Analysis of selection criteria of bridgeshortcut

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Submission date: 30-Jan-2024 04:04PM (UTC+0700)
Submission ID: 2281969063
File name: Analysis_of_selection_criteria_of_bridgeshortcut.pdf (4.34M)
Word count: 2992
Character count: 14545

RESEARCH ARTICLE | JUNE 15 2023

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AIP Conference Proceedings 2599, 070029 (2023)
https://doi.org/10.1063/5.0120610

Analysis of Selection Criteria of Bridge/Shortcut Construction on National Road Denpasar – Gilimanuk

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Abstract. Bali has variable contours (from ramps to steep) so that roads in Bali have a level of difficulty in vertical or horizontal alignment, also a heritage road that does not match the demands of current traffic such as the number of vehicles that are getting bigger, the size of the vehicle is getting bigger and the weight of the vehicle is getting heavier. In the area reviewed is a national road that is quite dense and has been done improvements in the form of bridges and shortcut roads on the Denpasar – Gilimanuk road including Samsam shortcut and Megati shortcut. Preliminary Survey with geometric data processing methods with maps, there are 53 curve points. Furthermore, the government urgently needs to process data from these 53 points into a priority point of handling given the very limited funds. The purpose of this study is to find a priority scale for the construction of bridges/shortcuts. Due to limited costs, other methods are needed, such as accident-prone points and traffic jams, as well as checking vertical alignments. The results of the survey and analysis obtained 7 points that are a priority for improvement because in terms of vertical, horizontal, and from points prone to accidents or congestion. It is recommended to be handled with the repair of alignment and the construction of bridges or shortcuts. It is recommended to be handled with the repair of alignment and the construction of bridges or shortcuts.

INTRODUCTION

Increased population mobility, logistic distribution, and tourism in Bali Province have a consequence of increasing the need for adequate, safe, convenient, smooth, and efficient transportation network facilities and infrastructure. For that, it is necessary to develop a new road network in the form of bridges or shortcuts in Bali Province. In planning a geometric path must be able to meet various requirements that have been set. So that security, comfort, and efficiency can be realized. The standard design of geometric planning must change over time to respond to changes that occur including the development of increasingly dense traffic flow. Bali has variation contours (from ramps to steep) so that roads in Bali have a level of difficulty in vertical or horizontal alignment, also a heritage road that does not match the demands of current traffic such as the number of vehicles that are getting bigger, the size of the vehicle is getting bigger and the weight of the vehicle is getting heavier. In making shortcuts, of course, there is the possibility of cutting hills to get a more efficient distance. The process of cutting hills requires the construction of retaining walls to prevent landslides[1]. In addition, risk analysis steps are needed to determine how to mitigate these risks to minimize *profit loss* [2]. In the area reviewed is a national road that is quite dense and has been made improvements - improvements in the form of bridges and shortcut roads on Denpasar road – Gilimanuk including Samsam shortcut and Megati shortcut.

A traffic accident occurs when a vehicle or other road users collide unexpectedly or accidentally, resulting in human casualties and property damages. Accidents occur as a result of the driver's lack of discipline, but also as a result of poor road conditions and geometric conditions [3]. In most cases, 3 (three) causal variables cause traffic accidents: road user factors, vehicle factors, and road factors [4]. Bali is a major tourist destination for

1st International Conference & Symphosium on Construction Industry Development
AIP Conf. Proc. 2599, 070029-1–070029-9; https://doi.org/10.1063/5.0120610
Published by AIP Publishing. 978-0-7354-4544-4/$30.00

both domestic and foreign visitors, which has resulted in increasing infrastructure and economic growth, as well as significant population mobility, which has an impact on traffic flow. Theoretically, high traffic flow is an opportunity for congestion and traffic conflicts. From 2017 to 2021 85 incidents, so it is necessary to analyze data related to horizontal and vertical alignments, accident-prone data, and congestion data to determine the construction of bridges or shortcuts given the limited funds.

METHODS

The method used in this study is qualitative, method qualitative method is a method that focuses on in-depth observations. Therefore, the use of qualitative methods in research can result in a more comprehensive study of a phenomenon. The data used in this study is direct survey data for the manufacture of vertical alignments, Google Earth for subsequent horizontal alignments that are adjusted to the regulations of the Binamarga.

Preliminary Survey

Horizontal alignment refers to the road's horizontal shape in a specific plane, which might enhance comfort, and security. Horizontal alignment, often known as "road alignment" or "road situation," is created by connecting straight lines with curved lines [5]. The preliminary survey will first use map data to locate horizontal alignment data, which will then be examined to see how many curves do not standard Bina Marga criteria [6]. Table 1 shows the design speed chosen with the road function for hills [7]

TABLE 1. Velocity of Plan

Road Function	Velocity of Plan (km/h)		
	Flat	Hills	highland
Primary road highway	60-120	50-100	40-80

TABLE 2. Radius (R_{min}) Required

V_r (Km/h)	120	100	80	60	50	40	30	20
R minimum (m)	600	370	210	110	80	50	30	15

FIGURE 1. Map for Determining alignment horizontal

Accident Prone Point, And Trafic Jam

Traffic accidents that occur often cause many fatalities, especially the roads that are part of the National road network such as the Denpasar-Gilimanuk road in Tabanan Regency with various geometric conditions passing through the lowlands and highlands. The high number of accidents and the long-distance traveled on these roads make there are accident-prone areas scattered along the Denpasar-Gilimanuk road. For this reason, traffic accident research was carried out on the Denpasar-Gilimanuk Tabanan road to determine accident-prone areas in each area of the road under review. This traffic accident research aims to determine accident-prone areas and accident-prone locations along the Denpasar-Gilimanuk road segment in a span of 3 years start from 2019 to 2021.

Value of traffic jam indicated by likert scale:

1. Never
2. Rare
3. Ever
4. Often
5. Very often

Survey Vertical Alignment

For a two-lane, two-way road, vertical alignment is the intersection of the vertical plane with the pavement surface area along the road axis, or along the inner edge of each pavement for highways with a median [8]. Direct measurement was used to determine the longitudinal cross-section of the road during the vertical alignment survey. The maximum slope criterion was used to examine the vertical alignment because it has a significant impact on heavy-loaded vehicles crossing the Denpasar-Gilimanuk route.

TABLE 3. Max Slope

VR(km/h)	120	110	100	80	60	50	40	<40
Slope Max (%)	3	3	4	5	8	9	10	10

RESULTS AND DISCUSSION

The demand for road infrastructure that meets criteria in terms of safety, smoothness, efficiency, and comfort. Before making recommendations for improving an alignment or building a bridge/shortcut, it's necessary to figure out what causes an obstacle to appear on the road segment in question. The length of the road under consideration in this study is 33 kilometers, from Adipura statueTabanan to the district border of Jembrana. This portion is being examined because it features a variety of contours and a high rate of accidents. The road map that is reviewed in this study is as follows.

FIGURE 2. Road segments reviewed with elevation level

Along the area reviewed there are 53 Curves. Here is a documentation of the bend conditions based on the results of field surveys.

FIGURE 3. Documentation of the bend conditions based on the results of field surveys.

Here is documentation of accidents and congestion that occur at the research site, based on the findings of field surveys and secondary data acquired some curves that are prone to accidents and congestion.

FIGURE 4. Photos of traffic accidents and traffic jams

Analysis

The examination begins with a review of the horizontal and vertical alignment with Bina Marga's Road Geometric requirements. The horizontal alignment analysis' conclusions are based on the minimal curve radius (Rmin) required by the standard radius criteria for the road function and design speed. The maximum slope is used to evaluate the vertical alignment. The alignment analysis revealed seven inappropriate bends. The alignment analysis yielded the following results.

TABLE 4. The alignment analysis

Curves Point	Koordinat	Alignment Horizontal		Alignment Vertical	
		Radius (m)	Radius Standard Bina Marga (m)	Slope (%)	Slope Standard (%)
Curve-1	8°32'11.79"S 115° 6'37.88"E	76	80	10	9
Curve-2	8°32'3.88"S 115° 6'42.72"E	78	80	12	9
Curve-3	8°32'1.54"S 115° 6'41.67"E	78	80	9	9
Curve-16	8°29'56.35"S 115° 3'22.34"E	70	80	5	9
Curve-17	8°29'54.04"S 115° 3'22.17"E	70	80	6	9
Curve-19	8°29'41.32"S 115° 2'50.96"E	40	80	7	9
Curve-21	8°29'32.16"S 115° 2'50.72"E	40	80	8	9
Curve-34	8°29'57.78"S 115° 1'28.00"E	45	80	7	9

.

TABLE 5. Accidents and traffic bottlenecks

Curves Point	Koordinat	Accident Prone Point (incident)			Total incident	Trafic Jam Point			Average
		2019	2020	2021		2019	2020	2021	
Curve-1	8°32'11.79"S 115° 6'37.88"E	5	2	1	8	4	3	3	3.3
Curve-2	8°32'3.88"S 115° 6'42.72"E	2	0	3	5	3	2	1	2
Curve-3	8°32'1.54"S 115° 6'41.67"E	7	4	3	14	4	4	3	3.7
Curve-16	8°29'56.35"S 115° 3'22.34"E	5	2	2	9	4	3	3	3.3
Curve-17	8°29'54.04"S 115° 3'22.17"E	5	2	2	9	4	3	3	3.3
Curve-19	8°29'41.32"S 115° 2'50.96"E	10	4	1	15	4	3	2	3
Curve-21	8°29'32.16"S 115° 2'50.72"E	5	3	3	11	4	3	2	3
Curve-34	8°29'57.78"S 115° 1'28.00"E	7	2	5	14	2	1	1	1.3

Result Discussion

The results of the analysis above show that the seven Curves are not in accordance with the standards and are prone to accidents and congestion. The following is an explanation of each of these Curves.

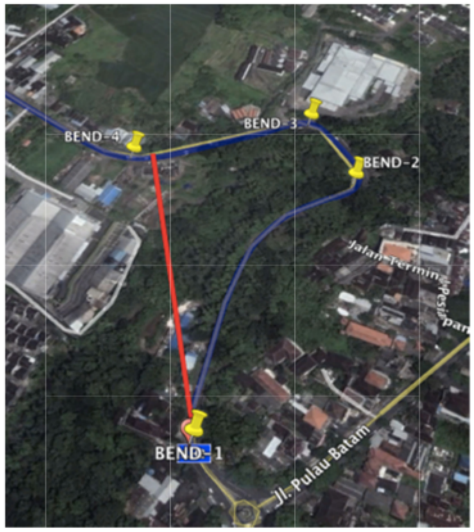

FIGURE 5. Curve layout 1-3.

From the picture above shows the number of curves 1-3. The superelevation at curves 1 to 2 does not meet road safety rules, so it is proposed that a shortcut from curve 1 cuts to bend 4. Shortcut recommendations are proposed because the land is still available in this area. This shortcut is expected to improve road safety and comfort to minimize the occurrence of accidents and faster travel times.

FIGURE 6. Curve 16-17

The picture above shows that is an overlapping transition curve between curves 16 and 17 which causes the road section to be prone to accidents. The recommendation for this section is to improve the alignment in the form of widening the road on curve 16 to maximize visibility. Another recommendation is to add street lighting and signs to minimize accidents at night.

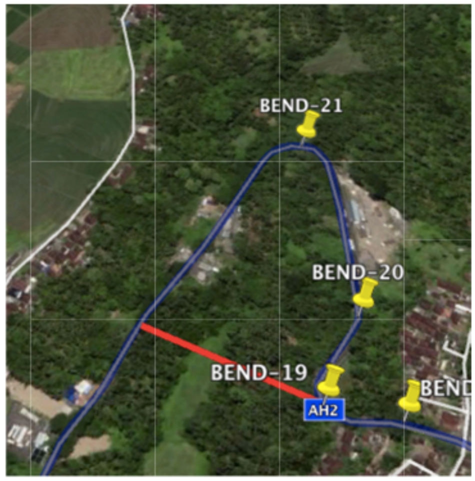

FIGURE 7. Curve 19-21

Accident data shows that 26 incidents occurred in this series of calculations. This condition is due to poor alignment on the road. Shortcut recommendations are proposed because the land is still available in this area. This shortcut is expected to improve road safety and comfort to minimize the occurrence of accidents and faster travel times.

FIGURE 8. Curve 34

The picture above shows that Rmin is much smaller than the required standard. This condition has an impact on being prone to accidents. The recommendation for this support is to change the bend type from FC type to SCS with respect to the minimum radius. Another recommendation is to add street lighting and guard rails equipped with reflectors.

TABLE 6. Results of the analysis and recommendations

Curves Point	Koordinat	Alignment Horizontal		Accident Prone Point (incident)			Total incident	Trafic Jam Point			Average	Alignment Vertical		Result	Recommendation
		Radius (m)	Radius Standard Bina Marga (m)	2019	2020	2021		2019	2020	2021		Slope	Slope Standard		
Curve-1	8°32'11.79"S 115° 6'37.88"E	76	80	5	2	1	8	4	3	3	3.3	10	9	This road segment is in one segment with high accidents and congestion so it is recommended to be developed shortcuts due to land availability.	Rec.Shortcut
Curve-2	8°32'3.88" S 115° 6'42.72"E	78	80	2		3	5	3	2	1	2.0	9	9		
Curve-3	8°32'1.54" S 115° 6'41.67"E	78	80	7	4	3	14	4	4	3	3.7	11	9		
Curve-16	8°29'56.35"S 115° 3'22.34"E	70	80	5	2	2	9	4	3	3	3.3	5	9	On this road is prone to accidents and congestion so it is recommended for the repair of alinyemen	Rec.perbaikan alignment
Curve-17	8°29'54.04"S 115° 3'22.17"E	70	80	5	2	2	9	4	3	3	3.3	6	9		
Curve-19	8°29'41.32"S 115° 2'50.96"E	65	80	10	4	1	15	4	3	2	3.0	7	9	This road segment is in one segment with high accidents and congestion so it is recommended to be developed shortcuts due to land availability.	Rec.Shortcut
Curve-21	8°29'32.16"S 115° 2'50.72"E	60	80	5	3	3	11	4	3	2	3.0	10	9		Rec.Shortcut
Curve-34	8°29'57.78"S 115° 1'28.00"E	44	80	7	2	5	14	2	1	1	1.3	11	9	On this road is prone to accidents and congestion so it is recommended for the repair of alinyemen	Rec. Perbaikan Alinyemen

CONCLUSSION

From the result of the above analysis it can be concluded that:

1. The recommendations proposed are the construction of shortcuts on sections that have available land and the improvement of alignments on sections with limited land. Another recommendation is the addition of lighting, signs, and the addition of guard rails.
2. The results of the analysis show that along the 33km of the road under review there are 53 curves. Of the 53 curves, seven curves are not up to standard and prone to accidents.
3. To address the limited funds, the determination of the priority of handling must take into account the condition of the existing alignment and the level of accident and congestion hazards.

ACKNOWLEDGEMENT

I am especially grateful for Mr. Dr. Ir. I Nengah Sinarta, ST, MT, and Dr. Ir. Putu Ika Wahyuni, ST, M.Si., MT, for constructive criticism and advice in the completion of this journal. I'd like to express my gratitude to Mr. I Kadek Windy Candrayana, ST, MT, and Listya Dewi, for helped me prepare my journal

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