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Feasibility Analysis of the Development Plan of Air Putih-Selat Baru Road from Traffic Perspectives

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Abstract

Along with the development of the population and according to the spatial layout of the Bengkalis Regency, a road plan is needed that can facilitate movement from Bengkalis District to Bantan District. Based on this condition, the Public Works and Spatial Planning Office of Bengkalis Regency plans to build the Air Putih - Selat Baru Poros Road. However, before carrying out the road construction work, it is necessary to assess the feasibility of the planned road construction using one of the study stages, namely a feasibility study. The method used in this study is the with and without method in terms of traffic. In the feasibility analysis from a Traffic point of view, the Degree of Saturation (DJ) indicator is used. After conducting a feasibility analysis, the results show that the degree of saturation of the existing road is still below the standard value (0.85), namely 0.15, so it can be said that it is not feasible in terms of traffic.

Keywords: *Project, Feasibility Study, Traffic.*

1. Introduction

Bengkalis is the outermost small island in Riau Province which is separated from Sumatra Island. Geographically, Bengkalis Island is located in the Malacca Strait at coordinates 1° 0' 13" North Latitude and 102° 28' 13" East Longitude and is directly adjacent to Malaysia. Administratively, Bengkalis Island is located in Bengkalis Regency, Riau Province with a total area of 7,773.93 Km^2 (Pemerintah Provinsi Riau, 2019)

In addition to its strategic location Bengkalis Regency has several tourist attractions dominated by beach tourism. Serat Baru Beach is one of the beach attractions for tourists visiting Bengkalis.

Infrastructure like roads are needed to support these important sectors. According to the local plan of Bengkalis Regency, Air Putih – Selat Baru Road will be built to reach Selat Baru Beach. The road is expected to not only support tourism in Selat Baru but also develop two districts: Bengkalis and Bantan.

However before any road construction works can be undertaken, the feasibility of the planned road construction needs to be assessed which is carried out through one of the research phases the feasibility study. Feasibility study itself is the activity undertaken to determine whether a project is feasible. This activity includes identifying problems and opportunities setting goals describing the situation and assessing possible benefits. This research will help you make the right decision when it comes to the field of civil engineering..

So the author wants to know the feasibility of planned axial road construction on transportation basis titled "Feasibility Analysis Of The Development Plan of Air Putih - Selat Baru Road On Traffic Perspectives".

2. Research methodology

This research begins with conducting a literature study, collecting data and then analyzing the conditions with and without the project. The data needed in this study comes from two data, namely primary data and secondary data. The primary data used is traffic counting data by conducting traffic volume surveys at the research location, namely on the Bantan road section for 18 hours within 3 days. Secondary data in the form of population data and GDP per capita data for Bengkalis Regency were obtained from the Bengkalis Regency Statistics Center and road geometry data from the Bengkalis Regency PUPR Service.

To be clearer, the flow of this research can be seen in the research flowchart, namely in Figure 1.

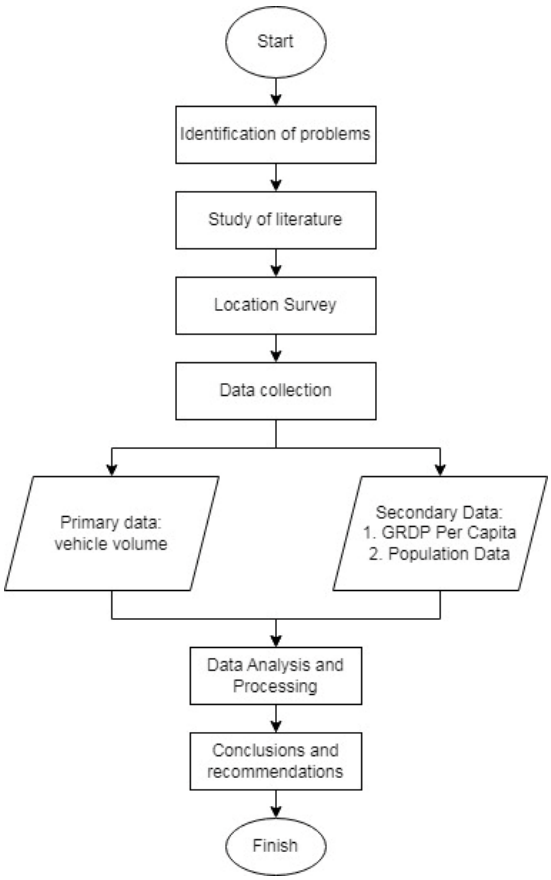

Fig. 1 Research Flowchart

2.1 Analysis of Traffic Data Without Project

Analysis of traffic data without a project is carried out by analyzing the degree of saturation of the existing road. The degree of saturation is obtained by comparing the current value and the capacity of the road (Kementrian Pekerjaan Umum, 2014). The calculation of the degree of saturation is in accordance with the 2014 Indonesian Road Capacity Guidelines, which are as follows:

DJ = $\frac{Q}{C}$.

Note:
Dj = Degree of saturation
Q = traffic volume (skr/hour)
C = Road capacity (skr/hour)

2.2 Traffic Forecasting

The method of forecasting the number of Annual Average Daily Traffic (LHRT) volumes is used to determine the growth of traffic on existing roads over the next few years. To get LHRT the following formula is used:

$$LHRT = \frac{QJP}{k}$$

Note:
LHRT = Annual Average Daily Traffic (skr/day)
Qjp = Peak hour traffic volume (skr/day)
K = Plan hours factor (%), 8% is used

The LHRT obtained from these calculations is the current year's LHRT, which is then used to calculate traffic growth in the following years. Compound interest is used to calculate the following year's LHRT (Kementrian Pekerjaan Umum, 2014). If the growth rate (i) uses gross domestic product and population. The first year of the forecast starts in 2023, when the proposed road will be operational. Forecasts are made up to a design age of 20 years. Here is the compound interest formula:

$$LHRT_n = LHRT_0 \times (1 + i\%)^n \times 365\ hari$$

Note:
$LHRT_n$ = Annual Average Daily Traffic for n year
$LHRT_0$ = Annual Average Daily Traffic for 0 year
i = Growth rate (%)

2.3 Kecepatan Arus Bebas

To find the speed of the vehicle when there are no obstacles or Dj = 0, the free speed calculation is used. Free flow speed is defined as the theoretical average speed of traffic flow when the density is zero or close to zero, felt at that speed under the geometric, environmental and traffic engineering conditions applicable to a section of road where there may be no other traffic. (Putri & Buana, 2020). The general form of the equation for determining the free flow speed of urban roads is:

$$. V_B = (V_{BD} + V_{BL}) \times FV_{BHS} \times FV_{BUK}$$

Note:
VB = Free flow speed at condition field (km/hour)
VBD = Basic free flow speed (km/hour)
VBL = Speed adjustment value due to width road (km/hour)
FVBHS = Free speed adjustment factor due to side friction
FVBUK = Free speed adjustment factor for city size

2.4 Travel Speed

Driving speed is the average speed of vehicles on the road section, driving speed is calculated from the time of driving. To determine driving speed, a graph of the relationship between degree of saturation and free flow speed is used in the 2014 PKJI (Kementrian Pekerjaan Umum, 2014) which can be seen in Figure 2.

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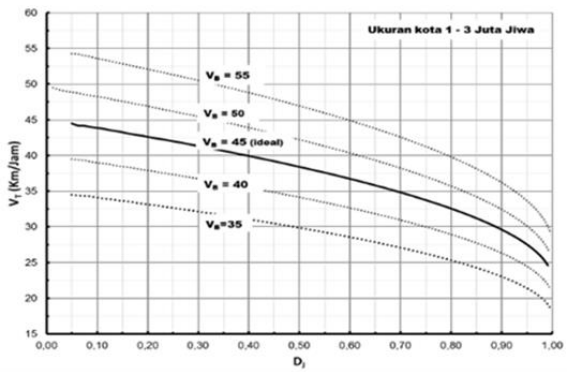

Fig. 2 Graph of the Relationship between DJ and Vt 2/2TT Street Type

2.5 Travel time

Travel time is the time it takes a driver to make one trip to cover one road segment. Travel time can be found using the following equation:

$$WT = \frac{L}{V_t}$$

Note:
WT = Travel time (hour)
L = Long road (km)
Vt = Travel speed (km/hour)

2.6 Trip Assignment analysis

Distance determination is one of the steps in traffic modeling to predict the percentage of vehicle movement from the existing route to the planned route. The purpose of the trip is to determine the current trip or the total trip in the considered network. In this study, the Diversion Curve method is used to calculate the percentage of vehicles on the existing and planned roads by comparing the travel time of the two existing routes (Hasyyati & Widyastuti, 2015). After carrying out the trip assignment, it is assumed that the start of the trip is at the same point between the existing path and the planned path. The following is the formulation of the driving task according to the Diversion Curve method.

$$P = 50 + \frac{50\,(d + 0{,}5t)}{\sqrt[2]{(d-50t)^2+4{,}5}}$$

Dimana:

P = Percentage of vehicles moving to new way (%)
d = The distance saved if passing a new road
t = Time saved if passing a new road

2.7 Analysis of Traffic Conditions With Project

The analysis of traffic conditions in the project relates to traffic conditions after the planned road construction. Analysis of this condition consists of two steps, namely analysis of vehicle volume and degree of saturation. Analysis of traffic volume is obtained from the mass percentage obtained from the calculation of the order of travel. The degree of saturation is used to determine the density of the road after the planned road is built.

3. Hasil dan Pembahasan

3.1 Data Lalu Lintas

The traffic data used is data from traffic counting for 18 hours carried out for 3 days. From the survey results, the highest volume of vehicles is obtained during peak hours with units of vehicles/hour. To make it easier for subsequent calculations, the vehicle data is converted into cur/hour units by multiplying the ekr factor.

In this study, there are two directions of vehicle movement, namely the direction of the city towards the New Straits and the direction of the New Straits towards the city. The two directions of movement, the traffic volume can be seen in Figure 3 and Figure 4. Based on Figure 5, peak hours are obtained at 17.00-18.00 WIB with a total vehicle volume of 618 cur/hour.

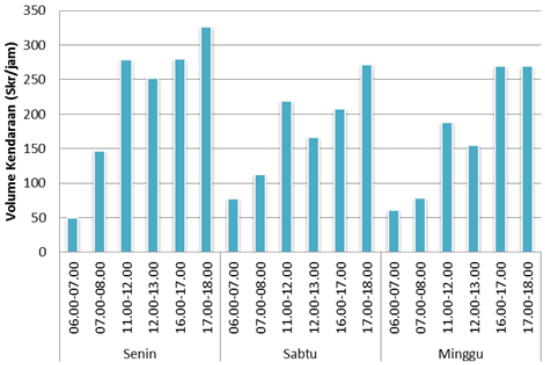

Fig. 3 Graph of Daily City Vehicle Volume Direction Towards Selat Baru

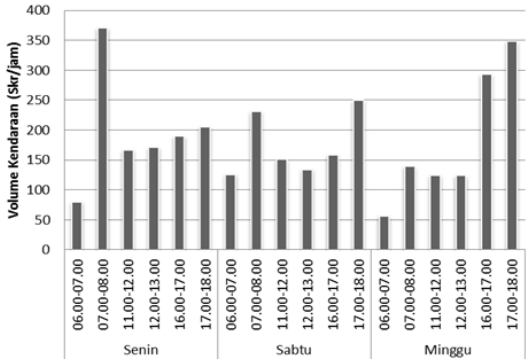

Fig. 4 Graph of Daily Vehicle Volume in Selat Baru Direction to City

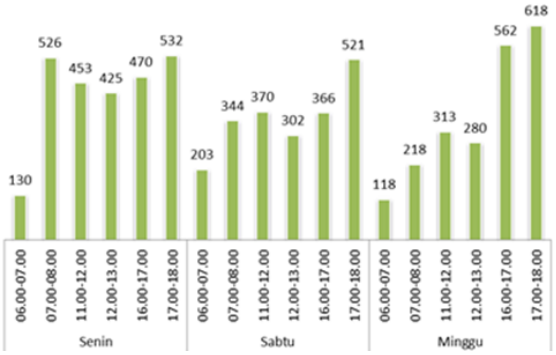

Fig. 5 Two Way Vehicle Volume Graph

3.2 Traffic Forecasting

Data on population growth and GDP per capita are needed to predict the volume of vehicles in the following years. This is because every movement of society will cause traffic movements. However, the GRDP data for Bengkalis Regency shows a negative value from 2017 to 2021 (Badan Pusat Statistik Kabupaten Bengkalis, 2023b) which can be seen in Table 1.

This negative value in the GRDP data indicates that the economy is experiencing a decline. Therefore, the percentage growth of the total population is used (Badan Pusat Statistik Kabupaten Bengkalis, 2023a) to forecast traffic volumes.

Table 1. Population Growth and GRDP of Bengkalis Regency

Year	Growth Percentage (%)	
	resident	GRDP Per Capita
2017	1.28	-3.02
2018		-2.93
2019	1.20	-1.04
2020	-1.30	-4.02
2021	1.40	-0.089

By using the percentage of population growth, a forecasting analysis is carried out for the next 20 years according to the planned age. Then an analysis of the degree of saturation of the existing road is carried out to determine the degree of saturation of the road in conditions without a project. The degree of saturation without project can be seen in Table 2.

Table 2. Degree of saturation without project

Year	Traffic Volume	Capacity	DJ
	(Q)	(C)	Q/C
2023	617	4648	0.13
2024	621	4648	0.13
2025	625	4648	0.13
2026	629	4648	0.14
2027	633	4648	0.14
2028	637	4648	0.14
2029	642	4648	0.14
2030	646	4648	0.14
2031	650	4648	0.14
2032	654	4648	0.14
2033	658	4648	0.14
2034	663	4648	0.14
2035	667	4648	0.14
2036	671	4648	0.14
2037	676	4648	0.15
2038	680	4648	0.15
2039	685	4648	0.15
2040	689	4648	0.15
2041	693	4648	0.15
2042	698	4648	0.15

After conducting traffic analysis, in Table 2, the degree of saturation of the existing road during the design life of 20 years is 0.15. The value of the degree of saturation is less than the saturation standard in the 2014 PKJI, which is 0.85. This shows that the existing road before the planned road has not experienced saturation.

3.3 Free Flow Speed

By using the geometric data of the 2014 PKJI as a reference for calculating the free flow speed, the free flow speed (VB) for each type of vehicle is obtained as shown in Table 3.

Table 3. Free Flow Speed

Description	MC	LV	HV	All Vehicles
V_{BD}	40	44	40	42
V_{BL}	-4	-4	-4	-4
FV_{BHS}	1.02	1.02	1.02	1.02
FV_{UK}	0.95	0.95	0.95	0.95
V_B	35	39	35	37

Based on Table 3 it is known that the free flow speed of SM and KB is 35 km/hour, KR is 39 km/hour, and the average of all vehicles is 37 km/hour.

3.4 Travel Speed

Travel speed was analyzed using a graph of the relationship between the degree of saturation (Dj) and the 2/2 TT road type found in the 2014 PKJI. By connecting the Dj value to the VB curve, the Vt value will be obtained for MC 34 km/hour, LV 39 km/hour, HV 34 km/hour and the average speed of all vehicles is 35.67 km/hour.

3.5 Travel time

The travel time is obtained from the length of the road divided by the travel speed from the previous calculation. After calculating the travel time on the existing road, it is 0.42 hours or 25.198 minutes and the travel time for the planned road is 0.39 hours or 23.112 minutes.

3.6 Analisis *Trip Assigment*

The percentage of vehicle displacement is obtained from the results of the Trip Assignment analysis using the Diversion Curve method. This method is a method that estimates the current attracted to the new road (Naryana, 2021). The decision to use a new road depends on the time and distance traveled when using or not using the new road.

The result of the trip assignment analysis obtained is that the displacement of drivers to the main road is 51.11% and the number of drivers who choose to use the existing road is 48.89%. The results of this analysis can be seen in Table 4.

Table 4. Trip Assignment analysis

Description	Value	Unit
Saved distance	1.24	Km
Saved time	2.086	Minutes
Percentage of New Roads (P)	51.11	%
Percentage of Existing Roads	48.89	%

3.7 Analysis of Traffic Conditions With Project

From the percentage of displacement obtained, traffic forecasting can be carried out over the design life of the road, which is 20 years, and the degree of saturation of the road can be obtained after the new

road is built. With the transfer of drivers to the new road, there will be a reduction in traffic volume on the existing road. This reduction in traffic volume will affect the degree of road saturation which can be seen in Table 5.

Table 5. Degree of Saturation With Project

Year	Traffic Volume	Capacity	DJ
	(Q)	(C)	Q/C
2023	315	4648	0.07
2024	317	4648	0.07
2025	320	4648	0.07
2026	322	4648	0.07
2027	324	4648	0.07
2028	326	4648	0.07
2029	328	4648	0.07
2030	330	4648	0.07
2031	332	4648	0.07
2032	334	4648	0.07
2033	337	4648	0.07
2034	339	4648	0.07
2035	341	4648	0.07
2036	343	4648	0.07
2037	345	4648	0.07
2038	348	4648	0.07
2039	350	4648	0.08
2040	352	4648	0.08
2041	354	4648	0.08
2042	357	4648	0.08

This analysis of the degree of saturation of the existing road shows the density of the existing road after the existence of the Air Putih – Selat Baru Road. In this condition, it can be seen that with the new road there is a decrease in the level of density on the existing road.

4. Conclusions and Recommendations

From this research it can be concluded that for 20 years the degree of saturation of the existing road before the planned road was built has increased every year, but has not yet reached saturation. This condition indicates that the Air Putih – Selat Baru Road is not yet needed to support the existing road in accommodating the traffic load towards the Selat Baru, so the planned construction of the Air Putih – Selat Baru Road is considered Inadequate in terms of Traffic.

It is suggested to the next author to carry out a feasibility analysis with different views such as an economic review in order to add value to the considerations for the construction of the Air Putih – Selat Baru Road for the government.

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