

Analysis of Road Safety Based on Road Type on National Roads in Bali Province

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ABSTRACT

The Province of Bali is one of the most popular tourist destinations in Indonesia which accounts for 40% of tourist visits in Indonesia. Apart from being a tourist spot, Bali also often hosts various state events. As a destination that is often in the public and world spotlight, it is important for Bali to have safer road infrastructure. However, based on data in the field, there are still many accidents that occur on National Roads in Bali and even tend to increase. If this is not handled, the impact will also be a problem in various aspects. This research aims to analyze road safety based on the type of road using the accident rate and fatality rate method on National Road sections in Bali Province. Based on the results of data analysis, this research shows the results of data accident rate or the highest accident rate is 160 incidents per 1 million vehicles per year on the Kosamba – Angentelu Bali road section. For data analysis of fatality rate or death rate, the highest is 245 per 1 million vehicles per year on Jalan A.Yani (Amlapura) Bali. And the type of road that has the highest accident rate and fatality rate number is the 2/2 UD road type.

Keywords: Road Safety; Traffic Accident; Accident Rate; Fatality Rate.

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INTRODUCTION

National roads are a land transport infrastructure that plays an important role in the distribution of goods and passengers as almost all cargo transport is focused on road services. But behind these advantages, the road has obstacles and problems caused by internal and external factors. National roads as a means of transport must have ideal conditions to provide comfort, smoothness, and safety for road users. Road transport safety is a global problem that is not just a transport problem, but a social issue for society, such as traffic accidents. Research on traffic accidents and how to prevent them is growing, and efforts are being made to reduce the number of accidents. All road users are highly likely to be at risk of accidents as traffic is increasing. To reduce the risk of accidents is to reduce the chances of road users being exposed to accidents, because it is impossible to reduce or prevent people from buying private vehicles or the desire to travel [1].

According to the World Health Organization (WHO), there are 1.35 million traffic accidents that cause deaths every year. As a result, there are 20 to 50 million more victims suffering non-fatal injuries and many of them becoming disabled. Traffic accidents also yield a 3% loss to most countries [2]. Traffic accidents themselves always occur from time to time and each year has a tendency to increase the number of incidents. According to the National Police Traffic Corps of the Republic of Indonesia (Korlantas Polri), the number of traffic accidents

in Indonesia reached 103,645 cases in 2021. The number is higher than the data of 2020, which was 100.028 cases. As for, traffic accident cases in 2021 have killed 25.266 people with material losses reached Rs.246 billion. While the total number of serious injuries in traffic accidents last year was 10,553 and 117,913 minor injuries.

IRTAD (2020) noted that the number of deaths from road accidents dropped significantly during the first month of 2020 as lockdown was imposed in many countries as a sign of the Covid-19 pandemic. However, in some countries, there was an increase in average speed and severity of traffic accidents. The United Nations, as an organization that plays an active role in the life of nations around the world, focuses on road accidents. One of the major United Nations concerns is the implementation of the road safety programme, as envisaged in UN Resolution 62/255 of 2010 on Improving Global Road Safety. The resolution reaffirms the commitment of Member States to work together to reduce the number of road traffic casualties. The birth of the resolution prompted the United Nations member states to join in supporting and competing in efforts to reduce the number of road accidents with their own national policies.

Indonesia, as a member of the United Nations, is also developing strategies to improve traffic safety aspects in order to reduce the number of road victims. One of the follow-up from Indonesia is to compile and publish the National Road Safety (RUNK) General Plan 2011-2035 as set out in the Inpress No. 4 of 2013. RUNK mentions five pillars in improving traffic safety and road transportation: safer management of LLAJ safer road, safer vehicle, safe people behavior and post-accident care (post-crash management).

Indonesia also had regulations contained in legislation. The first legislation was UU No. 38 of 2004 about roads, then followed by PP No. 34 of 2006 about Roads. Both of these legislations regulate the construction and management of roads that are sustainable, while in the aspects of maneuver and traffic system, the Government has issued PP No. 37 of 2017 about Traffic Safety and Road Transport.

The province of Bali is one of the most popular tourist destinations in Indonesia, accounting for 40% of tourist visits to Indonesia. To further increase tourist visits and economic growth, adequate accessibility is needed, such as robust road infrastructure [3]. The police note that accidents in the Bali province have an upward trend. The table 1. shows the number of accidents that occurred in the province of Bali during the period 2019 to 2021.

Tabel 1. Accident Data in Bali Province

Traffic accidents	The Number of Traffic Accidents in Bali Province		
	2019	2020	2021
Event	2462	1787	2133
Die	420	405	400
Severe Injuries	261	55	98
Minor injuries	3341	2560	2851

Source: <https://bali.bps.go.id/indicator/17/251/1/kecelakaan-lalu-lintas.html>

The number of traffic accidents in 2020 is experiencing an anomalous decline. Not following the trend of the past year. The police suspect that this decline is a consequence of the imposition of transport travel restrictions due to the impact of the Covid-19 pandemic as described above, so it is possible that the number of accidents will continue to rise when conditions are normal. (not in pandemic situation).

In a study entitled Evaluation Of Indonesian Road Safety Campaigns RUNK, it is said that the area that are prone to traffic accidents based on the type of roads in Surabaya is roads with 4/2UD type [4]. While the National Road cross district that exists on the island of Bali itself is still a few that has a road median. Therefore, the safety of the national road cross district traffic in the province of Bali is very necessary to review its security aspects, especially the safety aspects in the National road based on the type of the roads that exist. The following figure 1 shows a map of the location of the research reviewed.

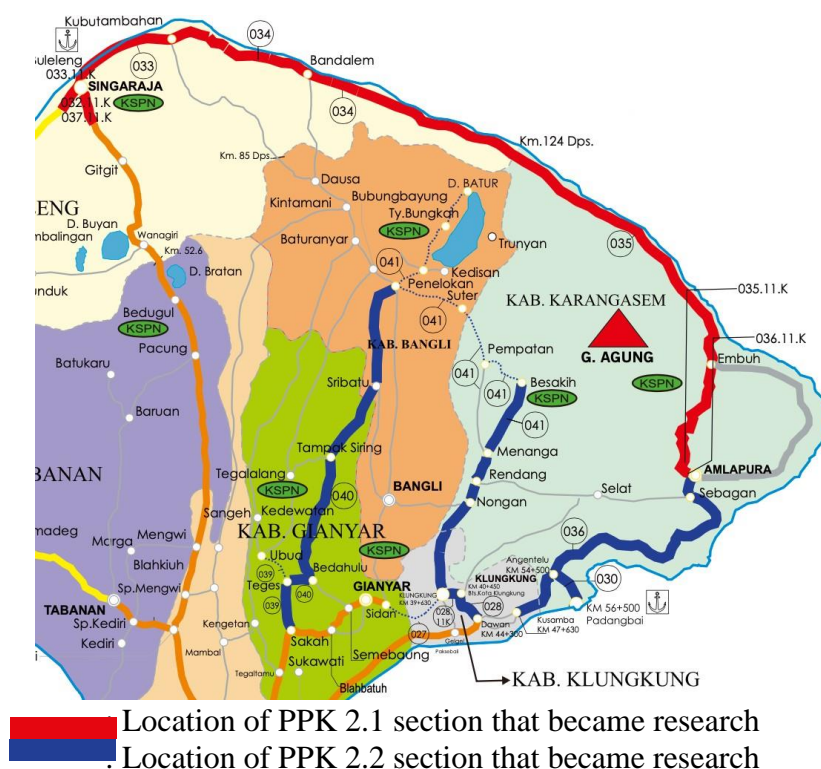


Figure 1. Bali Province National Road Research Location
Source: Ministry of PUPR Satker PJN II Bali document

Various studies on road safety have been carried out in various parts of Indonesia and even in almost all the countries of the world. However, the resulting conclusions must be different because of the different conditions and types of roads. Furthermore, there is no research related to road safety assessment based on the type of roads in the streets that will be reviewed in this study, making researchers motivated to learn more about the types of road that are potentially causing traffic accidents as an attempt to improve road safety that has led to a decrease in the number of road accidents.

METHODS

Data collection

The data collection required in this study uses secondary data overall. Obtained from related institution, namely Kementerian PUPR BBPJJN Jawa Timur Bali, Polda Bali, and BPS Bali.

Secondary Data

1. Traffic Volume
Vehicle traffic volume data is used to calculate variables in the calculation of accident rate, fatality rate. This data is obtained from Kementerian PUPR BBPJN Jawa Timur Bali.
2. The length of the road data
This data is used to calculate variables in the calculation of accident rate and fatality rate. This data is obtained from Kementerian PUPR BBPJN Jawa Timur Bali.
3. Type of the road data
The type of road data used as a comparison of which class of the road has a lot of accidents. This data is obtained from Kementerian PUPR BBPJN Jawa Timur Bali.
4. Traffic Accident Data
This data is used to calculate variables in the calculation of accident rate and fatality rate. This data is obtained from Polda Bali, and BPS Bali.

After obtaining the above data, the data processing process is to answer the problem formula in the research with the method used in this research, i.e. to calculate the accident rate and fatality rate on each type of road that exists after it is compared with the results of the calculation.

Accident Rate Analysis

Accident rate analysis is the calculation of the number of accidents on the road section per person per one (1) million vehicles per year. From the accident rate calculation data, it is known that even a high total number of road accidents, can have a low accident rate value. This is due to additional factors such as the length of the street, the LHR, and the time of the analysis period. The formula used by Hoobs (1985) is:

$$\text{Accident rate} = \frac{A \times 10^8}{LHRt \times T \times L \times 365} \quad (1)$$

The coefficient "A" represents the total number of accidents, then the determination "T" is the time period of the Analysis, and "L" is the length of a street, as well as the number of annual LHR volumes per street.

Fatality Rate Analysis

Fatality rate analysis is the calculation to determine the death rate on a street, which is based on the number of accident victims who died. The formula used by Hoobs (1985) is:

$$\text{Fatality rate} = \frac{F \times 10^8}{LHRt \times T \times L \times 365} \quad (2)$$

The coefficient "F" is the number of accidents causing deaths, then the determination "T" which is the time period of the analysis, and "L" the length of a street, as well as the amount of annual LHR volumes per street.

RESULTS AND DISCUSSION

This section will discuss the characteristics of traffic accidents, the type of road that has the highest accident rate, and the related evaluation of recommendations for solutions in terms of traffic safety. In identifying accident rate, required data of accident occurrence, LHR, and length of road using the equation 1. Identification is done against the entire street that exists at the research site in National Road Province of Bali PJN 2 Bali Territory Work Unit as in Figure 1 (35 roads). Then the following table 2 will be shown he number of accidents in the period of 2022 that will be used in the accident road equation.

Tabel 2. Number of accidents in the period of 2022

Street Name	Number of Accident
Jln. Jelantik Gingsir (singaraja)	10
Jln Veteran (singaraja)	7
Jln Ngurah Rai Selatan (singaraja)	7
Jln. Pramuka (singaraja)	9
Jln. Gajahmada	9
Jln. Ahmad Yani (Singaraja)	11
Jln. Dr. Sutomo (singaraja)	6
Jln.Raya Ubud	8
Jln. Sp Tohpati - Sp. Pantai Siut	26
Jln. Sudirman (Amlapura)	25
Jln. Sakah	24
Jln. Teges	25
Jln Imam Bonjol (singaraja)	38
Jln. Kubutambahan	12
Jln. Bondalem dsn tembok (KM 124 DPS)	13
Jln Bts. Kota Klungkung - Dawan	14
Jln. Flamboyan (semarapura)	7
Jln. Diponegoro (semarapura)	8
Jln. Diponegoro (singaraja)	11
Jln. SP. Pantai Siut - Kosamba	14
Jln. Kosamba - Angentelu	11
Jln. Angentelu - Padangbai	4
Jln. Untung Surapati (Amlapura)	4
Jln. Bts. Kota Amlapura - Angentelu	11
Jln. Airlangga (singaraja)	4
Jln. A.yani (Amlapura)	4
Jln. Surapati (singaraja)	12
Jln. Sakah - Blahbatu	10
Jln. WR. Supratman (singaraja)	10
Jln. Bts. Kota singaraja	15
Jln. Bedahulu	5
Jln. Tampak Siring - Istana	4

Presiden	
Jln. Klungkung - Besakih	7
Jln. Penataran Agung - Dalem Puri (Besakih)	13
Jln. Tampak Siring - Sp. Penelokan	4

From the data above in table 2, it can be seen that Imam Bonjol Street (Singaraja) has the highest number of accidents, but when data is being processed with equation 1 and equation 2 not necessarily the street that has the highest value of accident rate and fatality rate. Besides the number of accident data, the data that being required for calculation using accident rate and fatality rate equation will be shown in table 3 which is the number of LHR, data length of road, as well as data type of road on each street.

Tabel 3. Road Information Data

Street Name	LHR	Road Length (m)	Road Type
Jln. Jelantik Gingsir (singaraja)	1022	350	2/2ud
Jln Veteran (singaraja)	2236	390	2/2ud
Jln Ngurah Rai Selatan (singaraja)	2250	11580	2/2ud
Jln. Pramuka (singaraja)	2477	1620	2/2ud
Jln. Gajahmada	2659	1490	2/2ud
Jln. Ahmad Yani (Singaraja)	1003	620	2/2ud
Jln. Dr. Sutomo (singaraja)	568	540	2/2ud
Jln.Raya Ubud	1526	11270	2/2ud
Jln. Sp Tohpati - Sp. Pantai Siut	851	3300	4/2ud
Jln. Sudirman (Amlapura)	1137	4240	4/2ud
Jln. Sakah	1691	5610	2/2ud
Jln. Teges	1498	9230	2/2ud
Jln Imam Bonjol (singaraja)	839	2900	2/2ud
Jln. Kubutambahan	2002	3420	4/2ud
Jln. Bondalem dsn tembok (KM 124 DPS)	823	3250	4/2ud
Jln Bts. Kota Klungkung - Dawan	2012	3050	2/2ud
Jln. Flamboyan (semarapura)	442	350	2/1ud
Jln. Diponegoro (semarapura)	780	630	2/2ud
Jln. Diponegoro (singaraja)	1579	390	4/2ud
Jln. SP. Pantai Siut - Kosamba	885	550	4/2ud
Jln. Kosamba - Angentelu	1046	180	2/2ud
Jln. Angentelu - Padangbai	2036	470	2/2ud
Jln. Untung Surapati (Amlapura)	989	290	2/2ud
Jln. Bts. Kota Amlapura - Angentelu	578	390	2/2ud
Jln. Airlangga (singaraja)	1065	250	2/2ud
Jln. A.yani (Amlapura)	658	170	2/2ud
Jln. Surapati (singaraja)	881	310	2/2ud

Jln. Sakah - Blahbatu	2076	260	2/2ud
Jln. WR. Supratman (singaraja)	2228	330	2/2ud
Jln. Bts. Kota singaraja	1937	960	2/2ud
Jln. Bedahulu	2028	410	2/2ud
Jln. Tampak Siring - Istana Presiden	1178	2460	2/2ud
Jln. Klungkung - Besakih	1003	530	2/2ud
Jln. Penataran Agung - Dalem Puri (Besakih)	1786	460	2/2ud
Jln. Tampak Siring - Sp. Penelokan	1978	480	2/2ud

From the above data, a calculation analysis was carried out using equations 1 and 2 and 5 roads with the highest accident rate values are: Jln. Flamboyan (Semarapura), Jln. Kosamba – Angentelu, Jln. Bts. Kota Amlapura – Angentelu, Jln.A.yani (Amlapura), Jln. Surapati (Singaraja). And 5 streets with highest fatality rate are : Jln. Sp. Tohpati – Sp. Siut, Jln. Flamboyan (Semarapura), Jln. Airlangga (Singaraja), Jln. A.yani (Amlapura), Jln. Surapati (Singaraja). With the type of road with highest accident rate is 2/2 UD, and the type of road with highest fatality rate is 4/2 UD. The road conditions of both of the roads have no median or boundary between the two traffic streams. So the riders often don't pay attention to the column boundary line by taking the rider's track from the opposite direction.

Tabel 4. Analysis Result

Street Name	Accident Rate	Fatality rate	Road Type
Jln. Sp Tohpati - Sp. Pantai Siut	25 person/1 million vehicles for year	49 person/1 million vehicles for year	4/2ud
Jln. Flamboyan (semarapura)	124 person/1 million vehicles for year	177 org/1juta kend. Per tahun	2/1ud
Jln. Kosamba - Angentelu	160 person/1 million vehicles for year	0 person/1 million vehicles for year	2/2ud
Jln. Bts. Kota Amlapura - Angentelu	134 person/1 million vehicles for year	0 person/1 million vehicles for year	2/2ud
Jln. Airlangga (singaraja)	41 person/1 million vehicles for year	103 person/1 million vehicles for year	2/2ud
Jln. A.yani (Amlapura)	98 person/1 million vehicles for year	245 person/1 million vehicles for year	2/2ud
Jln. Surapati (singaraja)	120 person/1 million vehicles for year	100 person/1 million vehicles for year	2/2ud

The result of Accident Rate and Fatality Rate is only a measure of the number of accidents occurring, but excludes the amount of victims. Based on the analysis of the calculation of the accident rate and the fatality rate, the location indicated for each road that prone to accident and the path with the likelihood of accident victims died is different. Mostly roads with the highest accident rate and fatality rate have short roads.

CONCLUSIONS

Based on the result of the analysis calculation of the accident rate in 2022, the highest accident rate is not on high-accident streets. Five (5) roads with the highest accident rate are: Jln. Flamboyan (Semarapura), Jln. Kosamba – Angentelu, Jln. Bts. Kota Amlapura – Angentelu, Jln.A.yani (Amlapura), Jln. Surapati (Singaraja). And it is a 2/2 UD type of road. The number of accidents or Accident rate is just a measure of the number of incidents, but excludes the numbers of victims. From the results of the 2022 analysis it can be seen that 10 roads with high accident ratings have a long length road (long road) and a small LHR.

The fatality rate analysis is just to count the number of accidents that result in deaths on one street. This calculation is important to know, as it can be as an information as well as attention for drivers to be more careful in the following areas with fatal accident risk. Registered in 2022 the areas that entered the top 5 ranks of accidents with death victims are in sequence: Jln. Sp. Tohpati – Sp. Siut, Jln. Flamboyan (Semarapura), Jln. Airlangga (Singaraja), Jln. A.yani (Amlapura), Jln. Surapati (Singaraja). with the highest fatality rate in A.Yani (Amlapura) with as many as 245 people per 1 million vehicles per year. As well as having a 2/2 UD road type.

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