

## Evaluation of Side Barriers to the Level of Service on the Kelok 9 Bridge Road Section

Nadra Arsyad<sup>1\*</sup>, Jihan Melasari<sup>2</sup>

<sup>1,2</sup> Universitas Putra Indonesia “YPTK” Padang, Indonesia

\* Corresponding author, e-mail: nadraarsyad@UPIYPTK.AC.ID

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### ABSTRACT

*The Kelok 9 Bridge is uniquely designed and supported by a beautiful natural panorama. On one of these 9 curves, a rest area has been provided for road traffic users to rest, or for urgent needs when driving on the road, but because of its strategic location and very beautiful shape, it is often used as a tourist destination by most people, who travel to or from West Sumatra. This raises a new problem, this is because the local community sells by building buildings on the shoulder of the 9th bend. So the purpose of this study is to determine the effect of side friction on the performance of the 9th road section based on the level of service. This research examined the data and then analyzed using the Indonesian Road Capacity Guidelines. So on Sunday from 16.00-17.00 the h, the highest traffic volume value is obtained, with a traffic volume of 2.2221 Skr/hour and has area of Saturation of 0.613, indicating that the traffic conditions are heavy. Because the Degree of Saturation value is 0.613, the level of service for Jalan Kelok 9 C can be concluded that the flow is stable but the speed of vehicle movement is controlled.*

**Keywords:** Capacity; Speed; Service Level; Side Barriers; Turn 9.

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### INTRODUCTION

The road section is one of the bridges with many roads that are passed by various types of vehicles. This road is an inter-provincial crossroad that connects two provinces, namely Riau and West Sumatra Provinces. The Kelok 9 bridge has a very unique design and is supported by a very beautiful natural panorama. This is the main attraction for visitors so it is used as a tourist spot. The most influential type of side friction is caused by vehicles entering and leaving the road [1]. The service level of the Z.A PagarZ.A.am road is stated in the poor category, namely 1.6915 because it exceeds the tolerance limit of 1, so the service level F means poor service causes vehicles to tend to stop [2]. The high side activity of the road affects the side performance constraints on the Sam Ratulangi road, as a result, most of it does not have proper parking space so vehicles have to use the shoulder to the row body to park their vehicles [3]. In the analysis of road sections in Indonesia, in every developed country, side obstacles are only sufficient to take into consideration the shoulder width distance of the disturbance from the edge of the pavement [4]. Shadow terminal activity during the day with very high side obstacles, vehicle speed far below the design speed of 60 km/hour, road capacity decreases, and the average degree of sand duration is above 0.85 with a road service level of F[5]. Increasing the side resistance adjustment value can increase the capacity of the road section's capacity and reduction [6]. Side barriers greatly affect the level of service on a road section. Side obstacles have a significant influence on congestion which can cause conflict and affect the movement of traffic flow reducing road performance functions [7]. In flow conditions with

high speed and low traffic volume, the driver can choose the desired speed without obstacles, so with road conditions entering service level A characteristics, the Waringin highway can be declared a freeway [8].

On one of these 9 curves, a rest area has been provided for road traffic users to rest, or for urgent needs while driving on the road, but because of its strategic location and very beautiful shape, it is often used as a tourist destination by most people. who travel to or from West Sumatra.



Figure 1: Road Side Barriers

The high interest of visitors in the Kelok 9 Bridge Section, so that the community around the road section, take advantage of the opportunity to open a business such as trading. This creates new problems, this is because local people sell by building buildings on the shoulder of road Kelok 9, which results in traffic congestion. Every holiday the Kelok 9 bridge is never empty of visitors both from West Sumatra and visitors from outside West Sumatra, Of course, this makes the performance of the road section not optimal and causes traffic problems such as traffic jams, obstacles, safety, and co, comfort for other road users. obstructed towards the destination. So the aithis research aims to determine the effect of side obstacles on the performance of the Kelok 9 road section, which is reviewed based on the level of service.

## METHODS

The research location is on Jalan Kelok 9 in Lima Puluh Kota District, West Sumatra. The required research data is only primary data. Primary data is data obtained from direct observations in the field including road geometry, traffic speed, traffic volume, and side obstacles. Research data collection techniques, directly survey the field,d and take documentation.

Geometric Data Survey of the Kelok 9 bridge road, West Sumatra Province.

Road Type: 2/2TT (Two lanes, two undivided lanes)

Road Shoulder: 2.1 meters (left and right)

Road Width: 11 Meters (5.5 M/lane)

Traffic volume survey data, namely the volume of vehicles around Jalan Kelok 9. The other survey data, namely pedestrians, parking vehicles, buildings/sales places and stopped vehicles, slow vehicles, and vehicles going on and off the road.

The research was conducted for 2 days for LHR data collection, with a time of 3 hours. Observation times are 07.00 – 08.00 WIB, 12.00 – 13.00 WIB, 16.00 – 17.00 WIB. namely on a holiday (Sunday) 20 June 2021 and a working day (Monday) 12 July 2021. Based on survey data, vehicle traffic volume, road capacity, and road service levels [9].

## RESULTS AND DISCUSSION

### Traffic volume

Traffic volume analysis is carried out to obtain traffic volume during peak hours on the Kelok 9 road.

Table 1. Total vehicle volume

Time	Wednesday	Sunday
08.00 – 09.00	661	816
12.00 – 13.00	855	1.089
16.00 – 17.00	1.030	2.221

Based on Table 1, observations for two days, namely Monday and Sunday. On Monday, the peak hour is 16.00-17.00 with a traffic volume of 1,030 Skr/hour. On Sunday, the highest traffic volume is found at 16.00-17.00 with a traffic volume of 2,221 Skr/hour. So for capacity calculations, the highest traffic volume is used at 2,221 Skr/hour.

Table 2. Recapitulation of Side Obstacles

Day	Side Resistance Value	Side Obstacle Class
Minggu	332	T
Senin	198	S

Based on Table 2. The value of Monday's side resistance is 198/hour, with a medium side resistance class (S). Meanwhile, the side resistance value on Sunday, which was 332/hour, was included in the high side resistance class category (T). So the highest side resistance value is stated on Sunday. Because Sunday is a holiday, many road users carry out various activities on the Kelok 9 road section. Based on Table 2, the Monday side resistance value is 198/hour, with class medium side resistance (S). Meanwhile, the side resistance value on Sunday, which was 332/hour, was included in the high side resistance class category (T). Then the highest side resistance value is stated on Sunday. Because Sunday is a holiday, many road users do it with various activities on the Kelok 9 Bridge Road Section.

### Free Flow Speed of Vehicles

The Kelok 9 Bridge road section has a 2-lane 2-way undivided type (2/2 TT), with a width of 5.5 m/lane. Calculation of free flow speed is calculated based on [9]. This calculation focuses on light vehicles (KR), along with the calculation of the free flow of vehicles [9].

Basic free flow speed of light vehicles (Km/Hour)	VBD = 61
Speed adjustment for road width (Km/Hour)	FVBW = 3
Adjustment factor due to road function class and land use	FVBHS = 0.93
adjustment due to road functional class and city land use	FVBFI = 0.96

$$\begin{aligned}
 VB &= (VBD + FVBW) \times FVBHS \times FVBFJ && \dots\dots\dots(1) \\
 &= (61 + 3) \times 0,93 \times 0,96 \\
 &= 57,1 \text{ Km/Jam}
 \end{aligned}$$

Based on the results of calculations based on [9], the free flow speed of vehicles on the road at the Kelok Sembilan bridge as a result of the presence of roadside obstacles in this area is 57.1 Km/hour.

**Road Capacity**

Road capacity is the maximum flow that can be maintained per unit hour passing through a road segment under existing conditions. For 2/2TT roads, road capacity can be defined on two-way flows, but on multi-lane roads, flows are separated per the direction of travel, and capacity is defined per lane.

To get the value of road capacity that has been analyzed through primary data collection in the field. Due to location limitations, it should be close to the capacity of the road segment itself (as it turns out from the capacity of the intersections along the road). Capacity has also been estimated theoretically by assuming a mathematical relationship between density, speed, and current. The general equation for determining road capacity according to [9] is:

Basic capacity  $C_0 = 3000 \text{ Cur/hour}$   
 Road width adjustment factor  $FCW = 1.27$   
 Direction splitting adjustment factor  $FCPA = 1$   
 The adjustment factor for side and shoulder barriers  $FCHS = 0.95$

$$\begin{aligned}
 C &= C_0 \times FCLJ \times FCPA \times FCHS && \dots\dots\dots(2) \\
 &= 3000 \times 1,27 \times 1 \times 0,95 \\
 &= 3619 \text{ Skr/Jam/2 Arah}
 \end{aligned}$$

Based on the calculation above using equation (2) in [9], the capacity value of the 9-turn bridge for 2 directions is 3619 Skr/Hour.

**Degree of Saturation**

The degree of saturation (DJ) is the ratio of flow to capacity, functioning as a key factor in determining traffic performance at an intersection and also a road segment. The DJ value can indicate whether the road segment will have capacity problems or not. The general equation for the degree of saturation is

$$DJ = Q/C \quad \dots\dots\dots(3)$$

The research was carried out on Sunday, June 20, 2021, 16.00 – 17.00 WIB.

$Q = 2221 \text{ Skr/Hour}$   
 $C = 3619 \text{ Skr/Hour}$   
 Then  $= 2221/3619 = 0.613$

Table 3. Degree of saturation/hour

Time	Wednesday	Sunday
08.00 – 17.00	0,182	0,225
12.00 – 13.00	0,236	0,30
16.00 – 17.00	0,284	0,613

If converted based on equation (3) ( $DJ = Q/C$ ) which can represent that on Sundays at 16.00 – 17.00 it shows heavy traffic conditions and on other times and days, it shows low traffic

conditions.

To determine the level of service is done by using a comparison between vehicle volume in units of Hours/hour and road capacity. The calculation data was taken on Sunday at 16.00 – 17.00 WIB with a value of 0.613. So it can be concluded that the level of service on the Kelok 9 bridge road is C with the statement that the flow is stable, but the speed of vehicle movement is controlled.

## CONCLUSION

Based on geometric data for the Kelok 9 Bridge Road Section, West Sumatra Province, the road type is two lanes, two undivided lanes, with a shoulder width of 2.1 meters (left and right) and a road width of 11 meters (5.5 M/ lane). Based on the results of the analysis, the road section should not have vehicle congestion, causing delays. On holidays (Sundays) the road is used by traders and visitors to park and use the shoulder of the road for parking lots, resulting in problems with the road section.

In this study, data was obtained and analyzed using [9], the highest traffic volume value was obtained at 16.00-17.00 with a traffic volume of 2.2221 Skr/hour, and the results of the free flow of vehicles on the road on the curved 9 bridge due to obstacles side of the road is 57.1 Km/Hour, the value of the capacity of the curved 9 bridge for 2 directions is 3,619 Skr/Hour, On Sundays at 16.00 – 17.00 Degrees of Saturation is 0.613, indicating that the traffic conditions are heavy, with Degrees of Saturation 0.613 so you can It was concluded that the Service Level for Road Section C stated that the flow was stable but vehicle movement speed was controlled.

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