075	3300	0,92	1		0,81	0,86	2.115	0,51
	Sisingamangaraja	Morning	3.165	6000	0,91	1		0,84	0,86	3.944	0,80
	(without median)	Noon	2.514	6000	0,91	1		0,84	0,86	3.944	0,64
		Afternoon	1.892	6000	0,91	1		0,84	0,86	3.944	0,48
5	Sitellu Nempu	Morning	1.196	3300	0,92	1		0,84	0,86	2.193	0,55
	(2/1 D)	Noon	1.311	3300	0,92	1		0,84	0,86	2.193	0,60
		Afternoon	937	3300	0,92	1		0,84	0,86	2.193	0,43
	Sitellu Nempu	Morning	1.248	2900	0,87	1		0,81	0,86	1.758	0,71
	(2/2 UD)	Noon	1.201	2900	0,87	1		0,81	0,86	1.758	0,68
		Afternoon	1.136	2900	0,87	1		0,81	0,86	1.758	0,65
6	Persada	Morning	1.264	2900	0,56	1	0,94		0,86	1.313	0,96
		Noon	1.251	2900	0,56	1	0,94		0,86	1.313	0,95
		Afternoon	1.043	2900	0,56	1	0,94		0,86	1.313	0,79
7	Sulang Silima	Morning	1.161	3300	0,92	1		0,78	0,86	2.037	0,57
		Noon	1.051	3300	0,92	1		0,78	0,86	2.037	0,52
		Afternoon	945	3300	0,92	1		0,78	0,86	2.037	0,46

Source: Researcher calculation

5. DISCUSSION

Analysis of Traffic Flow Displacement

It states that the provision of road networks in each area should comply with criteria under the Minimum Service Standard so that the movement of humans and/or goods from the original places to the destination (D) can be guaranteed without interruption. This is under the government decree of Settlement Minister and Regional Infrastructure number 534/KPTS / M/2001. Accessibility and mobility are indicators of the availability of the road network.

In 2018 and 2023, 2028 (5 years and 10 years to come), the results from the processing of data, accessibility, and mobility indexes are based on the availability of the road network in Sidikalang, as follows:

1. The accessibility factor is the length of the route available per km2 area based on population density, namely connectivity/access from one place to the other. For areas with a population density of over 0.5% (moderate > five hundred people / km2), the 2018 Accessibility Index of Sidikalang City is 1.5 km / km2 of minimum value (SPM). It indicates that Sidikalang City has reached the highest number of road networks. When a more in-depth analysis was carried out, the provision of a road network, particularly in Kuta Gambir, was not evenly distributed. The accessibility index for SPM > 1.5 was 1.4.
2. The mobility factor is still very much below the 1.94 km SPM, with 1,000 people of 5 kilomètres / 1,000 people, and that is the ease of a person moving from the road to the City of Sidikalang on the basis of the village area The number of road networks in Sidikalang City remains much lower than the SPM, so it still has 273.92 km-106.13 km= 167.79 km..
3. The accessibility and mobility index for the road network in 2023 and 2028, using a

population prediction model as a result of the ' geometric method ' as similar to the method of calculating availability of the 2018 Sidikalang road network is as follows::

- City population growth per year = 1,58%
- Population projections per year n = $P_n = P_o$ x (1 + r)^n
- Yearly road development = 3,33%
- The area of the theoretical city (A) = 70,67 km^2

then: ①the population density of Sidikalang City $KP_n = P_{2018}$ x (1 + 3,33%)^n/A

KP_{2023} = 54.784 x (1 + 1,58%)^5 = 59.251 / 70,67 = 838,42 people/km^2

KP_{2028} = 54.784 x (1 + 1,58%)^{10} = 64.082 / 70,67 = 906,78 people /km^2

②the length of the Sidikalang City road $PJ_n = PJ_{2018}$ x (1 + 3,33% x n)

P_{2023} = 106.13 x (1 + 3,33% x 5) = 123.79 km

P_{2028} = 106.13 x (1 + 3,33% x 10) = 144.38 km.

③Accessibility index 2023 = 123.79 km / 70,67 km^2 = 1,75 km/km^2

SPM value (population density. > 500 people /km^2) adalah > 0,5 km/km^2

④Accessibility index 2028 = 144.38 km / 70,67 km^2 = 2,04 km/km^2

SPM value (population density. > 500 people /km^2) adalah > 0,5 km/km^2

⑤Mobility index 2023 = 5 km/1.000 people x 59,25 = 296,25 km,

It leads to a lack of road networks 190,12 km dari 106,13 km.

⑥Mobility index 2028 = 5 km/1.000 jiwa x 64,08 = 320,41 km

It leads to a lack of road networks 214,28 km dari 106,13 km.

4. Based on the mobility index of the Sidikalang city under the SPM, the road network still runs a 167,79 kilometer deficit in 2018, a 190,12 kilometer deficit in 2023 and a 214,28 kilometres ' deficit in 2028.

City Elements Analysis

There are three elements of the morphology of the city according to Smailes (1995), namely (1) land use (2) street plan/layout(3) the architectural style of buildings and their design, while, according to Johnson (1981), the three morphological elements are (1) the plan of the street (2) the buildings; (3) functions performed by its streets and buildings These two views suggest that the road elements (Yunus 2015: 108) are the most influential element of urban space formation (morphology). The shape of the city therefore depends largely on the presence / shape of the road. Unplanned road construction and the spatial pattern will lead to an irregular shape of the city (Yunus, 2015: 142) to make the road difficult to plan in the future.

In the form of a city the structure of the road network, the activity, and land use system are highly influential. In this section, the City of Sidikalang analysis is based on the geographic information system and the land use pattern (Figure 2). The analysis of Sidikalang City explained through the available road infrastructure and the arrangement of buildings and government offices, which are the concentration of the cities and the density of the population of the city and village of Sidikalang, public facilities (fasum) and social facilities (fasos) which are based on processed satellite imagery maps in 2018.

It can be stated based on the above data:

1. The primary collector road pattern of Sidikalang City is elongated and three-footed, followed by a local region with a circular shape, but not evenly distributed, with an urban (environmental) road parallel to the primary collector road at a relatively close distance so that the urban form resembles a ribbon Roads are still being constructed in the villages of Sidikalang, Batang Beruh and Huta Rakyat (table 6);
2. Structure of government offices, education, social and other less widespread and seemingly centered support facilities in Sidikalang and Batang Beruh (Tables 9 and 2),
3. The Sidikalang communes typically reside in high-accessibility, near CBD, office, public facilities as well as social facilities and shops, both for residential and businesses. As explained in Table 9 below, the concentration of people is still being focused in Sidikalang, Batang Beruh, Huta Rakyat, and Kuta Gambir.

Table 9 Accessibility, public and social distribution in Sidikalang Population

Village	Accessibility (km/km^2)	Offices and public facilities (%)	Educational infrastructure (%)	Health infrastructure (%)	Spiritual Infrastructure (%)	Population density (jiwa/km^2)
Sidikalang	4,45	53,42	27,78	7,69	16,50	2.858
Batang Beruh	3,92	24,66	28,89	15,38	24,27	1.788
Sidiangkat	1,08	1,37	8,89	7,69	10,68	324
Kuta Gambir	1,46	1,37	4,44	7,69	5,83	1.241
Bintang Hulu	1,24	8,22	2,22	7,69	7,77	375
Kalang	0,44	2,74	3,33	7,69	3,88	498
Huta Rakyat	2,22	2,74	3,33	7,69	6,80	1.622
Kalang Simbara	0,72	1,37	11,11	15,38	5,83	647
Bintang Mersada	1,20	1,37	2,22	7,69	7,77	396
Bintang	0,88	1,37	5,56	7,69	8,74	279
Belang Malum	0,54	1,37	2,22	7,69	1,94	545

Source: 2018 Statistics Indonesia, Sidikalang

4. The Regional Regulation on spatial planning details, spatial patterns, and spatial structures has not yet been adopted by Dairi Regency and spatial planning seems to be ignoring the implementation of the development. The researchers suggest that these regulations should be planned so that laws can be patrolled in the development process.
5. The Sidikalang Area is designated to serve a function for urban and not forest areas under the Dairi Regency Spatial Plan No. 7 of 2014. The "Inner Ring Road of the city of Sidikalang," connected by several villages Batang Beruh, Sidiangkat, Belang Malum, Kuta Gambir, Huta Rakyat, Kalang, Bintang Mersada, and Kalang Simbara, are provided for in Article 22 of this Article. This is very necessary to enforce because:
   a. The concentration of settlements will spread over the National Road Corridor again and will not concentrate again so that the city's shape is rectangular;
   b. Especially concerning mobility (reduced the road deficit from 167,79 km), the availability of the city transport system is increasing, and particularly for areas still under SPM (Kuta Gambir), the accessibility aspect can be increased.
   c. The city center traffic density (national road) is divided because there is no need to pass through the center of the city from outside Sidikalang to Medan and vice versa..

5.2 Road Capacity Analysis

Analysis of traffic behavior

The smooth traffic flow in a road segment is closely related to the capacity volume of road traffic and land use, especially the main roads because it is very busy. The analysis is rendered using several criteria, namely DS, NVK and integrated speed in ITP, of the service level of the main road sections (route sections for review) in the existing conditions. After the analysis, the following can be explained:

1. As shown in Table 8, the saturation degree (DS) or the volume ratio (NVK) value can be interpreted as follows:
   a. That the most congested road at this time during rush hour is the Pahlawan road in the second segment (width 5m) where the value of DS = 0.95 - 1.14 in the first segment DS = 0.58 - 0.69, Persada road with DS value = 0.79 - 0.96 and Sisingamangaraja road in the undivided road segment (4 / 2UD) DS = 0.48 - 0.80 and Sitellu Nempu road in the second segment (2 / 2UD) DS = 0.65 - 0.71. According to the 1997 MKJI, roads are said to be in stable condition if the degree of saturation is DS ≤ 0.75, or according to Tamin (2000: 541) NVK <0.8 stable road conditions; NVK 0.8 - 1.0 road conditions are unstable and NVK> 1.0 road conditions are critical.
   b. Dari nilai derajat kejenuhan di atas, maka jalan Pahlawan segmen kedua (lebar 5 m) sudah memasuki kondisi kritis (ITP: F). Jalan Persada dan Sisingamangaraja pada saat jam sibuk pagi hari tergolong dalam kondisi tidak stabil (ITP: E – D).
2. In line with the traffic densities in Table 3, the average travel speed of the vehicles should be approaching the free flow level. The loss of density is not proportional to the speed decreases due to "the number of vehicles parked on some routes with different types of vehicles, so, at long last, the speed following the vehicle ahead can not surpass each other"
3. On a road segment, the value of the index level of service (ITP) shows the general condition of the street section. The level of service is dependent on the numerical value of the saturation degree and if

it is in line with the average speed at free flow. The rate would impact the service level if the frequency is lower. Table 10 shows the ITP for the road (investigation) based on the saturation and speed degree.

Table 10 Road performance recapitulation-ITP

Roads	Speed			Degree of Saturation (DS)	ITP
	Route	Free flow	% of free flow		
Pahlawan (l = 7 m)	32,73	36,29	90,19	0,69	C
Pahlawan (l = 5 m)	21,16	28,96	73,07	1,14	F
Runding (B. Beruh)	29,65	31,24	94,91	0,54	B
Ahmad Yani (ki)	29,63	37,18	79,69	0,57	C
Ahmad Yani (ka)	29,63	37,18	79,69	0,49	B
Sisingamangaraja (ki)	28,65	37,18	77,06	0,51	B
Sisingamangaraja (ka)	28,65	37,18	77,06	0,59	C
Sisingamangaraja (4/2UD)	26,81	35,53	75,46	0,80	D
Sitellu Nempu (2/1)	24,23	38,56	62,84	0,60	C
Sitellu Nempu (2/2 UD)	17,70	28,43	62,26	0,71	C
Persada	25,04	28,67	87,34	0,96	E
Sulang Silima	21,18	38,56	54,93	0,57	C

Source: Researcher calculation

5.2.2 Road Performance Projection

The following table 11 gives an overview of the results of the road survey in the next few years.

Table 11 Matrix of degree of saturation (V / C ratio) of Sidikalang City

No	Roads	Degree of Saturation (DS = VCR)					
		2019	2020	2021	2022	2023	2024
1	Pahlawan (l = 7 m)	0,69	**0,80**	0,91	**1,02**	1,14	1,25
	Pahlawan (l = 5 m)	**1,14**	1,33	1,51	1,69	1,88	2,06
2	Runding (B. Beruh)	0,54	0,68	**0,81**	0,94	**1,08**	1,21
3	Ahmad Yani (ki)	0,57	**0,79**	**1,01**	1,23	1,45	1,67
	Ahmad Yani (ka)	0,49	0,68	**0,86**	**1,05**	1,24	1,43
4	Sisingamangaraja (ki)	0,51	0,63	**0,75**	0,87	0,98	**1,1**
	Sisingamangaraja (ka)	0,59	0,72	**0,85**	0,99	**1,12**	1,26
	Sisingamangaraja (4/2UD)	**0,80**	0,99	**1,18**	1,37	1,56	1,75
5	Sitellu Nempu (2/1)	0,60	**0,76**	0,92	**1,08**	1,25	1,41
	Sitellu Nempu (2/2 UD)	0,71	**0,91**	**1,11**	1,31	1,5	1,7
6	Persada	**0,96**	**1,24**	1,52	1,79	2,07	2,35
7	Sulang Silima	0,57	0,72	**0,87**	**1,02**	1,17	1,32

Source: Researcher calculation

As described previously, the performance of each section may change to a faster or slower rate, depending on the increased / change in activities in the Dairi Regency and neighboring areas. When vehicle rise / decline is greater than data the road condition changes more quickly, from stable to unstable or vice versa..

5.3 Problems and benefits of management

The recommended ways to increase road availability and tackle declines in road performance (DS ≤ 1 or S ≥ FV) can be divided into three groups:

a. Short/immédiate handling in the form of regional enforcement and crossroad construction traffic light. Congestion of traffic on the traffic section on this road is caused by Siurang intersection vehicles overtaking each other, and no one succumbs (Sitellu Nempu with Nusantara; Sitellu Nempu and Trikora; Pahlawan with the Runding; Sisingamangaraja with the Merdeka Road).
b. Medium-term (first 5 years), that is: capacity increase of the Pahlawan road from 2/2 UD, 7 to 5 m wide to 4-way double-track divided (4/2d, width 3,5 to 4 meters per lane; max capacity 6,000 pcu / hours / direction) and road building of the inner ring of four two-ways roads (4/2D, width 3,5 to 4 meters per lane, maximum capacity 6,000 pcu / hour / direction) to allow the construction of four two-way routes (4/2D, maximum capacity 6,000 pcu / hour).
c. Capacity increase of 6, m to 8 m Sulang Silima road 6 m to 9 m Sitellu Nempu, 4.6 m to 9 m Persada road, and Runding 6 m to 8 meters. Construction of a new road network (169.79 km can be built in 10 years) to resolve the gap in road length so that priority areas with accessibility

aspects smaller than the MSS value and priority development goals can be achieved by making the index value of mobility a practice. This has enhanced the performance of the road network in Table 12 and Figure 3.

Table 12 Matrix of the degree of saturation (V / C ratio) of Sidikalang City modeling results

Roads	Degree of saturation (DS = VCR)									
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2035
Pahlawan (l = 7 m)	0,43	0,52	0,57	0,61	0,66	0,71	**0,75**	0,80	0,85	1,03
Runding (B. Beruh)	0,55	0,62	0,69	**0,76**	0,83	0,89	0,96	1,03		
Ahmad Yani (ki)	**0,83**	0,95	1,08	1,21	1,34	1,46	1,59	1,72		
Ahmad Yani (ka)	0,70	**0,81**	0,91	1,02	1,13	1,24	1,35	1,46		
Sisingamangaraja (ki)	0,53	0,60	0,66	0,73	**0,79**	0,85	0,92	0,98	**1,05**	
Sisingamangaraja (ka)	0,64	0,72	**0,79**	0,87	0,94	1,02	1,10	1,17		
Sisingamangaraja (4/2UD)	**0,94**	1,05	1,16	1,28	1,39	1,50	1,62	1,73		
Sitellu Nempu (2/1)	0,51	0,57	0,64	0,71	**0,77**	0,84	0,91	0,97	1,04	
Sitellu Nempu (2/2 UD)	0,63	0,71	**0,80**	0,88	0,97	**1,05**	1,13	1,22		
Persada	0,64	0,72	**0,81**	0,89	0,98	**1,06**	1,15	1,23		
Sulang Silima	0,60	0,67	**0,75**	0,83	0,90	0,98	**1,06**	1,13		

Source: Researcher calculation

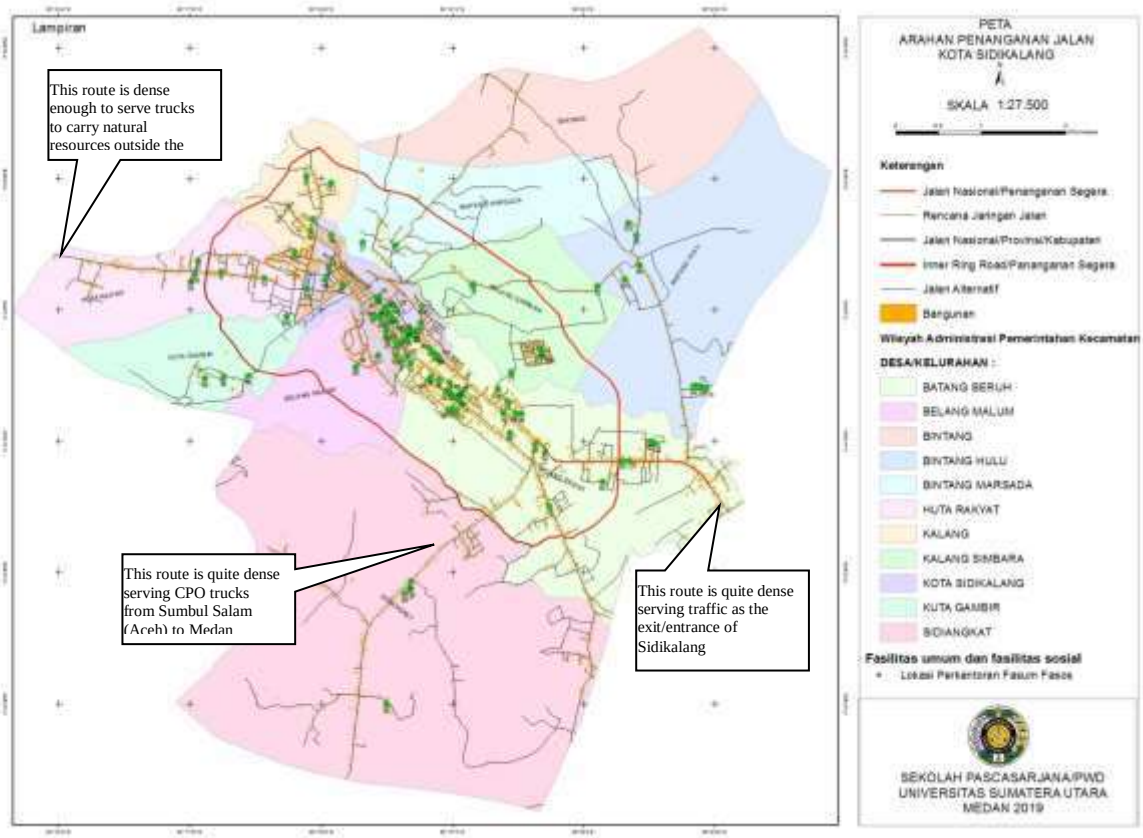


Figure 3. Road modeling map results in Sidikalang

d. Medium term (second 5 years), improvement of road network performance, especially Ahmad Yani and Sisingamangaraja, because these two road segments do not allow widening of roads related to commensurate buildings, it is recommended: increasing the capacity of roads which function the same as those two roads (Empat Empat Lima) - RSU - FL Tobing - Development - Kartini - Church - Nusantara); structuring / removal of government buildings especially those that do not have sufficient vehicle parking areas, serving the community directly and adjacent to the main road (Population and Civil Registry Office, Dairi Regency PUPR Office Office and Simpang Salak Elementary School, SD Inpres, SMP N- 3 and Vocational

School N-1 in the Ahmad Yani street corridor, and 5 elementary school units behind the Jauli Manik National Building which are in the Sisingamangaraja corridor).

6. CONCLUSION AND SUGGESTION

Conclusion

The results showed that the availability and the performance of road sections in Sidikalang City had an impact on the development of the urban area, where:

a. The general accessibility requirements in district of Sidikalang were met except for Kuta Gambir 1.4 km per sq. m. (> 1.5 km per sq. m). The total length of the road is not sufficient to support ease of movement (mobility aspects) for Sidikalang City, where the mobility index is 1.9 km/1,000 people from a minimum of 5 km/1,000 people, so that the community still bears a greater burden in carrying out its movements due to the road network shortages (167.79 km away).
b. The capacity of Sidikalang City's main road network, a review section, can still be maintained to provide the volume of traffic up to a maximum hour, when the saturation rate of ITP categories B and C is < 0.75. Sisingamangaraja road segments in the middle section, namely the part which is not given the direction (UD) and the Persada road is already in an unstable condition (the saturation rate is 0.80 and 0.96 with ITP categories D and E), also roads which are already in critical condition, namely the hero road segment with a length of 5 m, where the saturation degree is 1.14

Suggestion

It is recommended that the availability and mobility of road network networks in Sidikalang city to comply with minimum service standards (SPM):

a. In support of urban expansion and the development of wider urban areas, the design of the network of roads, and increased mobility and distribution in population concentration zones, the development of Sidikalang's inner ring road network and the road network between national roads or roads in areas still of low density.
b. It is advisable to carry out the construction of road light at the crossroads and to comply with regulations to reduce side barriers to maintain and improve the capacity of the road to facilitate the smooth movement of goods, services and/or people to or within Sidikalang. Widening the Pahlawan street, Sulang Silima street, especially in the narrowed section, Sitellu Nempu street, Persada road, and Runding road. Increasing the capacity of the Empat Lima road - RSU road - F.L.Tobing - Pembangunan - Kartini road - Church road - Nusantara road. Structure of government buildings, public facilities, and social facilities and urban and rural terminals (type C).

REFERENCE

1. *Adisasmita, Sakti Adji, (2011). "Transportasi dan Pengembangan Wilayah" cet.ke-1 ed.ke-1, Graha Ilmu, Yogyakarta.*
2. *Adisasmita, Sakti Adji, (2017). "Perencanaan Transportasi" cet.ke-2 ed.ke-1, Universitas Terbuka, Tangerang Selatan.*
3. *Alkadri, Muchdie & Suhandojo. (2001). Tiga Pilar Pengembangan Wilayah: Sumberdaya Alam, Sumberdaya Manusia dan Teknologi. Jakarta: Pusat Pengkajian Kebijakan Teknologi Pengembangan Wilayah. BPPT.*
4. *Anonim, (1997). "Manual Kapsitas Jalan Indonesia (MKJI)." Departemen Pekerjaan Umum Direktorat Jenderal Bina Marga, Jakarta.*
5. *Keputusan Menteri Permukiman dan Prasarana Wilayah Nomor 534/KPTS/M/2001 tentang Pedoman Penentuan Standar Pelayanan Minimal Bidang Penataan Ruang, Perumahan dan Permukiman dan Pekerjaan Umum.*
6. *Miraza, H.B. (2005). "Perencanaan Dan Pengembangan Wilayah", ISEI, Bandung.*
7. *Sandy. I.M. (1992). Pembangunan Wilayah. Monografi. Institut Pertanian Bogor. Bogor.*
8. *Sirojuzilam, (2015). Pembangunan Ekonomi Regional. Medan: USU Press.*
9. *Tarmin, Ofyar Z. (2000). "Perencanaan dan Permodelan Transportasi" ed.ke-2, ITB, Bandung.*
10. *Yunus, Hadi S. (2015) "Struktur Tata Ruang Kota," PUSTAKA PELAJAR, Yogyakarta.*