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Analysis of Road Damage Using the Bina Marga Method on the Lamongan City - Mojokerto Border Road Section

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ABSTRACT

Road as an important facility for the community to achieve a desired goal both mobilizing goods and services. On the Lamongan City – Mojokerto Regency Border Road Section of STA 20+000 - 26+000 based on the field has experienced a decrease in road services that are not stable / comfortable with a lot of damage to the road. This study aims to determine the priority order value of road surface damage based on the Bina Marga method, determine the handling of road maintenance and the cost of handling road maintenance based on the two methods. From the results of the research, the priority order value of road damage on the Lamongan City - Mojokerto Border Road Section of STA 20+000 - 26+000 with the Bina Marga method is the priority order value of road damage 5.5, this includes a periodic maintenance handling program, the cost of handling road maintenance with the Bina Marga method is Rp. 9,479,663,479.46.

Keywords: Bina Marga Method, Road Damage, Road Section, Maintenance

1. Introduction

Government Regulation of the Republic of Indonesia No. 38 of 2004 on Roads states that roads have an important role in realizing the development of the nation's life. Therefore, roads are needed by the community in carrying out their daily activities. Therefore, roads need to be evaluated periodically so that the level of service can be maintained (Kusmaryono & Sepinggan, 2020). Roads are important facilities for the community in order to achieve a desired goal both mobilizing goods and services. For this reason, people need roads that are safe and comfortable for their users, in order to achieve stable road criteria, there are technical provisions that must be met by a road section so that the road can function optimally to meet the Minimum Road Service Standards in serving road users in traffic and transportation activities.

There are special roads and public roads. Special roads are roads that are not intended for general traffic, but for individuals or business entities, certain agencies whose organizers can be government agencies or private parties. Public roads are roads intended for general traffic, including expressways or toll roads. In terms of the road network system, several network systems are distinguished, including the primary road network system and the secondary road network system. The primary road network system is a node connecting roads with the role of serving the distribution of goods and services for all regions at the national level by connecting all nodes of tangible distribution services to activity centers. Secondary roads are road network systems within nodes with the role of serving the distribution of goods and services to communities within urban areas.

Urban road as a road in a node in an urban area that connects the city center with other urban areas that are permanently developed with the main activities in settlements, concentration and distribution of government services, social services and economic activities, not agriculture, with peak traffic flow conditions in the morning and evening. Intercity roads as roads connecting nodes outside the city which on both sides have no continuous and permanent development, although some have permanent development, but few, rare and far apart, such as restaurants, factories, villages, small kiosks, food stalls, and others. Based on its function, roads are divided into arterial roads, primary arterial roads, secondary arterial roads, collector roads, primary collector roads, secondary collector roads, local roads, primary local roads, secondary local roads. Arterial roads are public roads that serve the main transportation with long-distance travel characteristics, high average speed, and limited number of entrances.

Primary arterial roads are arterial roads in the primary system that connect between national activity centers or between national activity centers and regional activity centers. Secondary arterial roads are arterial roads in the secondary system that connect primary areas with the first secondary area, or between the first secondary area, or between the first secondary area and the second secondary area. Collector roads are public roads that function to serve collector or divider transportation with characteristics of medium distance travel, medium average speed, and limited number of entrances. Primary collector roads are collector roads as a primary system that connects efficiently between national activity centers and local activity centers, between regional activity centers, or between regional activity centers and local activity centers.

Secondary collector roads are collector roads as a secondary system that connects between second secondary areas, or between second secondary areas and third secondary areas. Local roads are public roads that serve local transportation characterized by short-distance travel, low average speed, and an unrestricted number of driveways. Primary local roads are local roads in the primary system as an efficient link between national activity centers and environmental activity centers, between regional activity centers and environmental activity centers, between local activity centers, or between local activity centers. Secondary local roads are local roads in the primary system as an efficient link between national activity centers and environmental activity centers, between regional activity centers and environmental activity centers, between local activity centers, or between local activity centers.

Based on their status, roads are divided into national roads, provincial roads and district roads. National roads are roads organized by the central government consisting of primary arterial roads, primary collector roads. Provincial roads are roads organized by the provincial government consisting of primary collector roads, primary collector roads and provincial strategic roads. Regency roads are roads organized by the regency government consisting of primary collector roads that do not include national roads and provincial roads. The type of road structure is flexible pavement and rigid pavement, the road has a road service life which can be maintained by road maintenance so that it can reach the planned road service life. Road conditions that often receive heavy and repetitive traffic can degrade the performance of the road surface, which can increase the risk of accidents (Indonesia, 1970) and reduce the comfort of road users (Saputro et al., 2023).

Pavement condition is an important aspect in terms of determining road maintenance and repair activities. to assess the condition of the pavement, it is necessary to first determine the type of damage, the cause, and the level of damage that occurs (Triyanto, 2021). In general, road damage is caused by several reasons, namely the age of the road plan that has been passed, puddles of water on the road surface that cannot flow due to poor drainage, soft soil structure, repeated overloaded traffic loads that cause the life of the road to be shorter than planning. The impact of traffic can cause negative problems, The increasing need for mobility affects the demand for increased vehicle use. The increase in vehicle mass reduces the quality and life of the road structure as the load exceeds the planned road class limit.

Broadly speaking, road damage can be divided into two parts, namely structural damage and functional damage. Structural damage types consist of cracking, deformation, surface defects, wear and tear, cracking, and settlement of utility plantings. Functional damage types, on the other hand, usually include roughness and deflection that cause inconvenience to road users. Road damage includes potholes, alligator cracks, bleeding/fatness, block cracks, cracking, sinking, edge cracks, longitudinal grooves and longitudinal/transverse cracks. However, over time the performance of the road will experience a decrease in condition in accordance with the increasing age of the road, resulting in an obstacle in the smooth running of a trip. Road conditions whose function has decreased so that it does not get worse, it is necessary to carry out road maintenance so that the road function increases again so that it becomes a steady road that is comfortable for road users. To keep the road condition at a decent performance in serving various modes of transportation, it is necessary to evaluate the road surface to find out whether the road is still in good condition or needs an improvement program, routine maintenance or periodic maintenance.

Routine Maintenance is road asset maintenance work that is carried out every year. Routine maintenance work can be grouped as cyclical work, work that has a certain frequency in maintenance standards, such as cutting vegetation, cleaning channels, and culverts. Routine maintenance work can also be categorized as reactive work, Determining the type and timing of work based on the level of intervention (specified in the maintenance standard), for the required maintenance. Example: patching work is done when a pothole is observed. Routine maintenance can also use mechanical / thin preventive treatments that can be done according to local conditions, including asphalt rejuvenation (binder rejuvenation: fog seal), crack sealing, crack filling, burda / burtu (spray bitumen chip seal), spray bitumen sand seal, Latasir (sand sheet), emulsified asphalt slurry (emulsified asphalt slurry seal).

Special Works are unforeseen works, such as emergency works to deal with landslides and floods that make the road impassable, and local repair works to make the road passable for traffic. The Special Works budget consists of a major natural disaster budget, other special budgets and a reserve budget. Periodic Maintenance is a work activity that protects the integrity of the road surface and is carried out at intervals of several years. This work is carried out in response to deteriorating road conditions and helps to reduce deterioration of the road structure. It does not include works that extend the life of the pavement, i.e. strengthening or rehabilitation works, reconstruction, or capacity enhancement works such as road widening, re-alignment and raising of the road surface. For asphalt roads, examples include overlays, shoulder repairs, thin asphalt overlays, including preventive maintenance, regrooving, sealing, repairing complementary structures, replacing/repairing missing/damaged road equipment, marking, re-marking, pothole filling.

For roads not covered with asphalt/cement concrete, raking, adding, and re-mixing of materials (ripping and reworking existing layers) can be carried out when reshaping the surface; and maintenance/hygiene cleaning. For non-asphalt roads, periodic maintenance includes gravel overlay work and road body leveling. Upgrading/Rehabilitation are major works such as thick resurfacing, structural and pavement reconstruction works in response to severely deteriorated road conditions. This work is generally called road rehabilitation or road improvement. Rehabilitation works must be accompanied by a detailed design.

Road surface condition assessment is one of the stages to determine the type of evaluation program that needs to be carried out. Two methods that can be used in assessing road conditions are the Bina Marga method and the PCI (Pavement Conditional Index) method (Harfa et al., 2023). The condition of road damage through surveys or visual observations, namely by measuring the length, width, depth and area of each damage that occurs, then analyzed by the Bina Marga and PCI (Pavement Conditional Index) methods from the results of the analysis can later determine what type of repair is used in road maintenance and calculate the maintenance costs (Hafel et al., 2023).

Based on the explanation above, the Lamongan City - Mojokerto Border Road Section is a road with a flexible pavement structure and based on its function, it is a primary collector road which connects efficiently between national activity centers with the activity centers of Lamongan Regency and Mojokerto Regency, between regional activity centers and Lamongan Regency activity centers. Making community activities in the region have a high level of mobility, productivity and economic activity. In the section, the mobility of cargo cars is very high because there is excavation C where the load exceeds the standard capacity, resulting in the load supported by the road body is very heavy so that it can cause a shorter road service life. Based on its status, the Lamongan City – Mojokerto Regency Border Road Section is a provincial road which as the organizer / has the authority is the East Java provincial government represented by the East Java BinaMarga Public Works Office.

Lamongan City – Mojokerto Regency Border Road Section STA of 20+000 - 26+000 based on the field has experienced a decrease in road services that are not stable / comfortable with a lot of damage to the road, so that it can endanger road users, slow down the mobility of road users and have an impact on the economy of the surrounding area (Yuliandra et al., 2022; Yunardhi, 2019). Given the importance of this road that connects between the centers of economic activity of the district, East Java province and the National. So it is necessary to analyze the value of the road damage index as a rare one of the stages to determine the type of road maintenance evaluation program that needs to be done. Road damage index analysis can use two methods, namely the Bina Marga method (Faisal, 2020). The results of the assessment of the condition of the road surface damage that has been determined visually analyzed by the two methods can be made a reference in handling road maintenance so that the road can be stable and comfortable for road users (Lasarus et al., 2020).

In accordance with the main discussion, the purpose of this research is to identify the priority order value based on the Bina Marga method that occurs on the Lamongan City – Mojokerto Regency Border Road Section STA of 20+000 - 26+000. Furthermore, determining the handling of the priority order value of the Bina Marga method and calculating the cost of handling road maintenance with the Bina Marga method (Purnomo & Putra, 2022; Santosa et al., 2021; Setiawan & Lestarini, 2022).

2. Methodology

2.1. Research Location

The location of this research was carried out on the Lamongan City – Mojokerto Regency Border Road Section of 106 at STA 20+000 - 26+000, the research was carried out by going to the location by visually seeing the condition of the road damage and the severity.

2.2. Data Collection Technique

In this data collection stage, there are 2 (two) types of data collected, as for the data - the data is as follows:

a. Primary Data

Primary data is data obtained by direct observation and measurement at the research location, the primary data needed in this study includes several important aspects. First, calculating the type of vehicle or class of vehicle passing a point on the Lamongan City – Mojokerto Regency Border Road Section of STA 20+000 - 26+000, which involves direct observation to record the number and type of vehicles such as passenger cars, trucks, buses, and motorcycles. Second, identifying the types of road damage that exist on the Lamongan City - Mojokerto District road section at STA 26+000 - 26+000, which involves direct observation of road conditions to recognize damage types such as cracks, potholes, and waves.

Third, measuring the road damage which includes the length and width of each identified damage. Fourth, taking photo documentation of each type of road defect found as visual evidence and further reference. Finally, determining and recording the specific location of each road defect using STA (Stationing) markers for precise location reference. This data will be obtained through direct observation and measurement at the study site, and is essential for road condition analysis and planning of necessary improvements.

b. Secondary Data

Secondary data is data obtained through existing data sources, from related agencies, books, reports, journals or other relevant sources. The secondary data required in this research includes several aspects. First, secondary data in the form of research location sketches obtained from the internet, such as Google Maps. Second, data on the name of the road section, STA, length, road width, unit price data, and maintenance handling methods were all obtained from the East Java Bina Marga Public Works Office. These data will support the analysis and interpretation of road conditions and the planning of necessary maintenance measures.

The method of collecting road damage data in the field is as follows:

a) Dividing the road into 30 segments from a total road length of 6 km, road width of 7 m. each segment is 200 m with a width of 7 m according to the width of the road.
b) Identify the types of road damage that exist in each segment.
c) Calculate and measure the dimensions of damage for each type of damage in each segment.
d) Document each type of damage in each segment.
e) Identifying the class of vehicles passing at a point from 7:00 am to 7:00 pm for 2 days.

2.3. Research Instruments

The instruments used in this study include: (a) a road damage survey form, available in the appendix table, or a device that records information such as the date, location, segment, section, sample unit size, number and size of panels, type, severity, and quantity of damage; (b) a traffic enumeration survey form, also found in the appendix, which records vehicle class and the number of passing vehicles; (c) a handheld tally counter; (d) a wheeled meter for measuring distance; (e) a ruler (mistar); (f) a network map for the road network being surveyed; and (g) a digital camera.

2.4. Data Analysis Technique

The researcher calculates the data obtained through the survey results in the field with the Bina Marga method, while the steps for analyzing road damage condition data using the Bina Marga method are calculating traffic volume, calculating LHR, determining the type of road and traffic class, labeling the survey results and grouping the data according to the type of damage, summing up each number for all types of damage and determining the road condition value, and calculating the Priority Order value (Delfina et al., 2023).

3. Results and Discussion

3.1. Data Description

Data was obtained from direct visual surveys in the field by recording and measuring the dimensions of road damage on the road damage form and recording the traffic volume of the type of vehicle class passing by on the traffic enumeration form.

3.2. Identification of Road Damage Types

From the results of the survey in the field, researchers obtained the types of pavement damage found at the research location by identifying road damage conditions and measurements for each type of damage in each of the 30 segments, the following types of damage are presented at the research location and the damage code in table 1.

Table 1. Road Damage Type and Code

Damage Code						
111	112	114	115	117	118	120
Holes	Wavy	Collapes	Break Down	Crack	Longitudinal Cracks	Exfoliated

Source: Processed by Researchers, 2024

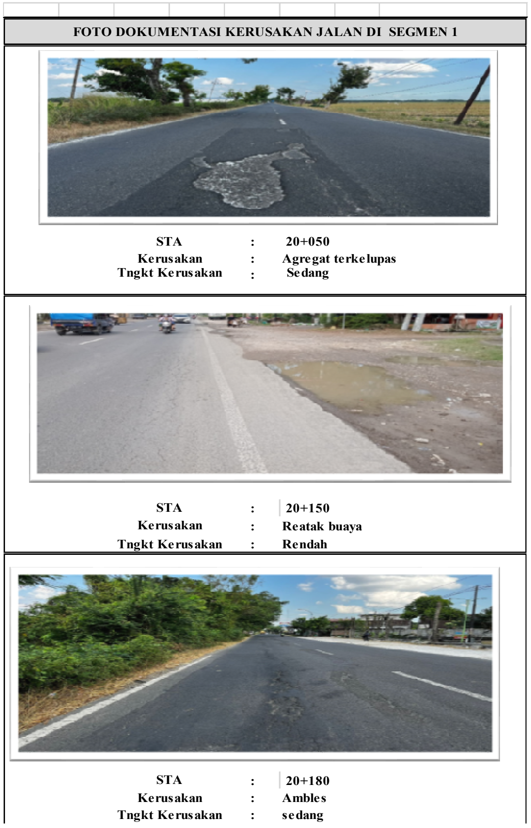
Giving code to each type of damage makes it easy to record in the survey form and the following are the results of road damage surveys on Segment 1 STA 20+000 - 20+ 200 and Segment 2 STA 20+200 - 20+400 in table 2 and for Segments 3 to 30 can be seen in the attachment table.

Table 2. Road Damage Survey Results

No	KM Lngan			Position			Damage Category*)	Average Size **)				Damage level
				Ki	Cl	Kn		P (m')	L (m')	D (m')	A (m^2)	
(1)	(2)			(3)			(4)	(5)	(6)	(7)	(8) = (5) x(6)	(11)
	SEGMENT 1											
1	20 + 050	-	20 + 056	-	-	√	120	6,00	4,00	0,03	24,00	Medium
2	20 + 150	-	20 + 154	-	-	√	117	3,80	1,80	-	6,84	Low
3	20 + 180	-	20 + 183	-	√	-	114	2,80	1,10	0,03	3,08	Medium
	SEGMENT 2											
4	20 + 220	-	20 + 223	-	-	√	117	2,50	1,60	-	4,00	Medium
5	20 + 290	-	20 + 295	-	-	√	120	4,50	2,00	0,05	9,00	Medium
6	20 + 315	-	20 + 317	-	-	√	114	1,80	1,80	0,03	3,24	Medium
7	20 + 370	-	20 + 373	√	-	-	117	3,30	2,00	-	6,60	Medium

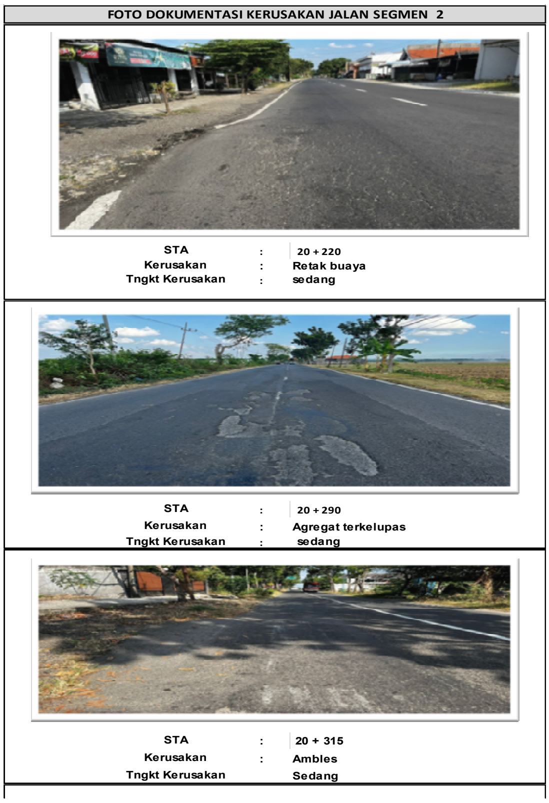
Source: Processed by Researchers, 2024

The table above explains that in segment 1 there are 3 types of road damage, namely Aggregate peeling at STA 20 + 050 with a length of 6 m, width 4 m into 4 cm of damage with moderate severity. Crocodile cracks at STA 20+150 with a length of 3.8 m, width 1.8 m and damage area of 6.84 m^2 with low severity and subsidence damage at STA 20+180 length 2.8 m, width 1.1 m, depth 3 cm and damage area 3, 08 m^2 with moderate severity In segment 2 there are 4 road damages, namely crocodile cracks at STA 20+220 length 2.5 m, width 1,6 m and an area of 4 m^2 with moderate severity, chipped aggregate at STA 20+290 with a length of 4.5 m, width of 2 m, depth of 4 cm and an area of 9 m2 with moderate severity, AMBLES at STA 20+315 length of 1.8 m width of 1.8, depth of 3 cm and an area of 3.24 m^2 with moderate severity and alligator cracks at STA 20+370 length of 3.3 m, width of 2m and an area of 6.6 m^2 with moderate severity. Photos of road damage in segment 1 and segment 2 can be seen in Figure 1 and Figure 2. which illustrates the location of the point where there is pavement damage.



Source: Processed by Researcher, 2024

Figure 1. Photo of Segment 1 Road Damage



Source: Processed by Researcher, 2024

Figure 2. Segment 2 Road Damage Details

From the results of recording the class of vehicles and the number of vehicles passing through the traffic enumeration form can be seen in the appendix table of traffic enumeration results, the peak traffic volume at certain hours can be seen in table 3.

Table 3. Peak Traffic Volume

Day	Hours	MC	LV	HV
1st Morning	07.00-08.00	1200	810	206
1st Afternoon	16.00-17.00	1100	723	175
2nd Morning	07.00-08.00	1100	797	208
2nd Afternoon	17.00-17.00	990	742	225
Number (Vehicle/Hour)		4390	3072	814
Total (smp/hr)		2195	3072	1058,2

Source: Processed by Researchers, 2024

The table above explains that on the first day the peak hour of traffic volume at 07.00 -08.00 WIB, for 2-wheeled or three-wheeled vehicles (MC) as many as 1200 vehicles / hour, for light vehicles (LV) as many as 810 vehicles / hour and for heavy vehicles as many as 206 vehicles / hour. For day 2 the peak traffic volume is also the same at 07.00 - 08.00 WIB.

3.3. Analysis of Road Damage Data by Bina Marga Method

The steps to be taken in analyzing the data in the Bina Marga method are as follows:

a. Calculating the amount of traffic flow (Qsmp) based on table 3 calculated by following formula is known:
   a) LV : Light Vehicle times value emp = 1
      LV = 3072 x 1 = 3072
   b) HV : Vehicle weight times emp value = 1,3
      HV = 814 x 1,3 = 1058,2
   c) MC : Motorcycle times emp value = 0,5
      MC = 4390 x 0,5 = 2195
   d) Qsmp = calculated by the formula 2.2 = 6325,5 smp/hours

b. Calculating LHR with formula 2.3 with a divisor of 0.11 because the research location is outside the city.
   a) Diketahui Qsmp = 6325,5 smp/jam
   b) LHR = 57504,6 smp/jam

c. Determine the Traffic Class based on table 4 LHR = 57504.6, based on table 4 if the LHR value> 50,000 then the road traffic class value is equal to 8.

d. Table the survey results and group the data according to the type of damage. In segment 1 at STA 20+00 - 20+200 and segment 2 at STA 20+200 - 20+400 can be seen in table 4 and for the next segment up to segment 30 can be seen in the table attachment.

e. Add up each number for all types of damage and assign a road condition score based on table 4. Segment 1 has the following types of pavement damage: aggregate chipping (120), alligator cracking (117) and subsidence (114), thus determining the number of damages by labeling them in Table 4..

Table 4. Total Deterioration Rate of Segment 1

NO	Type of Damage	Number of Damage Types	Damage Width Score	Extent of damage	Depth Numbers	Ambient Length Figure	Damage rate
1	120	3	-	-	-	-	3
2	117	5	3	1	-	-	5
3	114	-	-	-	-	2	2
	Total damage						10

Source: Processed by Researchers, 2024

In segment 2, there are 3 types of damage: alligator cracking (117), aggregate chipping (12) and subsidence (114), determining the number of damages.

Table 5. Total Deterioration Rate of Segment 2

No	Type of Damage	Number of Damage Types	Damage Width Score	Extent of Damage	Depth Numbers	Ambient Length Figure	Damage rate
1	114	-	-	-	-	2	2
2	117	5	3	1	-	-	5
3	120	3	-	-	-	-	3
Total damage							10

Source: Processed by Researcher, 2024

For segment 3 to segment 30, the way to give the damage number of the pavement is by labeling it by giving the damage number based on table 5. in the same way as above.

f. Determine the road condition value based on table 5. It is known that the total damage number of segment 1 is 10 then based on table 5 the road condition value is 4. It is known that the total damage number of segment 2 is 10 then based on table 5 the road condition value is 4.

g. Calculating the priority order to determine whether the handling goes into upgrading, periodic or routine handling. With formula 2.1.

   a) Priority order of segment 1
      Known road traffic class = 8
      Road consi value of segment 1 = 4
      Priority Order (UP) calculated by formula 2.1 = 5
      Based on table 5, the priority order value of 5 includes periodic handling.

   b) Priority order of segment 2
      Known road class = 8
      Road condition score of segment 1 = 4
      Priority order (UP) calculated by formula 2.1 = 5
      Based on table 5, the priority order value of 5 includes periodic handling.

The value of the priority order of segments 3 to 30 is calculated as above with the equation formula 2.1. from all the rare - rare Bina Marga methods from segment 1 to segment 30, the overall value of the segment can be seen in table 6.

Table 6. Bina Marga Method Research Results All Segments

Segment	Total Damage Rate	Road Condition Score	Priority Order Value	Handling Description
1	5	4	5	periodically
2	10	4	5	periodically
3	0	2	7	routine
4	2	4	5	periodically
5	5	4	5	periodically
6	5	3	6	periodically
7	1	2	7	routine
8	4	3	6	periodically
9	4	2	7	routine
10	1	2	7	routine
11	4	4	5	periodically
12	2	3	6	periodically
13	5	4	5	periodically
14	4	4	5	periodically
15	5	5	4	periodically
16	5	5	4	periodically
17	5	5	4	periodically
18	5	4	5	periodically
19	4	3	6	periodically
20	4	3	6	periodically
21	5	4	5	periodically
22	1	4	5	periodically
23	1	4	5	periodically
24	5	4	5	periodically
25	5	3	6	periodically
26	5	2	7	routine
27	5	3	6	periodically
28	1	4	5	periodically
29	5	3	6	periodically
30	1	4	5	periodically
Average			5,5	periodically

Source: Processed by Researchers, 2024

3.4. Calculating the Handling Cost of Bina Marga Method

Handling techniques are based on the East Java Bina Marga source that:

a. Routine handling using AC-WC hot asphalt by patching / taking the damaged asphalt to a depth of 5cm as wide as the damaged area is patched with new hot asphalt.

b. Periodic handling by coating / overlaying one layer with a thickness of 6 cm using AC-WC hot asphalt, roads that experience damage to subsidence depth> 5 cm are carried out structural repairs with a depth of 36 cm where 30 cm for CTB degree and 6 cm for ATB degree.

Table 7. Unit Price

NO	TYPE OF MATERIAL	UNIT	UNIT PRICE (RP)
1	Laston Surface layer (AC-WC)	Ton	1.835.773,00
2	Laston intermediate layer foundation leveler (ATB)	Ton	1.649.042,00
3	Cement Treated Base(CTB)	M^3	540.216,00
5	Adhesive layer	liter	22.953,00
6	Binder permeable layer	liter	23.585,00
7	Graded pavement excavation	M^3	39.544,00

Source: Bina Marga East Java, 2024

Based on table 7. the results of the Bina Marga method analysis of all segments state that there are two treatments carried out in road maintenance, namely periodic and routine handling, the treatment is detailed as follows:

a. Periodic handling

a) From table 7. which are handled by periodic methods are segment 1 (STA 20+000-20+200), segment 2 (STA 20+200-20+400), segment 4 (STA 20+600-20+800), segment 5 (STA 20+800-21+000), segment 7 (STA 21+200-21+400), segment 8 (STA 21+400-21+600), segment 11 (STA 22+000-22+200), segment 12 (STA 22+200-22+400), segment 13 (STA 22+400-22+600), segment 14 (STA 22+600-22+800), segment 15 (STA 22+800-23+000), segment 16 (STA 23+000-23+200), segment 17 (STA 23+200-23+400), segment 18 (STA 23+400-23+600), segment 19 (STA 23+600- 23+800), segment 20 (STA 23+800-24+000), segment 21 (STA 24+000-24+200), segment 22 (STA 24+200-24+400), segment 23 (STA 24+400-24+600), segment 24 (STA 24+600-24+800), segment 25 (24+800-25+000), segment 27 (STA 25+200-25+400), segment 28 (25+400-25+600), segment 29 (STA 25+600-25+800) and segment 30 (STA 25+800-26+000) the total length is 5000 m, the width of the road is 7 m the area of the road handled is the length of the road x the width of the road.

Area = 5,000 x 7 = 35,000 m^2
Handling volume = area x aspaL thickness x asphalt specific gravity
Volume = 35,000 x 0.06 x 2.246 = 4716.6 tons.

b) Repair of structures that subsided > 5cm based on survey results in segment 4 with an area of 19.62 m^2, segment 5 with an area of 3.6 m^2, segment 7 with an area of 58 m^2, segment 11 with an area of 35.6 m^2 and segment 14 with an area of 7.5 m^2. The total area of subsidence damage amounted to 124.32 m^2. Pavement excavation volume is area x excavation depth.

Volume galian = 124,32 x 0,36 = 44,76 m^3.
Volume CTB = 124,32 x 0,30 x 2,16 = 80,55 m^3.
Volume ATB = 124,32 x 0,06 x 2,246 = 16,75 tonnes

b. Routine handling

From table 8. which are handled routinely are segment 3 (STA 20+400-20+600), segment 6 (STA 21+000-21+200), segment 9 (STA 21+600-21+800), segment 10 (STA 21+800-22+000) and segment 26 (STA 25+000-25+200) with a total damage area of 285 m^2 and a large volume of volume, Volume = road damage area x asphalt thickness = 285 x 0.05 x 2.246 = 32.01 tons.

The results of calculating the cost of handling periodic maintenance and routine maintenance of the Bina Marga method.

Table 8. Total handling cost

no	Item type	Unit	Volume	Unit price (RP)	Price (RP)
1	2	3	4	5	6=4x5
	Periodic handling				
1	AC-WC t= 6 cm	Ton	4.716,60	1.835.773,00	8.658.606.931,80
2	Adhesive layer	liter	29.808,91	22.953,00	684.203.957,14
3	Cement Treated Bas (CTB) t= 30 cm	M3	80,55	540.216,00	43.514.398,80
4	ATB	Ton	16,75	1.649.042,00	27.621.453,50
5	Pavement excavation	M3	44,76	39.544,00	1.769.799,63
6	Binder permeable layer	liter	22,91	23.585,00	540.379,52
	Routine Handling				
7	AC-WC	Ton	32,01	1.835.773,00	58.763.093,73
8	Adhesive layer	liter	202,30	22.953,00	4.643.465,35
total cost					9.479.663.479,46

Source: Processed by researchers, 2024

Table 8 explains that the cost of handling the bina marga method is periodic maintenance handling of Rp. 9,416,256,920.38 and the cost of handling routine maintenance of Rp. 63,406,559.08. The total cost of overall maintenance handling amounted to Rp. 9,479,663,479.46.

4. Conclusion

Based on the analysis that has been done, several conclusions can be drawn from this research. First, the priority order value of the road surface based on the Bina Marga method is 5.5. Second, the Bina Marga method handling with a road surface priority order value of 5.5 is included in the periodic handling category. Third, the cost of handling road maintenance using the Bina Marga method, which includes periodic maintenance and routine maintenance, is Rp. 9,479,663.46. Based on the analysis results of the research obtained, for better results, several suggestions can be proposed. First, further research needs to be done on the comparison with the Geographic Information System (GIS) method. Second, further research is needed on rigid pavement.

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