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Selection Analysis of the Route for the Widening of the Palima-Baros Road Selection

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ABSTRACT
The Palima – Baros road section as a connecting road between Serang City and Pandeglang Regency has a fairly high traffic flow, as can be seen from the density of the road during morning and afternoon rush hours and weekends. Congestion often occurs on roads that have a surface layer in the form of flexible pavement. The existing condition of the 3.25 m wide road, (2/2-UD, 0.5 m shoulder and unmaintained drainage, has a lost of service level category at level C (2021-2025) and is at level F in 2032. Efforts widening as one of the solutions to overcome congestion was chosen by analyze an alternative road widening routes. The method used is quantitative analysis, processing survey data based on the economic value, environmental, social impact, and length of route. The results show that the alternative route widening 1 (one) is the most good to choose, the score of the level of economic feasibility is 1.6 with environmental and social impacts of 0.8 (the smallest) and the length of the track is 585 m (shorter than other alternative routes, 705 m).

Keywords: *Road widening, Quantitative Analysis, Survey data, Social Impact*

1. INTRODUCTION

Roads as a function of accessibility and mobility have a very important role in people's lives. Open access to an area and affordability is one of the important factors for the development of the region. The Palima – Baros road section has a road width of 6.5 m, the shoulder of the road is 0.5 m within the National Road Network and connects Serang City with Pandeglang Regency. The road surface is in the form of flexible pavement with worn conditions, consisting of 2 (two) lanes and 2 (two) directions, not using the median (2/2-UD), and waterways that are not maintained. This section of the road looks very congested during the morning and evening rush hours and on weekends starting from before the Baros market to the Palima intersection. The existence of side barriers in the Baros Market area in the form of parking vehicles in front of the store, on the side of the road and the presence of sellers make traffic flow in the area often hampered. As the road that is most often passed by the peoples from Serang City to Pandeglang Regency and vice versa, this road segment is indeed very congested.

Various community activities require movement or traffic. Traffic itself is the movement of vehicles, people, or animals. The higher the activity carried out, the more traffic that occurs. Traffic movement can be smooth, safe, comfortable, and economical if it is supported by adequate traffic infrastructure [6]. One of the reasons for the declining condition of road services is the lack of optimal existing road networks, so that it can hamper economic growth [7].

This research is to find out which alternative for widening the route is the best to choose. According to Law No. 38 of 2004, the road is a land transportation infrastructure consisting of all parts of the road, complementary buildings and equipment used for traffic on the ground surface, above the ground surface, below the ground and/or water surface, and above the water surface, except railroads, lorries, and cableways. There are three main variables in measuring the working power of a road section, namely the volume, speed and density of the road section (Suwardo, Haryanto, Iman, 2016). According to Indonesian Road Capacity Manual 1997, the road segment performance parameters are the Degree of Saturation (DS) and Level of Service/LOS, as well as V/C. Putu Asih Anggarini, et al have conducted previous research that has analyzed the performance of the Imam Bonjol Denpasar-Bali road, and showed that in the existing condition (in 2019), the road has a degree of saturation (DS) of 1.61 - 2.14, with a lost of service at level F in each segment. In previous studies, researchers have

Table 1. Level of Service

Type	Road description condition	% Free Flow Speed	Degree of Saturation (DS)
Type A	a. Free flow of traffic without obstacles	≥ 90	≤ 0,35
	b. Low traffic volume and density		
	c. Vehicle speed is the driver's choice		
Type B	a. Stable traffic flow	≥ 70	≤ 0,54
	b. Speed starts to be affected by traffic conditions, but can still be selected according to the driver's wishes		
Type C	a. Traffic flow is still stable	≥ 50	≤ 0,77
	b. Travel speed and freedom of movement are already affected by the large volume of traffic so that the driver can no longer choose the speed he wants		
Type D	a. Traffic flow has started to become unstable	≥ 40	≤ 0,93
	b. Changes in traffic volume greatly affect the amount of travel speed		
Type E	a. Traffic flow is unstable	≥ 33	≤ 1,0
	b. Volume is approximately equal to capacity		
	c. Congestion often occurs		
Type F	a. Traffic flow is stuck at low speed kecepatan	< 33	> 1,0
	b. Congestion often occurs		
	c. Low traffic flow		

obtained the results of the analysis of the performance value of the Palima-Baros Road Section. The road capacity is 2623 pcu/hour, the level of road service in 2021 is already at level C (lasts until 2025), and will enter level F in 2032. One solution to the problem on the Palima – Baros road is by widening the alternative. The calculation of the analysis refers to the 1997 Indonesian Road Capacity Manual Manual. In his book, (Putranto, LS 2016), the expression of past performance traffic so that it can be more measurable contains variables: traffic volume, speed, road capacity, degree of saturation (DS), and travel time.

1.1 Analysis of vehicle operating costs (VOC)

Vehicle Operational Costs (VOC) can be determined by calculating variable costs, namely the cost of using fuel, using oil, using tires, the cost of spare parts and mechanic wages. These five VOC variables will be affected by changes in vehicle speed and mileage. The calculation of VOC uses a formula issued by LAPI-ITB from its research in 1997 on VOC which basically states that the five variable cost factors above are a function of vehicle speed.

1.2 Fuel Consumption (FC)

FC = Basic FC x (1 ± (lv + hv + mc); FC Basic of vehicle class I = 0,0284S2 - 3,0644S + 141,68; FC Basic of vehicle class IIA = 2,26533 x (FC Basic of vehicle class I) ;FC Basic of vehicle class IIB = 2,90805 x (FC Basic of vehicle class I) ; S = speed of vehicle (km/hour)

1.3 Tire Cost

Vehicle class I: Y = 0,0008848S – 0,0045333; Vehicle lass IIA: Y = 0,0012356S – 0,0064667; Vehicle class IIB: Y = 0,0015553S – 0,0059333 ;S = speed of vehicle (km/hour) ; Y = tire usage per 1.000 km

1.4 Spare parts maintenance cost

Vehicle class I: Y = 0,0000064S + 0,0005567; Vehicle class IIA: Y = 0,0000332S + 0,0020891; Vehicle class IIB: Y = 0,0000191S + 0,0015400; S = speed of vehicle

(km/hour) ; Y = Spare parts maintenance cost per 1.000 km

1.5 Maintenance Fee (Mechanic)

Vehicle class I: Y = 0,00362S + 0,36267 ; Vehicle class IIA: Y = 0,02311S + 1,97733 ; Vehicle class IIB: Y = 0,01511S + 1,21200 ; S = Speed of vehicle (km/hour) ; Y = mechanic working hours per 1.000 km.

1.6 Cost of depreciation

Vehicle class I: Y = 1/(2,5S + 125) ; Vehicle class IIA: Y = 1/(9,0S + 450) ; Vehicle class IIB: Y = 1/(6,0S + 300); S = Speed of vehicle (km/hour) ;Y = cost of depreciation per 1.000 km (equal to ½ vehicel depreciation value).

1.7 Capital Interest

Capital Interest = 0,22% x (new car price)

1.8 Insurance Fee

Vehicle class I: Y = 38/500S; Vehicle class IIA: Y = 60/(2571,42857S); Vehicle class IIB: Y = 61/(1714,28571S); S = Speed of vehicle (km/hour) ;Y = depereciation cost per 1.000 km (equal to ½ vehicle depreciation value).

2. METHODS

This study uses quantitative methods, by collecting data on vehicle operational costs (economic value), traffic characteristics data, road geometric data, travel time and alternative route lengths.

Figure 1. Palima – Baros Street location

3. RESULTS AND DISCUSSION

In the transportation system it can be seen that equilibrium conditions can occur at several levels. The simplest is the balance in the road network system. Each actor runs to find the best route for each that minimizes travel costs (eg time). As a result, they looked for several alternative routes which eventually ended up in a stable route pattern. Geometric data before widening shows, the length of the road segment is 585 m, the width of the road is 6.5 m, the shoulder width is 0.5 m, the side barriers are high, the average incline is 3 m/km, the average descent is -3 m/km, roughness road 3m/km, rush hour volume 1657.33 smp/hour, road capacity 2623, degree of saturation (DS) 0.6317, average speed 44 km/hour. After widening the road, the width of the road is 14 m, the shoulder is 1.5 m, the rush hour volume is 1657.33, the road capacity is 7220, the degree of saturation (DS) is 0.2995, the average speed is 65 km/hour.

If the consumption value of the VOC component has been obtained per kilometer mileage, then to determine the VOC price in units of Rp/km and the total cost required to travel a road segment in rupiah, data on the unit price of the VOC component obtained from the average market price is required. currently in effect. Not all types and brands of the three groups of vehicles can be taken for data for VOC analysis, based on field observations that have been carried out, several types and brands of vehicles that most often pass and the travel time is recorded for this type of motorcycle is the automatic type with the Honda beat gasoline brand. , for the type of light vehicle is a passenger car type with the Toyota Avanza brand with Pertamax fuel and for heavy vehicle types it will be represented by a 2 axle 6 wheel truck with the Mitsubishi Truck 120 PS brand. With the determination of the type and brand for each type of motor vehicle, the brand and price of lubricating oil, tires and spare parts will automatically follow. In this analysis, the brand and price of the VOC component with the middle price and the most frequently used will be taken. Automatic motorcycles often use Top One brand oil with a market price of around Rp. 35.000,-/lt, using IRC brand tires with a market price of around Rp.150.000,-/pc. The market price for a second hand motorcycle of this type and brand in good condition is around Rp. 8,500,000. For Toyota Avanza passenger cars usually use Prestone brand lubricating oil with a market price of Rp. 370,000, -/4 liter (Rp. 92,500/ Liter), using Bridgestone SF-318 brand tires size 165 R13 with a market price of Rp. 643,000,- /pc. The following is a picture of the plan for widening the Palima- Baros road, consists of three plans.

Table 2. Widening alternative election criteria

Location Available				
No	Site selection criteria	Alternative 1	Alternative 2	Alternative 3
1	Economic feasibility	There is a difference in the value of the VOC benefits after the widening of Rp. 427,856 vehicles/hour, and Road User Cost Savings (RUCS) 145.0613, NPV value > 0 (in the 5th year) and BCR = 1,05 (>1), then the road is feasible to build.	There is a difference in the value of the VOC benefits after the widening of Rp. 415,776 vehicles/hour, and Road User Cost Savings (RUCS) 142,203 NPV value > 0 (in the 5th year) and BCR = 1.05 (>1), then the road is feasible to build.	There is a difference in the value of the VOC benefits after the widening of Rp. 410,231 vehicles/hour, and Road User Cost Savings (RUCS) 141,421, NPV value > 0 (in the 5th year) and BCR = 1.05 (>1), then the road is feasible to build.
2	New road function	With the widening of this road, it will reduce congestion along the Baros Market, so travel time will be shorter	With the widening of this road, it will reduce congestion along the Baros Market, so travel time will be shorter	With the widening of this road, it will reduce congestion along the Baros Market, so travel time will be shorter
3	Environmental and social impact	Provide environmental and social impacts in the form of reducing roadside trading areas and shop parking lots along the widening route, closing access roads to the market during the execution of work, relocation of traders affected by eviction, and resulting in the loss of customers who move. The implementation of the work is relatively easier because there is an existing road, there is no need for very large land leveling.	Provide environmental and social impacts in the form of reducing roadside trading areas and shop parking lots along the widening route, moving traders affected by evictions, and resulting in the loss of moving customers. In addition, more residential buildings were affected by the widening. For the implementation of the work, it will take a long time for land acquisition because in addition to the trade location that is already on the side of the road, the settlements behind it are affected by eviction	Provide environmental and social impacts in the form of reducing roadside trading areas and shop parking lots along the widening route, closing access roads to the market during the execution of work, relocation of traders affected by eviction, and resulting in the loss of customers who move, as well as the Baros Market building. more affected by widening. The larger Baros Market building was affected by the eviction.
4	Road network development	Road widening is part of the development of a road network that can open up greater access from the two areas, Serang and Pandeglang. The opening of greater road access can increase the generation and attraction of a wider movement, so that it can further activate the regional economy.	Road widening is part of the development of a road network that can open up greater access from the two areas, Serang and Pandeglang. The opening of greater road access can increase the generation and attraction of a wider movement, so that it can further activate the regional economy.	Road widening is part of the development of a road network that can open up greater access from the two areas, Serang and Pandeglang. The opening of greater road access can increase the generation and attraction of a wider movement, so that it can further activate the regional economy.
5	Traffic characteristics :	The characteristics of alternative 1 are straight and flat roads, there are no bends, the average vehicle speed is 65 km/hour with a short travel time, in free flow conditions it is only 0.5 minutes with a distance of 0.585 km	The characteristics in alternative 2 are almost the same as the characteristics of alternative 1, it is a straight and flat road, there are no bends, the average vehicle speed is 65 km/hour with a short travel time, in free flow conditions it is only 0.5 minutes with a distance of 0.705 km (longer)	The characteristics of alternative 3 are almost the same as characteristic 2, which is a straight and flat road, there are no bends, the average vehicle speed is 65 km/hour with a short travel time, in free flow conditions it is only 0.5 minutes with a distance of 0.705 km
6	Availability of land and building acquisition	The land requirement is 7,779 m2	The land requirement is 7,905 m2	The land requirement is 7,996 m2

Figure 3. Trace plan 1(one) widening of Palima – Baros Road

Figure 3 shows the road widening plan on both sides of the road.

Figure 4. Trace plan 2 (two) widening of Palima – Baros Road.

Figure 4 shows the road widening plan on the right side of the road.

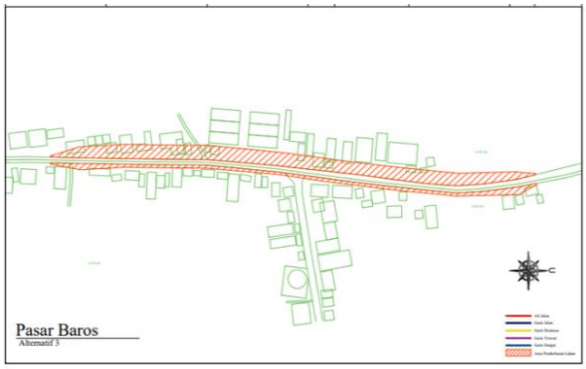

Figure 5. Trace plan 3 (three) widening of Palima – Baros Road

Figure 5 shows the road widening plan on the left side of the road. The criteria for selecting the widening side which include cheaper costs in terms of land acquisition, vehicle speed after the widening phase, traffic impacts and environmental and social impacts that arise during land acquisition and road widening work, can be seen in Table 2.

Table 2 shows, Economic feasibility for alternative route (1) have VOC benefits after the widening of Rp. 427,856 vehicles/hour, and Road User Cost Savings (RUCS) 145,0613, NPV value > 0 (in the 5th year) and BCR = 1,05 (>1), then the road is feasible to build. For alternative route (2), There is a difference in the value of the VOC benefits after the widening of Rp. 415,776 vehicles/hour, and Road User Cost Savings (RUCS) 142,203 NPV value > 0 (in the 5th year) and BCR = 1.05 (>1), then the road is feasible to build.Then for the altrenative route (3), the value of the VOC benefits after the widening of Rp. 410,231 vehicles/hour, and Road User Cost Savings (RUCS) 141,421, NPV value > 0 (in the 5th year) and BCR = 1.05 (>1), then the road is feasible to build. So, altrenative route (1) have most good benefit for economic value. On new road function, all alternative have same value, these are With the widening of this road, it will reduce congestion along the Baros Market, so travel time will be shorter. For environmental and social impact, alternative route (1) has easier implementation of the widening work because there is an existing road, there is no need for very large land leveling than alternative route (2) and (3).

The characteristics of alternative (1) are straight and flat roads, there are no bends, the average vehicle speed is 65 km/hour with a short travel time, in free flow conditions it is only 0.5 minutes with a distance of 0.585 km. The characteristics in alternative (2) are almost the same as the characteristics of alternative 1, it is a straight and flat road, there are no bends, the average vehicle speed is 65 km/hour with a short travel time, in free flow conditions it is only 0.5 minutes with a distance of 0.705 km (longer)The characteristics of alternative (3) are almost the same as characteristic 2, which is a straight and flat road, there are no bends, the average vehicle speed is 65 km/hour with a short travel time, in free flow conditions it is only 0.5 minutes with a distance of 0.705 km. Availability of development funds including land and building acquisition), for alternative route (1), the land requirement is 7,779 m2 , alternativ route (2) is 7,905 m2 and alternative route (3) is 7,996 m2.

4. CONCLUSION

From the results of research on the Palima - Baros Road, it can be concluded several things, namely the chosen alternative road is alternative 1, with road widening 4/2 D, 14 m, road shoulder 1.5 m. Alternative route (1) have VOC benefits after the widening of Rp. 427,856 vehicles/hour, have most good benefit for economic value. On new road function, all alternative have same value,

these are with the widening of this road, it will reduce congestion along the Baros Market, so travel time will be shorter. For environmental and social impact, alternative route (1) has easier implementation of the widening work because there is an existing road, there is no need for very large land leveling than alternative route (2) and (3). The characteristics of alternative (1) are straight and flat roads, there are no bends, the average vehicle speed is 65 km/hour with a short travel time, in free flow conditions it is only 0.5 minutes with a distance of 0.585 km. for alternative route (1), the land requirement is 7,779 m2 , alternativ route (2) is 7,905 m2 and alternative route (3) is 7,996 m2. Free flow speed of the road = 65 km/hour, this means that the vehicle speed on the Palima - Baros road section when the density is empty is 65 km/hour, after widening it becomes 71 km/hour. The highest traffic flow during rush hour towards Serang – Pandeglang is 1657.33 Smp/hour, with a road capacity value of 2623 Smp/hour, DS degree of saturation is 0.6317 and the average speed of light vehicles is 44 km/hour. , travel time is 0.8 minutes (existing road). After widening, the road capacity will be 7,220, DS 0,2295, travel time is 0,5 minutes. Prior to the widening, the road service class (Level of Service, LOS) was at level C, which indicates that the traffic flow is still stable, but the speed and freedom of movement have been affected by the large volume of traffic so that the driver can no longer choose the speed he wants. In the 5th year, the road service class is at level D, where the traffic flow has started to become unstable, changes in traffic flow affect the amount of travel speed. After the widening, the road service class was at level A until the 8th year, only entering the B level in the 9th year.

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