Analysis of Road Damage with PCI (Pavement Condition Index) Method in Uluwatu Highway

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Abstract. Roads are a very important means of land transportation for the community in facilitating the economy and culture between regions in Indonesia. With good road conditions, it will make it easier for the community to hold other social activities. One of the road locations in Badung Bali Regency that has been damaged is the Uluwatu highway. On these roads, there is frequent congestion during rush hour, which makes conditions even less conducive for motorists. Uluwatu Highway is a connecting route between the Sarbagita area and Trans Metro Dewata with the tourism area in the Bukit Jimbaran area. The types of road damage found on North Uluwatu Road are crocodile skin cracks, spots, box cracks, longitudinal cracks, edge cracks, and grain release. Based on the results of the calculation of the PCI value in Segment I to Segment 30, the highest PCI value was found in Segment 23, which was 69 (good), while the lowest PCI value was found in Segment 3, which was 42 (reasonable). The average PCI score of Jalan Gunung Agung is 55.5 where the rating is categorized as good.

Keywords: Highway, Pavement Condition Index (PCI), Road Damage

1 Introduction

The road is a means of land transportation that covers all land areas, as well as complementary buildings and equipment necessary for traffic, which is at ground level, above ground level, below ground and/or water level, and above water level, except for railways, truck roads, and cable roads (Department of Public Works, Directorate General of Highways, 1997). Roads are infrastructure that connects an area and plays an important role in realizing a service community (Harvey & Knox, 2016). According to the binding material, road pavement lining is classified into two categories: flexible and rigid (Gabr, Hopkins, Coonse, & Hearne, 2000). Bending pavement is a road pavement with asphalt as a binding material (Erlingsson, 2012). Rigid pavement is a road pavement with a binding material of concrete as the foundation and the main surface of the wear layer, commonly called rigid cement concrete pavement (Mohod, & Kadam, 2016).

The North Uluwatu Highway has suffered damage to the pavement such as the road surface which has patches, cracks, grain release, and other damage. It is suspected that the cause of sidewalk damage on Jalan Uluwatu is because it is often passed by vehicles

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transporting goods that exceed the load and high intensity. Road damage is one of the common problems that are often encountered in Indonesia, damaged roads will of course affect the smooth mobility of goods and services. One of the stages in evaluating road conditions is to assess the existing condition of the road. The value of this road condition will be a reference to determine the type of handling program that must be carried out (Fatikasari, 2021). In addition, damaged roads can also have an impact on the comfort and safety of road users (Warsito & Rachmawati, 2019). Road damage needs to be taken seriously, one way to maintain the quality of road service is to evaluate the condition of the road surface. One of the stages in evaluating road conditions is to assess the existing road conditions. Roads as part of the national transportation system play an important role, especially in supporting the economic, social and cultural, and environmental sectors, and are developed through a regional development approach to achieve balance and equitable development between regions, form and strengthen national unity to strengthen national defense and security, and form spatial structures to realize national development goals (Government of Indonesia, 2004). Curved pavement is a pavement that uses asphalt as a binding material while rigid pavement is a type of road pavement that uses concrete as the main material of the pavement (Rachman and Sari, 2021). The combination of pavement types is called composite pavement where the concrete of the structure is for the sublayer, while the asphalt for the sublayer is for the surface layer (Flintsch, Diefenderfer & Nunez, 2008).

One of the steps to assess the surface condition of the North Uluwatu Highway is to assess the condition of the existing road. The values obtained in this analysis will be used as a reference to determine the repair method for the North Uluwatu Highway. One of the methods used to analyze road damage in Indonesia is the PCI Method. The selection of the right road maintenance program is carried out by assessing the condition of the road surface according to the type of damage that is visually determined (Lokollo et al., 2020).

2 Methodology

The location of study was carried out on North Uluwatu road which is located in South Kuta District, Badung Regency, Bali with a length of 3 Km. The selection of this location is based on the condition of the North Uluwatu road which has suffered a lot of damage. The location of the study is shown in Figure 1.

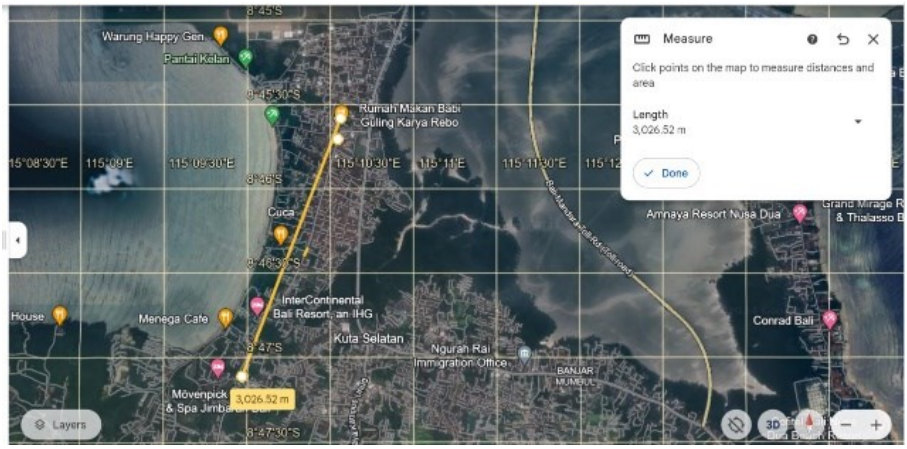

Figure 1. Location of North Uluwatu road

Research Stages. The analysis of the condition of the pavement of the North Uluwatu highway in this study uses the Pavement Condition Index (PCI) method which consists of: a. Calculate density (degree of damage); b. Determine the deduction value of each type of damage; c. Calculate the maximum deduction value that can be reduced (m); d. Calculate the total reduction value (TDV); e. Determine the corrected reduction value (CDV); f. Calculate the PCI (Pavement Condition Index) value.

Data Analysis. Based on the survey results, the researcher identified the types of damage that existed on the flexible sidewalk of Jalan Uluwatu Utara. Types of damage on the road include crocodile skin cracks, patches, box cracks, transverse cracks, longitudinal edge cracks/cracks and grain release. After conducting research on the damage to the bending pavement that occurred on the road, the damage was dominated by the type of edge/longitudinal cracks covering an area of 669.4 m2. The following table 1 shows a recapitulation of the damage to the sidewalk of Jalan Uluwatu Utara along 3 Km.

Table 1. Types of road damage

Types of pavement damage	Total area	Unit
Crocodile skin cracks	420.6	m^2
Patch	503	m^2
Fine cracking	133.62	m^2
Transverse cracking	9.1	m^2
Break the connection	669.4	m^2
Grain release	0.55	m^3

The Uluwatu Road section in this study has a length of 3 km and a width of 6.5 meters. This road pavement assessment is divided into 3 segments that are adjusted to the environment along the road. The analysis of the damage level of North Uluwatu Road from STA 0+000 to STA 3+000 based on the results of the analysis of the level and type of damage was obtained using the PCI method. In the analysis of road damage assessment using the PCI (Pavement Condition Index) method, the road is divided into 30 segments, with a road length per segment of 100 m and a road width of 6.5 m.

3 Result and Discussion

3.1 Result

Severity. The classification of road damage levels from STA 0+000 to STA 0+100 can be seen in Table 2.

Table 2. Severity

	Types of road damage	Severity
1	Crocodile skin cracks	M
2	Patch	M
3	Break the box	L
4	Transverse cracking	M
5	Break the connection	H

Density (percentage of damage). The density or damage rate is the percentage of the area of a type of damage to the area of a segment unit measured in square meters or long meters.

Table 3. Density value

No	Types of damage	Severity	Area (m^2)	Density (%)
1	Crocodile skin cracks	M	49.2	7.569
2	Patches	H	31	4.769
3	Fine cracking	L	4.2	0.323
4	Transverse cracking	L	1.4	0.215
5	Crack the connection	H	13.8	2.123
	Grain release	M	0.096	0.015

Reduce Value. DV (deduct value) is the reduction value for each type of damage obtained from the relationship curve of density level and severity.

Maximum Reduction Value (M) and Q
m= 1+(9/98)×(100-HDV)
m = 1+(9/98)×(100-42)
m = 6.327

Total Reduction Value (TDV). The Total Reduction Value is obtained from the total number of Reduction Values from each damage to the road section reviewed so that the Total Reduction Value (TDV) is obtained.

Corrected Reduction Value (CDV). After knowing the niIai TDV (Total Deduct Value) and q (Number of Deducts More than 5 points), then the niIai CDV (Corrected Deduct Value) can be searched by plotting the niIai TDV (Total Deduct Value)

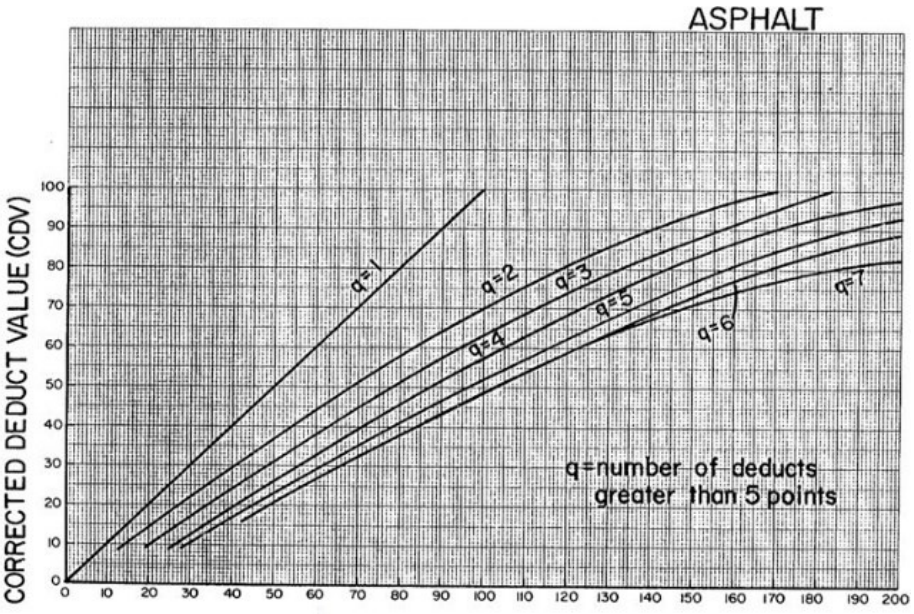

Figure 1. Corrected reduction value

Pavement Condition Index (PCI). The PCI value for segment 1 can be calculated as follows: PCI value = 100-CDV = 100-56 = 44. The PCI value on STA 0+000 to STA 0+100 is 44, so the condition of the pavement in segment 1 of Jalan Uluwatu Utara is considered reasonable. The results of the calculation of the PCI value for each segment of North Uluwatu Street can be seen in the following figure.

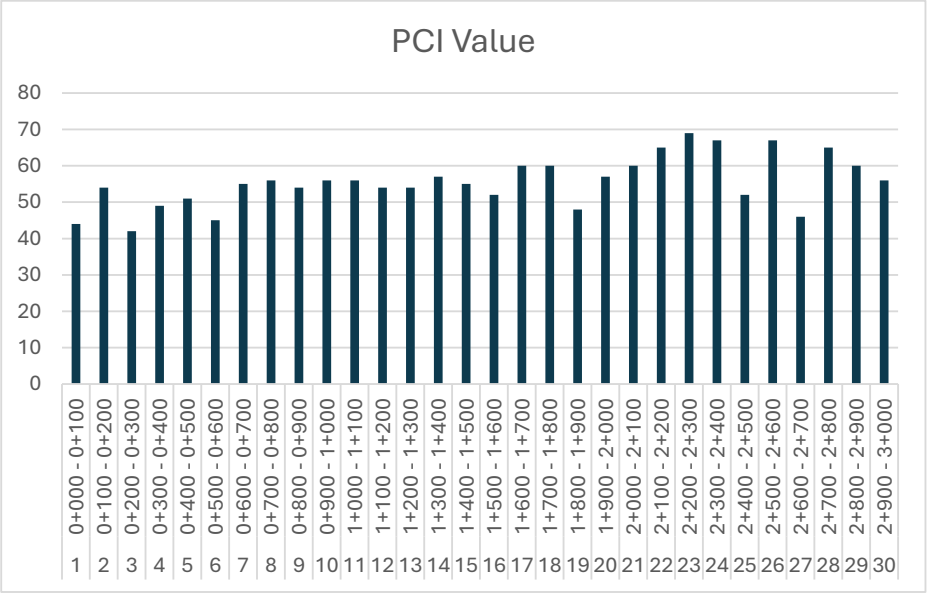

Figure 1. PCI value per segment

3.2 Discussion

Based on the results of the calculation of the PCI value in segment I to segment 30, the highest PCI value was found in segment 23, which was 69 (good) while the lowest PCI value was in segment 3 out of 42 (reasonable). The average PCI score of Jalan Uluwatu Utara is 55.5 where the rating is categorized as good**.** By looking at the results of the analysis of the calculation of the value of the road pavement condition index based on the type and level of severity using the PCI rule, it is necessary to make improvements to improve the condition of the road pavement on the North Uluwatu Road section. Based on the results of the analysis, it is known that for handling pavement damage on the North Uluwatu Highway, it is only necessary to overlay.

4 Conclusion

The average PCI score of Jalan Raya Uluwatu Utara is 55.5 where the rating is categorized as good. Thus, damage handling is carried out by overlaying to improve the condition of the pavement so that it can serve the traffic load. If the road condition is not immediately repaired and deteriorates, then the costs that will be incurred for repairs and maintenance will be more expensive. In addition, damage that is not handled immediately will have a bad impact on service and also the safety of road users.

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