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ROUTINE MAINTENANCE PLANNING CONSULTANCY FOR PANGKAH KULON - BOOLO ROAD, LOCATION: UJUNGPANGKAH DISTRICT, GRESIK REGENCY

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Abstract
Road infrastructure is the lifeblood of a region's economy because it connects and increases the movement of people and goods. Traffic jams in the city of Gresik fall into the severe category. This is evidenced by the long queues of vehicles and the time it takes to decompose traffic jams for hours. The Gresik Regency Government, through the Highways Public Works and Water Resources Office, needs to carry out systematic and appropriate planning to overcome the above problems. Maintenance is carried out by preparation, topographic survey, traffic survey, and then the calculation of the pavement plan. From the analysis results obtained CBR subgrade = 3%; DDT = 4; IP = 2.5; FR = 1.0; LER = 2.18; ITP = 9.5; Ipo = 3.9 – 3.5. After the calculations, we obtained a 10 cm asphalt surface layer (4 cm ACWC, 6 cm ACBC) and 20 cm CTB fill for leveling.

Keywords: Maintenance, Roads, Asphalt, Flexible Pavement

1. INTRODUCTION

Highways are major roads that connect one area to another that is used for both motorized and non-motorized vehicles (Hadi et al., 2021). Road infrastructure is the lifeblood of a region's economy because it connects and increases the movement of people and goods (Junaidi, 2016). Roads are a vital transportation infrastructure that connects one area to another. With adequate road conditions, it can spur economic growth in the areas it passes, especially in the Gresik Regency area.

Transportation has a very important role in areas, be it rural or semi-urban, or urban areas in developing countries because it provides access for people to meet their daily needs for goods and services and improves socio-economic life (Silondae et al., 2016).

The existence of transportation as a supporter of community movement will positively impact a region's increasing growth and progress. However, it should be realized that the current transportation development has both positive and negative impacts, such as congestion, chaos, and traffic accidents. This negative impact causes by increased population growth, which impacted the increasing demand for transportation facilities and infrastructure. Congestion is caused by an imbalance between road needs and population density (Ismawanda & Muzayanah, 2018).

Traffic jams in the city of Gresik fall into the severe category. This is evidenced by the long queues of vehicles and the time it takes to decompose traffic jams for hours. Congestion in Gresik usually occurs due to the small road conditions. Still, it is traversed by large industrial vehicles so that if a vehicle strike occurs, it will cause congestion. In addition, the condition of road traffic in Gresik City, where heavy vehicles pass a lot, causes road conditions to be damaged more quickly, which can result in queues.

The road network in an area is very dependent on topography, the shape of an area and the coverage of its service area, and several other factors forming the road network pattern. The function of the road network at this time is not only to move passengers and goods but also to have a strategic role. And others. The function of the road is to connect one area to another. Roads are the most important infrastructure in the national and regional economy (Silondae et al., 2016).

Based on this, it is important for the Government of Gresik Regency further to optimize road development, improvement, and maintenance activities. The Gresik Regency Government, through the Highways Public Works and Water Resources Office, needs to carry out systematic and appropriate planning to overcome the above problems. Hence, the researchers analyze Routine Maintenance Plans for Jalan Pangkah Kulon - Bolo, the Ujungpangkah District, Gresik Regency, to support and expedite the flow of traffic and infrastructure through this route in line with economic developments in the areas concerned. This study was aimed to analyze the Planning for Routine Maintenance of Jalan Pangkah Kulon - Bolo, located in Ujungpangkah District, Gresik Regency.

2. LITERATURE REVIEW

2.1. Traffic

Traffic lanes (traveled way or carriageway) are all parts of the road pavement intended for vehicle traffic (Sukirman, 1994; Catro, 2014). The traffic lane consists of several lanes of vehicles. Vehicle lanes are part of a traffic lane intended to be passed by a series of four or more wheeled vehicles in one direction. So, the minimum number of lanes for a 2-way road is 2 and is generally referred to as a 2-lane 2-way road. The traffic lane for one direction consists of at least one traffic lane.

2.2 Width of The Traffic Lanes

The width of traffic lanes is the part that most determines the cross-sectional width of the road. The width of passenger vehicles generally varies between 1.5 m – 1.75 m. Bina Marga takes the planned vehicle width for passenger cars to be 1.7 m and 2.50 m for truck/bus/semi-trailer vehicle plans. According to Krisna (2019), the Freeway has a minimum road width of 3.5 meters; Highways have a minimum road width of 3.5 meters; Medium Roads have a minimum road width of 7 meters, and Small roads have a minimum road width of 5.5 meters. The width of the traffic lanes can only be determined by direct observation in the field because 1) one vehicle can't follow a vehicle's path exactly, 2) a traffic lane can't be the same as the maximum vehicle width. For safety and comfort, every driver needs space between the vehicle, and 3) It is impossible to keep the vehicle track parallel to the traffic lane axis because the vehicle will experience side forces such as surface unevenness, centrifugal force at bends, and wind forces while moving. Who prepares.

2.3. Number of The Traffic Lanes

The number of lanes required depends on the volume of traffic that will use the road and the level of road service expected. The transverse slope of the traffic lane on a straight road is primarily intended for road drainage needs. Water that falls on the road surface quickly flows into the sewers. The cross slope varies between 2% - 4% for this type of surface coating using a binder such as an asphalt or cement. The more impermeable the layer is, the smaller the cross slope that can be used.

2.4. Planned

Planned vehicles are vehicles whose dimensions and turning radius are used as a reference in geometric planning (Safitri & Sari, 2014). Judging from the shape, size, and power of the vehicles that use the road, these vehicles can be grouped into several groups. Generally, it can be grouped into passenger cars, buses/trucks, semi-trailers, and trailers. For planning, each group is represented by a standard size and is referred to as the design vehicle. The size of the planned vehicles for each group is the largest size representing the group. To assess each vehicle in the passenger car unit (CPU), the following coefficients are used for roads in flat areas:

Motorcycle	: 0.5
Passenger car	: 1.0
Light truck / microbus < 5 tons	: 2.0
Medium trucks > 5 tons	: 2.
Buses	: 3.0
Heavy trucks > 10 tons	: 3.0

2.5. Road Service Level

The required width and number of lanes cannot be properly planned even though the VJP/LHR has been determined. This is because the level of comfort and safety the road plan provides has yet to be determined. The required lane width will be wider if the expected service from the road is higher. The freedom of movement felt by the driver will be better on roads with adequate side freedom, but this demands a wider road use area as well.

2.6. Level of Road Service

Level Road service level is a measure used to determine the quality of a particular road section in serving the flow of traffic that passes through it (Mintorogo & Kadarini, 2016). Level of Service (LOS) describes the operational conditions of traffic flow and drivers' perceptions of speed, travel time, comfort, freedom of movement, security, and safety. The Highway Capacity Manual divides the level of road comfort/service into six conditions as follows:

1) Service level A with the following characteristics:
    a. Free traffic flow without obstacles
    b. Low traffic volume and density
    c. Vehicle speed is the driver's choice
2) Service level B
    a. Stable traffic flow
    b. Starting speed is affected by traffic conditions but can still be selected according to the driver's wishes

3) Service level C
    a. traffic flow is still stable
    b. Travel speed and freedom of movement are affected by the traffic volume, so the driver can no longer choose the speed he wants.
4) Level of service D
    a. The traffic flow has started to become unstable
    b. Changes in traffic volume greatly affect the magnitude of the travel speed.
5) Level Service E
    a. Traffic flow is unstable
    b. The volume is approximately the same as the capacity
    c. Traffic jams often occur
6) Level of service F
    a. Traffic flow stuck at low speed
    b. Traffic jams often occur
    c. Low traffic.

The value limits of each level of road service are influenced by the function of the road and where the road is located. Toll roads outside the city are, of course, desirable to serve vehicles at high speeds and provide free space for movement during the design life of the road. Secondary collector roads inside the city can be planned for service level E at the end of the design life, with faster speeds lower than intercity roads.

2.7. Improvement of Old Roads

Improvement of old roads is carried out to improve or increase the quality and quantity of roads for community use. This is so that the road is in good condition and can accommodate more vehicles. The objectives of designing an old road improvement can be:

a. The old road pavement structure has exceeded its service life (design life), which requires new reconstruction.
b. The old road pavement structure has exceeded its service life (planned life) but is still in a condition that only requires rehabilitation in a few places.
c. Old roads with changes in traffic characteristics so that the existing structure cannot carry the traffic load.
d. Occurrence of pavement structures due to natural conditions, natural disasters, or other causes.
e. Road capacity is no longer able to accommodate traffic flow.

2.8. Flexible Pavement Planning (Asphalt)

The flexible pavement structure consists of layers consisting of sub-base course – base course – surface course overlaid on the sub-grade. The subgrade jointly bears the traffic load. The thickness of the pavement structure is made in such a way as to limit the ability of the subgrade to carry the traffic load, or it can be said that the thickness of the pavement structure is very dependent on the condition or bearing capacity of the base.

3. RESEARCH METHOD

In the research, several stages were carried out to carry out Routine Maintenance Planning for Pangkah Kulon-Bolo Road, Ujung Pangkah District, Gresik Regency. The following are the stages of work carried out:

3.1. Preparation Stage

The consultant will carry out the preparatory work from the issuance of the Work Commencement Order (SPMK) by the Service User. The entire series of preparatory activities will be carried out by the Consultant in coordination with the service user to achieve an emphasis on the concept of carrying out the work in accordance with the scope of activities and their aims and objectives. Some of the activities that the Consultant will carry out in the preparatory stage include:

1) Preparation for personnel mobilization and work team coordination.
   Includes the following activities:
   a. Work organization arrangement.
   b. Preparation of plans and division of labor.
   c. Inventory of the necessary supporting facilities.
2) Preparation of a work plan
   Includes the following activities:
   a. Formulation of details of activities and schedule of activities.
   b. Formulation of the schedule for the assignment of experts and their respective responsibilities.
   c. Formulation of the concept of work output.
3) Review of previous technical planning
4) Identification of potentials and problems
5) Inventory of Supporting Data
6) Preparation of Preliminary Report

3.2. Data Identification Stage

3.2.1. Preliminary Survey

The preliminary survey is intended to visually collect data in the field to support proposals for handling road construction improvements based on technical and economic considerations. The scope of the preliminary road survey includes a survey to determine the following:

a. Whether or not the road section is widened.
b. Whether or not backfill is necessary for pavement elevation.
c. Are the dimensions of the edge channel sufficient.

3.2.2. Topographic Survey

It is a measurement that aims to transfer the condition of the earth's surface from the location measured on paper in a planimetric map. This map will be used as a base map for geometric planning and plotting roads. Things to pay attention to:

a. Placement of points of intersection and points of extension of straight lines.
b. Positioning of axis lines, which includes placement of straight lines and locations of bends.

c. Topographical measurement.
d. Flat profile and cross-section of the measurement drawings.

The topographic survey also intends to collect coordinates and ground-level data along the road plan within the specified corridor to prepare topographic maps with a scale of 1:1,000 (used for geometric road planning) and 1:500 scale (used for road planning and avalanche management). The scope of topographic measurement activities includes:

a. Stake installation
b. Horizontal Control Point Measurement
c. Vertical Control Point Measurement
d. Situation Measurement
e. Measurement of Cross Section

3.2.3. Traffic Survey

Survey activities are intended to:

a. Inventory of existing road conditions.
b. Average vehicle speed.
c. Inventory of each type of vehicle that passes through certain road sections in a unit of time so that the Average Daily Traffic (LHR) can be calculated as the basis for road planning.

Scope of traffic survey activities is as follows:

1) Vehicle volume survey, carried out at 3 location points: a) Road sections, b) Crossroads, c) Four-way intersections. All types of vehicles passing from the front/rear must be recorded. Recording is done on each line and by at least 2 people (1 person, 1 counter). The recording is done in the survey format that has been provided.
2) The calculation period is carried out within 12 hours (starting at 06.00 - 18.00 on the same day that has been determined to implement the calculation).
3) Grouping of vehicles (RTC-Manual)

In calculating the amount of traffic, vehicles are divided into 8 groups (motorized/non-motorized vehicles), including the following division:

Table 1 Types of Vehicles

Types of	Vehicles
1	Motorcycles, scooters, mopeds, and 3-wheeled motorized vehicles
2	Sedans, jeeps, and station wagons
3	Opelets, pick-ups, suburban, combi, minibusses
4	Pick-ups, Micro Trucks, Delivery Cars (pick-up box)
5	a. small bus b. Big bus
6	Truck 2 axis
7	a. 3 axle truck b. articulated truck c. Semi-trailer trucks
8	Motorized vehicles: bicycles, rickshaws, horse carts, carts

(Source: Researcher Data)

4. RESULT AND DISCUSSION

4.1 Calculation of Asphalt Pavement Construction

Table 2 CBR Subgrade Research Results

Subgrade	Watch readings		Load (lb)	
	Top	Bottom	Top	Bottom
0.01250	28	35	23	29
0.025	45	55	37	45
0.05	71	110	58	91
0.075	94	170	78	141
0.10	130	210	107	107
0.15	160	265	132	219
0.20	205	310	170	257
0.30	232	330	192	273
0.40	238	334	197	277
0.50	244	337	202	279

(Source: Researcher Data)

Table 3 Price of CBR

	Price CBR %	
	0.1"	0.2"
UP	107/3000 x 100 = 3.57	170/4500 x 100 = 3.78
DOWN	174/3000 x 100 = 5.80	257/4500 x 100 = 5.71

(Source: Researcher Data)

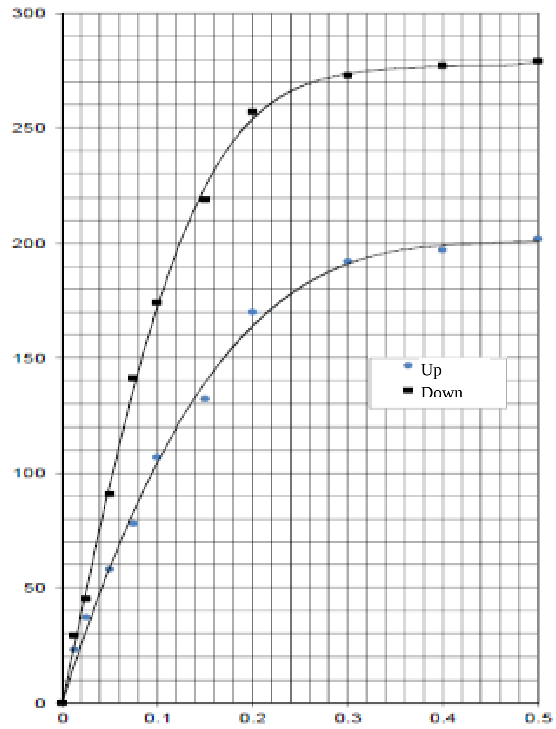

Figure 1 Graph of The Subgrade CBR Value
(Source: Researcher Data)

4.2. Traffic Data 2020

Light vehicles 2 ton (1 + 1)	= 282 Vehicles
Small truck 6 ton (2 + 4)	= 18 Vehicles +
Total	= 299 Vehicles

The Development of traffic per year is predicted to be = 5%

Pavement Material:

Asphalt a1	= 0,4
Class A Aggregate (CBR 100) a2	= 0,14
Class B Aggregate (CBR 50) a3	= 0,12
CTB a2	= 0,16

LHR 2040 end planned year $(1+i)^n$
Light Vehicles 2 ton (1 + 1) = 747 Vehicles
Small Vehicles 6 ton (2 + 4) = 47 Vehicles
Equivalence Value (E) of each vehicle
Light Vehicles 2 ton (1 + 1) = 0,0002 + 0,0002 = 0,0004
Small Truck 6 ton (2 + 4) = 0,0036 + 0,0577 = 0,0613
Big Truck 2 axis 13 ton (5 + 8) = 0,1410 + 0,9238 = 1,0648

First Equivalent Cross (LEP)
(2020) C x LHR x E
Light Vehicles 2 ton (1 + 1) = 0,50 x 282 x 0,0004 = 0,06
Small Truck 6 ton (2 + 4) = 0,50 x 18 x 0,0613 = 0,54 +
Total = 0,60

Final Equivalent Cross (LEA) 20th year
(2040) C x LHR x E
Light Vehicles 2 ton (1 + 1) = 0,50 x 747 x 0,0004 = 0,15
Small Truck 6 ton (2 + 4) = 0,50 x 47 x 0,0613 = 1,43 +
Total = 1,58

Middle Equivalent Cross (LET)
LET = 0,5 (LEP + LEA20) = 0,50 x (0,60 + 1,58) = 1,09

Cross Equivalent Plan (LER)
LER = LET x UR/10 = 1,09 x 20/10 = 2,18

Table 4 Surface Index at the beginning of UR (Ipo)

Pavement types	Ipo	Roughness *)-mm/km
Laston	≥ 4.00	≤ 1000
	3.9 – 3.5	> 1000
Lasbutang	3.9 – 3.5	≤ 2000
	3.4 – 3.0	> 2000
HRA	3.9 – 3.5	≤ 2000
	3.4 – 3.0	> 2000
Burda	3.9 – 3.5	< 2000
Burtu	3.4 – 3.0	< 2000

Pavement types	**Ipo**	**Roughness *)-mm/km**
Lapen	3.4 – 3.0	≤ 3000
	2.9 – 3.5	> 3000
Latasbum	2.9 – 2.5	
Buras	2.9 – 2.5	
Latate	2.9 – 2.5	
Dirt road	≤ 2.4	
Gravel road	≤ 2.4	

(Source: Researcher Data)

Table 5 Regional Factors

Rainfall	**Grade I (<6%)**		**Grade II (6-10%)**		**Grade III (>10%)**	
	% Heavy Vehicles		**% Heavy Vehicles**		**% Heavy Vehicles**	
	≤ 30%	**>30%**	**≤ 30%**	**>30%**	**≤ 30%**	**>30%**
Climate I < 900 mm/year	0.5	1.0 – 1.5	1.0	1.5 – 2.0	1.5	2.0 – 2.5
Climate II ≥ 900 mm/year	1 .5	2.0 – 2.5	2.0	2.5 – 3.0	2.5	3.0 - 3.5

(Source: Researcher Data)

Table 6 Minimum of Limit

Itp	**Thickness Min Thickness (Cm)**	**Material**
< 3.00	5	Laps. Protector, BURAS, BURTU / BURDA
3.00 – 6.70	5	LAPEN/asphalt macadam, HRA, Asbuton, LASTON
6.71 – 7.49	7.5	LAPEN/ asphalt macadam, HRA, Asbuton, LASTON
7.50 – 9.99	7, 5	Asbuton, LASTON
≥ 10.00	10	LASTON

(Source: Researcher Data)

Table 7 Minimum of The Thickness

ITP	Min thickness (cm)	Material
< 3.00	15	Crushed stone, Stab. Hold with cement, Stab. Soil with lime Crushed
3.00 – 7.49	20	stone, Stab. Hold with cement, Stab. Soil with lime
	10	LASTON THE Crushed
7.50 – 9.99	20*)	stone, Stab. Hold with cement, Stab. Soil with lime, Macadam foundation
	15	LASTON THE Crushed
10.00 – 12.24	20	stone, Stab. Hold with cement, Stab. Soil with lime, Macadam foundation, LAPEN, THE LASTON Crushed
≥ 12.15	25	stone, Stab. Hold with cement, Stab. Soil with lime, Macadam foundation, LAPEN, LASTON OVER

(Source: Researcher Data)

Table 8 Relative Strength Coefficient

Relative Strength Coefficient			Material Strength			Type of Material
a1	a2	a3	MS (kg)	Kt (kg/cm)	CBR (%)	
0.42	-	-	800	-	-	Laston
0.40	-	-	744	-	-	
0.35	-	-	590	-	-	
0.32	-	-	454	-	-	
0.30	-	-	340	-	-	
0.35	-	-	744	-	-	Asbuton
0.31	-	-	590	-	-	Lasbutag
0.28	-	-	454	-	-	
0.26	-	-	340	-	-	

Relative Strength Coefficient			Material Strength			Type of Material
a1	**a2**	**a3**	**MS (kg)**	**Kt (kg/cm)**	**CBR (%)**	
0.30	-	-	340	-	-	HRA
0.26	-	-	340	-	-	Asphalt Macadam
0.25	-	-	-	-	-	Lapen (mechanical)
0.20	-	-	-	-	-	Lapen (manual)
-	0.28	-	590	-	-	
-	0.26	-	454	-	-	Upper Laston
-	0.24	-	340	-	-	
-	0.23	-	-	-	-	Lapen (mechanical)
-	0.19	-	-	-	-	Lapen (manual)
-	0.15	-	-	22	-	Stab. soil with cement
-	0.13	-	-	18	-	
-	0.15	-	-	22	-	Stab. soil with lime
-	0.13	-	-	18	-	
-	0.14	-	-	-	100	Crushed stone (class A)
-	0.13	-	-	-	80	Crushed stone (class B)
-	0.12	-	-	-	60	Crushed stone (class C)
-	-	0.13	-	-	70	Grain / pitrun (class A)
-	-	0.12	-	-	50	Granite / pitrun (class B)
-	-	0.11	-	-	30	Granite / pitrun (class C)
-	-	0.10	-	-	20	Soil / sandy loam

(Source: Researcher Data)

ITP
CBR subgrade = 3%; DDT = 4; IP = 2.5; FR = 1.0
LER = 2.18; ITP = 9.5; Ipo = 3.9 – 3.5

Pavement thickness
ITP = a1.D1 + a2.D2 + a3.D3

6,5	=	0,4	d1	+	0,16	d2	+	0,4	d3
6,5	=	0,4	d1	+	0,16	20	+	0,4	0
6,5	=	0,4	d1	+	3,20				
0,4d1	=	6,5	d1	3,20					
0,4d1	=	3,30							
d1	=	8,25	cm						

10 cm thick asphalt (AC BC = 6 cm, AC WC = 4 cm
New fill CTB leveling 20 cm

Table 9 Layering

Asphalt surface layer	D1	10 cm	4 cm 6 cm
New fill CTB levelling	D2	20 cm	
The layer of eksisting asphal	D3	0.0 cm	

(Source: Researcher Data)

5. CONCLUSION

From the calculation results of asphalt pavement construction, the following is needed: Ac Wc 4 cm and Ac Bc 6 cm, with a CTB thickness of 20 cm for reconstructing the type of road that has collapsed. In addition, asphalt pavements that have fine cracks or crocodile skin cracks and bitumen peeling off need to be re-coated with 4 cm thick ACWC asphalt, while asphalt pavement that has holes it will be covered with 6 cm ACBC asphalt, and for asphalt pavements that have collapsed reconstruction is required with Excavation of existing pavement as needed and given 20 cm thick CTB and 10 cm asphalt layer on top.

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