ROAD DAMAGED FACTOR ANALYSIS AT SIGNALIZED INTERSECTION (Case Study: The Traffic Light in Front of UNISSULA, Jl. Raya Kaligawe KM 4, Semarang)

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ABSTRACT

Road damage is common occurrence at signalized intersections. This causes delays in vehicle mobility and leads to congestion. This research seeks to investigate the types of damage occurring at signalized intersections, the factors causing the damage, and the alternatives to prevent the damage. Based on RCI method the value is 4,4, it means that on the location, the condition of the road are bad, many holes, and irregular surface. And also in the location often flooded, and affected by centrifugal force from the U turn, and the vibrating force while the vehicles waiting for the traffic light, and affected on the previous flexible layer get damaged. Based on that result, the repair possibility at the Traffic Light jalan Kaligawe KM. 4 (main road in front of Universitas Islam Sultan Agung) Semarang should use rigid pavement. And there are some specification items that relevant with the condition of the road: concrete slab thickness = 15cm, concrete slab length = 100m, shrink joint applied in space 5m, cross joint (dowel) applied with straight wire that have 32mm diameters, length 45cm, and space between the wire is 30cm, and tie bar use whorl beam that have 16mm diameters, length 70cm and space 75cm.

Keyword : *crossroadroad; damaged; road repair; transportation*

1. INTRODUCTION

One of the main component in national economic growth, especially in Java, is Jl. Raya Pantura. The Terboyo Industrial Area consists of several important infrastructure, including Kaligawe Industrial Area, Sultan Agung Hospital, Terboyo Terminal, and UNISSULA. The amount of infrastructure existing in that area unavoidably affects the pavement in the area. Therefore, there needs to be serious road handling to prevent damage to the pavement layer and prevent congestion. The identified problems at a traffic light include damage from braking force, U-turn force (centrifugal), and vehicle weight while waiting for the green light. The wavy asphalt pavement in the traffic light is caused by the vibration force from vehicles. Incorrect or sub-optimal type of pavement in such signalized intersection area results in a decreased comfort experienced by riders and drivers. Road damage in a signalized intersection area also results in long queues and delays in vehicle mobility at the intersection.

Analysis of Road Damage and Method for Handling Damage on Road Surface

Data regarding road damage in details are needed to plan and execute road rehabilitation projects. Such data may include type of damage, severity of damage, and location of damage which can be obtained from survey results regarding pavement damage (Priyana, 2018). An example of method for damage assessment is the Bina Marga method, whose results are in the form of priority order that must be done for roadwork. Another method that can used is the Road Condition Index (RCI) method, which is used for getting information regarding level of damage, presented in the form of charts for later stage analysis (ASTM International, 2007). Meanwhile, the Method by Indrasurya and Dirgolaksono (1990) attempts for knowing level of damage caused by various factors to the existing damaged roads (Nashruddin, 2021). In effort for road maintenance or roadwork, initial assessment is needed to determine the capability of specified pavement type, to ensure that the pavement functions properly.

2. RESEARCH METHOD

Sample and Data Collection

A descriptive method was used in this research to investigate and focus on the research object, which is Jl. Raya Kaligawe, specifically at the traffic light in front of UNISSULA, Semarang. The data used in this research included physical road condition, existing pavement, traffic volume, result of CBR test, etc. These data were collected through field assessment, documentation, and literature review. Field assessment was done by taking notes regarding the existing condition obtained during the survey. Whereas sources for literature review were in the form of books, articles, as well as previous research.

Data Analysis

The data analysis on this research was done using descriptive method. The analysis was conducted to determine type of damage (RCI value), calculate the thickness of pavement structure, calculate the overlay thickness, and calculate the concrete slab thickness. To produce data as needed, the focus of the analysis was directed at the road conditions, techniques for repairmen, and budget plan.

3. FINDINGS AND DISCUSSION

Roadwork and Overlay

Data from the survey results regarding rebound deflection can be used for planning the overlay thickness, as this research only obtained the average deflection at 1.156 mm and obtained no secondary data of *Benkelman Beam as a whole*. The determination of overlay thickness was done using the planned deflection result as shown below (Figure 1), showing the calculation results of overlay thickness.

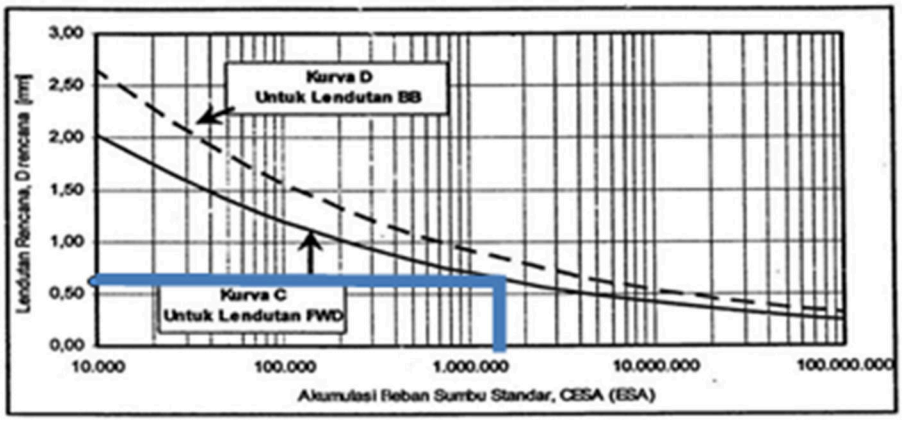

Figure 1. The Connection Between Plan Deflection and Traffic

The planned deflection was determined at 0.70 mm, based on Figure 1 above. After the values of planned deflection were obtained, they are presented as the following Figure 2.

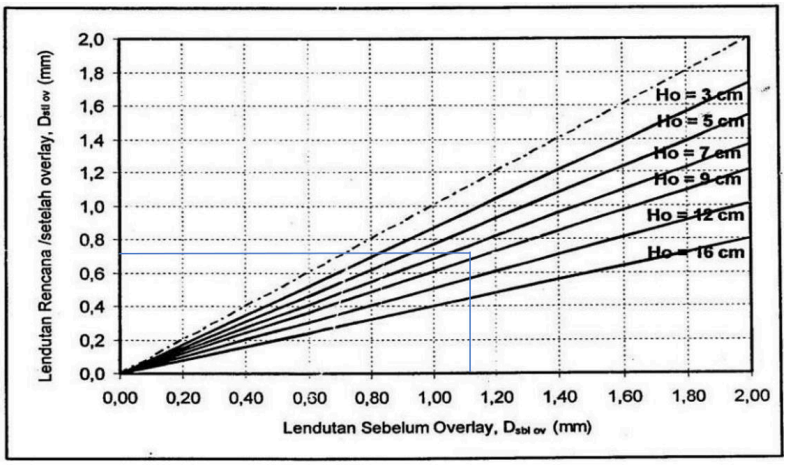

Figure 2. *Overlay*

Figure 2 shows that the required overlay thickness amounted to 10.9 cm. In accordance with the table of design and construction of asphalt pavement 02/M/BM/ 2013,

the overlay thickness used was 11 cm, with AC-WC thickness at 4 cm, AC-BC thickness at 7 cm, minimum allowable AC-WC wear layer at 4 cm, and allowable thickness between AC-BC at 6 cm.

Summary of Pavement Repair Dimension

The dimension data on pavement repair (roadwork) at the traffic light on Jl. Raya Kaligawe KM. 04 (in front of UNISSULA) Semarang can be determined from the previous calculations, whose results are summarized on Table 1.

Table. 1 Summary of Pavement Repair Dimension

Flexible Pavement		Overlay		Rigid Pavement	
WC	-	AC WC	4 cm	Thickness	15 cm
AC Binder	-				
AC Base	-	AC Binder	6 cm	Length	500 cm
LPA	-			Dowel	D32 Plain spokes, length 45 cm, in-between distance 30 cm.
Sandstone	-			Tie Bar	D16 threaded steel, length 79 cm, in-between distance 75 cm.

Pavement Repair Cost

The calculation of pavement repair cost on Jl. Raya Kaligawe KM. 04 (in front of UNISSULA) Semarang consisted of: alternative 1 of overlaying method and replacing asphalt with rigid pavement, while alternative 2 of using rigid pavement (presented on table 2 and table, respectively).

Table 2. Cost for Alternative 1

	Description	Cost (IDR)
1.	Land Work	26,992,586.40
2.	Concrete Pavement	541,247,419.65
3.	Asphalt Pavement	478,104,384.61
Amount of Cost		1,046,344,390.66
Tax Increment (PPN) of 11%		115,097,882.97
	Total	1,161,442,273.64
	Rounded up	**1,161,442,000.64**

Table 3. Cost for Alternative 2

	Description	Cost (IDR)
1.	Land Work	37,712,670.00
2.	Concrete Pavement	1,082,494,839.30
3.	Bar Work	8,399,025.00
Amount of Cost		1,128,606,534.30
Tax Increment (PPN) of 11%		124.146,718.77
	Total	1,252,753,253.07
	Rounded up	**1,252,753,000.00**

From the above calculations, the total cost for alternative 1 amounts to IDR 1.161.442.000 and for alternative 2 amounts to IDR 1.252.753.000.

Maintenance Cost

Good road condition needs maintenance to sustain its level of service and achieve its optimal use-life (Rahman, 2011).

Table 4. Cost Comparison Analysis

	Description	Cost (IDR)	Total Maintenance Cost (20 years) (IDR)	Total (IDR)
1	Alternative 1: a. overlay b. replacement (asphalt to rigid pavement)	1,161,442,000	155.800.000	1,317,242,000
2	Alternative 2 rigid pavement	1,252,753,000	7,233,000	1,259,986,000

Table 4 shows that the total cost incurred in alternative 2 (concrete pavement) is cheaper compared to alternative 1 (asphalt pavement, overlay, replacing old pavement with concrete) by 4.89 %.

4. CONCLUSION

Based on the average RCI (Road Condition Index) value obtained (4.4), it is known that the road condition was bad. There were potholes and uneven surface on said road. The factors causing damage at the traffic light on Jl. Raya Kaligawe KM.4 (in front of UNISSULA) Semarang, deflected or chipped pavement) included braking force from vehicles and erosion due to tidal flooding (ROB). The concrete pavement is selected in this research as the existing condition on said road (tidal flooding) rend asphalt pavement and

overlaying prone to damage. The recommended item specifications are concrete slab thickness = 15 cm, concrete slab length = 100 m, shrink fits installed every 5 m; dowel uses plain spokes with a diameter 32 mm, length 45 cm, in-between distance of 30 cm; tie bar uses threaded steel with a diameter 16 mm, length 70 cm, and distance 75 cm.

5. SUGGESTION

Based on the research results that have been elaborated previously, the following recommendations are proposed:

1. There needs to be routine assessment and review on pavement condition, especially for national roads.
2. Annual assessment of vehicle volume needs to be conducted to monitor the growth.
3. Road at traffic light area is prone to braking force from vehicle, thus concrete pavement is suitable to minimize damage on road surface.

6. REFERENCES

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