Analysis of Pavement Thickness Planning and Overlaying Method on Trans Sumatera Toll Road, Pekanbaru – Dumai

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Abstract

The construction of Trans Sumatera Toll Road aims to facilitate transportation and industrial sector development along the Sumatera region. This research aimed to uncover the pavement thickness of Trans Sumatera Toll Road on Pekanbaru-Dumai section, obtain the asphalt thickness for each asphalt overlay method, compare the AC-WC in terms of thickness results and heavy equipment productivity, and determine the more effective method of AC-WC overlay. This research used the field survey to gather primary data on the field and also collect secondary data from several institutions. The road pavement was analyzed using the MDPJ 2017. Meanwhile, the heavvy equipment productivity was analyzed using direct single overlay and double overlay methods. The heavy equipment specifications and productivity calculations were measured using AHSP 2017. The analysis results showed that the flexible pavement thickness on the Trans Sumatera Toll Road Section Pekanbaru-Dumai were: 300 mm LPA, 105 mm AC-Base, 60 mm AC-BC, and 40 mm AC-WC. The AC-WC thickness with direct single overlay method was 98.7% and it needed 6 hours of Asphalt Finisher work. Meanwhile, the AC-WC thickness with double overlay was 99.2% and it needed 18 hours of Asphalt Finisher. In terms of AC-WC overlay productivity, the direct single overlay method was more effective. However, in terms of thickness, the double overlay method was more effective.

Keywords: Road Pavement; AC-WC Thickness; Trans Sumatera Toll Road; Overlaying; Heavy Equipment Productivity

1. Introduction

Toll roads are public roads that are part of the road network system and as national roads whose users are obliged to pay a certain toll fee (BPJT 2005). The development oftransport road network in achieving national development, economic development, and growth and brings notable social benefit (Fani et al. 2020). Toll roads are built with the aims of accelerating the realization of road networks in which part or all of its funding are from the road users for the sake of easing government's burden, smoothen traffic in developed areas, improve equitable distribution of development results and justice, and ease government fund burden through road participation (Irfan, Rasyid, and Handayani 2018). Toll road services target the smoothness, safety and comfort of its service users (Hadiwardoyo, Sumabrata, and Berawi 2012). In order to achieve such target, there are operational benchmarks defined in the form of service time at the substation, toll road travel time, level of smoothness, level of facilities, level of customer complaints and standards of road level (Ruiz and Guevara 2020).

According to PT Hutama Karya, the construction of Pekanbaru-Dumai Toll Road is a part of the Trans-Sumatera road that connects Pekanbaru and Dumai in Riau province. This toll road has 6 sections: Section I Pekanbaru-Minas, Section II Minas-South Kandis, Section III South Kandis-North Kandis, Section IV North Kandis-South Duri, Section V South Duri-North Duri, and Section VI North Duri-Dumai. The Pekanbaru-Dumai Toll Road aims to smoothen the transportation route in Sumatera; streamline the Pekanbaru-Dumai travel time which initially took 4 hours, now it can be done in 2 hours. The maximum speed limit in that toll road is set at 100 km/hour. The Pekanbaru-Dumai Toll Road uses the flexible pavement. At the initial stage, there will be 2x2 road section, and at the final stage, there will be 2x3 road section.

In practice, the flexible pavement in the Pekanbaru-Dumai Toll Road Construction Project utilized 2 asphalt overlaying methods, namely the direct single asphalt finisher with 9.2 meters of width and double direct asphalt finisher with 5.1 meters and 4.1 meters of width. The overlayed asphalt was then solidified using heavy equipments. The heavy equipment productivity was also a major influence on the results and speed of the work.

(Andalalin Report on The Trans Sumatera Toll Road Construction Project., 2018)

2. Research Methodology

This research utilized surveys and direct field observation to gather input data and then calculated those data to obbtain the desired performance results (Bina Marga 2019). The survey was conducted by means of manual techniques in field observation and data collection (Direktur Jenderal Bina Marga 2017). The survey results were processed both inside and outside the laboratory. The observation was conducted directly, while the data collection was carried out by means of field survey and at the Trans Sumatera Toll Road Section Pekanbaru-Dumai 4A Construction Project (Jasa Marga 2019). The research data consisted of primary and secondary data. The primary data were collected through direct field observation by gathering the field pavement data (Isradi, Subhan, and Prasetijo 2020). This phase of data collection was carried out by the quality control team of PT Hutama Karya Infrastruktur by inserting core drill equipment into the test object to determine the density of field asphalt. Meanawhile, secondary data were the data supporting existing primary data taken from a related institution, namely maps of research locations, daily traffic data and road network images (Isradi, Arifin, and Sudrajat 2020). Road features include roads and road characteristics such as length of tangent, length of curve, shoulder width, lane width, and access point (Prasetijo et al. 2018)

The road pavement planning used in this research wass from the *Manual Desain Perkerasan Jalan 2017* (Direktur Jenderal Bina Marga 2017), Bina Marga General Directorate, Ministry of Public Works and Public Housing of The Republic of Indonesia. There were 2 overlay methods ussed by the HKaston at the Trans Sumatera Toll Road, Pekanbaru Dumai Section 4A, namely the direct single asphalt finisher with 9.2 meters of width and double direct asphalt finisher with 5.1 meters and 4.1 meters of width. The asphalt temperature was measured first using thermometer before doing the overlay. If the temperature has reached the standard, the overlay would then be carried out. After the overlay, the step was followed by initial pavement using Tandem Roller, secondary pavement using Pneumatic tire roller, and the final pavement using Tandem Roller (Isradi et al. 2021). The asphalt was then let still up to 12 hours before carrying out the coredrill test to determine the field density. Figure 1 below shows the research location:

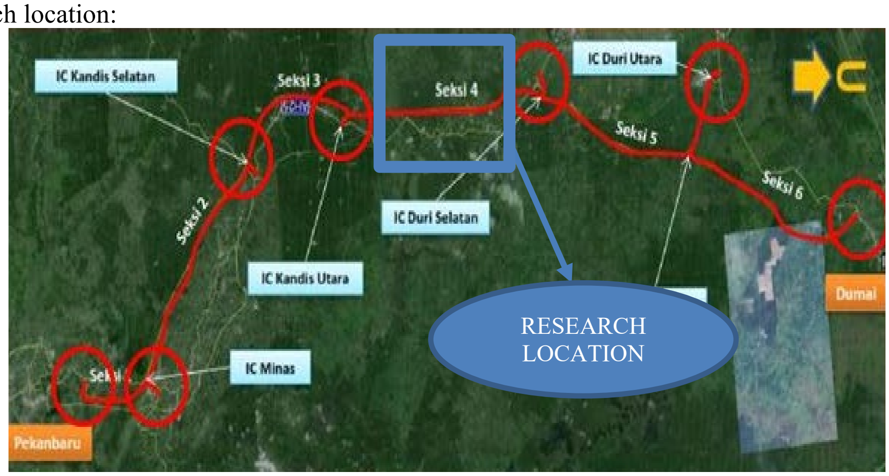

Figure 1. Research location map
(PT Hutama Karya Infrastruktur's Trans Sumatera Toll Road, Pekanbaru-Dumai Section 4A Construction Project)

3. Results and Analysis

3.1 Pavement Thickness Planning

The pavement planning thickness at the Trans Sumatera Toll Road, Pekanbaru-Dumai used the flexible pavement. The pavement planning thickness also utilized the Road Pavement Design Manual 2017. The pavement of pavement used in the Trans Sumatra Toll Road Construction Project for the Pekanbaru - Dumai Section was flexible pavement.

3.1.1 Determining The Lifespan of The Plan

The lifespan of the plan was determined based on the pavement type and pavement elements to be planned (Isradi et al. 2020). Based on Table 1, the lifespan of the plan will be 20 years. Therefore, there will only be routine road maintenance, instead of new road construction in the next 20 years.

Table 1. Lifespan of New Road Pavement Plan (UR)

Pavement Types	Pavement Elements	Plan Lifespan (years)[1]
Flexible Pavement	Asphalt layer and grained layer[2]	20
	Road foundation	40
	All pavements for areas where it is not possible to get an overlay, such as: city roads, underpasses, bridges, tunnels	
	Cement Treated Base (CTB)	
Stiff pavement	Upper foundation layer, lower foundation layer, cement concrete layer, and road foundation	
Road without cover	All elements (including road foundation	Minimum 10

Note:

1. If it is considered difficult to use the above lifespan plan, a different lifespan plan can be used. However, the lifespan plan must be analyzed using a discounted lifecycle cost first in order to show that the chosen lifespan plan can provide the lowest discounted lifecycle cost. Interest value is taken from the average interest rate of Bank Indonesia which can be obtained from http://www.bi.go.id/web/en/Moneter/BI/+Rate/Data+BI+Rate/.
2. The lifespan plan must take into account the road capacity.

Source: (Road Pavement Design Manual of Directorate General of Bina Marga, 2017)

3.1.2 Calculating The ESA Value

Based on the 2017 Pavement Design Manual, the pavement type would vary based on traffic estimates, design lifespan, and road foundation conditions. Table 2 below shows the traffic data in Sumatera region, while Table 3 illustrates the traffic growth in Sumatera.

Table 2. Traffic Data of 2020

No	Vehicle Classification	LHR 2020
1	Category I (Sedan, Jeep, SW)	3952
2	Category I (Pick Up Truck, Small Box Vehicle)	967
3	Category I (Medium-sized Public Transportation, ¾-sized Bus)	228
4	Category I (Big Bus)	192
5	Category II (2-axle Small Truck)	291
6	Category II (2-axle Medium Truck)	1186
7	Category III (3-axle Truck (Including CPO Truck))	1979

8	Category IV (4-axle Truck)	209
9	Category V (5-axle Truck)	1

Source : (Andalalin Report on Trans Sumatera Toll Road Construction., 2018)

Table 3. Traffic Growth Factors

	Java	Sumatera	Kalimantan	Average in Indonesia
Arterial and urban	4.80	4.83	5.14	4.75
Rural collector	3.50	3.50	3.50	3.50
Village road	1.00	1.00	1.00	1.00

Source: (Road Pavement Design Manual of Directorate General of Bina Marga, 2017)

The traffic growth during the plan lifespan is calculated by the cumulative growth factor:
Traffic Growth Multiplier Factors

$$R = \frac{(1 + 0.01\, i)^{UR} - 1}{0.01i}$$

$$R = \frac{(1 + 0.01(4.83\%))^{20} - 1}{0.01(4.83\%)}$$

$$R = 20.09\ \%$$

According to the plan, there will be 2 lanes and 2 tracks. Thus, based on the Road Pavement Design Manual Number 04/SE/Db/2017 for the 2 tracks road, the value of the directional distribution factor (DD) is taken as 50%. In addition, based on Table 4, the directional distribution value of the lanes (DL) will be 80% for two lanes of each track.

Table 4. Lane Distributional Factors

Number of Lanes in Each Track	commercial vehicles on the design track (% to the commercial vehicle population)
1	100
2	80
3	60
4	50

Source: (Road Pavement Design Manual of Directorate General of Bina Marga, 2017)

In pavement design, traffic loads were converted to standard loads (ESA) using the Vehicle Damage Factor. Table 5 shows the VDF value of each type of vehicle for the Sumatra region. In addition, Table 6 shows an example of ESA Value calculation for the Sumatra region in 2020. In accordance with the classification of vehicles on toll road, then the VDF value for each group in the pavement planning of the Pekanbaru – Dumai Section 4 Toll Road can be calculated using the following formula:

$$ESA_4 = \left(\frac{Lij}{SL}\right)^4$$

$$ESA = \left(\sum LHRT_{vehicle\ category} x\ ESA_4\right)\ x\ D_L$$

$$ESA_{TH\text{-}1} = (\Sigma LHR_{JK} \text{ x } VDF_{JK}) \text{ x } 365 \text{ x } DD \text{ x } DL \text{ x } R$$

$$CESA4 = ESA \; x \; 365 \; x \; R$$

$$CESA5 = TM \; x \; CESA4$$

Table 5. VDF value for each category of commercial vehicle

Type of vehicle	Sumatera				Java				Kalimantan				Sulawesi				Bali, Nusa Tenggara, Maluku, and Papua			
	Actual load		Normal		Actual load		Normal		Actual load		Normal		Actual load		Normal		Actual load		Normal	
	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5
5B	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
6A	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5
6B	4.5	7.4	3.4	4.6	5.3	9.2	4.0	5.1	4.8	8.5	3.4	4.7	4.9	9.0	2.9	4.0	3.0	4.0	2.5	3.0
7A1	10.1	18.4	5.4	7.4	8.2	14.4	4.7	6.4	9.9	18.3	4.1	5.3	7.2	11.4	4.9	6.7	-	-	-	-
7A2	10.5	20.0	4.3	5.6	10.2	19.0	4.3	5.6	9.6	17.7	4.2	5.4	9.4	19.1	3.8	4.8	4.9	9.7	3.9	6.0
7B1	-	-	-	-	11.8	18.2	9.4	13.0	-	-	-	-	-	-	-	-	-	-	-	-
7B2	-	-	-	-	13.7	21.8	12.6	17.8	-	-	-	-	-	-	-	-	-	-	-	-
7C1	15.9	29.5	7.0	9.6	11.0	19.8	7.4	9.7	11.7	20.4	7.0	10.2	13.2	25.5	6.5	8.8	14.0	11.9	10.2	8.0
7C2A	19.9	39.0	6.1	8.1	17.7	33.0	7.6	10.2	8.2	14.7	4.0	5.2	20.2	42.0	6.6	8.5	-	-	-	-
7C2B	20.7	42.8	6.1	8.0	13.4	24.2	6.5	8.5	-	-	-	-	17.0	28.8	9.3	13.5	-	-	-	-
7C3	24.5	51.7	6.4	8.0	18.1	34.4	6.1	7.7	13.5	22.9	9.8	15.0	28.7	59.6	6.9	8.8	-	-	-	-

Source: (Road Pavement Design Manual of Directorate General of Bina Marga, 2017)

Table 6. ESA5 Value

No.	Vehicle Types	Axle Configuration	LHR 2020	LHR 2040	UR	i	R	DL	DD	TM	VDF4	VDF5	ESA4	ESA5	CESA 20 YEARS	
															CESA4	CESA5
1.	Category 1 (Sedan, Jeep, SW)	1.1	3952	10151.46	20	4.83%	20.09%	80%	50%	1.80	1.00	1.00	3161.60	3161.60	231858.89	231858.89
2.	Category 1 (Pick Up Truck, Small Boxx)	1.1	967	2483.92	20	4.83%	20.09%	80%	50%	1.80	0.55	0.50	425.48	386.80	31202.97	28366.34
3.	Category I (Medium-sized Public Transportation, ¾-sized Bus)	1.2	228	585.66	20	4.83%	20.09%	80%	50%	1.80	4.50	7.40	820.80	1349.76	60194.13	98985.91
4.	Category I (Big Bus)	1.2	192	493.19	20	4.83%	20.09%	80%	50%	1.80	10.10	18.40	1551.36	2826.24	113770.43	207264.95
5.	Category II (2-axle Small Truck)	1.2	291	747.49	20	4.83%	20.09%	80%	50%	1.80	10.50	20.00	2444.40	4656.00	179262.36	341452.11
6.	Category II (2-axle Medium Truck)	1.2	1186	3046.47	20	4.83%	20.09%	80%	50%	1.80	15.90	29.50	15085.92	2789.60	1106340.02	2052643.44
7.	Category III (3-axle Truck (Including CPO Truck))	1.22	1979	5083.44	20	4.83%	20.09%	80%	50%	1.80	19.80	39.00	31347.36	61744.80	229887.90	458112.53
8.	Category IV (4-axle Truck)	1.22-22	209	536.86	20	4.83%	20.09%	80%	50%	1.80	20.70	42.80	3461.04	7156.16	253818.60	524803.67
9.	Category V (5-axle Truck)	1.22-22	1	2.57	20	4.83%	20.09%	80%	50%	1.80	24.50	51.70	19.60	41.36	1437.38	3033.17
TOTAL			9005.00	23131.05									58317.56	109312.32	4276772.6	8016521.00

Source: Author's Process,2020

3.1.3 Determining The Pavement Type

The choice of pavement type is influenced by traffic volume, design lifespan, and road foundation conditions. Therefore, with the 20 years of lifespan and traffic value on the planned lane 8.016.521 ESA5 from Table 5 and Table 6; then in Table 7, the pavement structure was determined using AC ≥ 100 mm thick with a grained foundation layer with Design chart - 3B.

Table 7. Road Pavement Structure

Pavement Structure	Design Chart	ESA (million) in 20 years (power of 4 unless otherwise specified)				
		0 – 0.5	0.1 – 4	>4 - 10	>10 - 30	>30 - 200
Stiff pavement with heavy traffic (above the soil with a CBR ≥ 2.5%)	4	-	-	2	2	2
Stiff pavement with low traffic (rural and urban areas)	4A	-	1, 2	-	-	-
Modified AC WC or modified SMA with CTB (ESA to the power of 5)	3	-	-	-	2	2
AC with CTB (ESA to the power of 5)	3	-	-	-	2	2
AC ≥ 100 mm thick with a grained foundation layer (ESA to the power of 5)	3B	-	-	1, 2	2	2
Thin AC or HRS over grained foundation layer	3A	-	1, 2	-	-	-
Burda or *Burtu* with A-Class LPA or real rocks	5	3	3	-	-	-
Soil Cement Foundation Layers	6	1	1	-	-	-
Perkerasan tanpa penutup (*japat*, jalan kerikil)	7	1	-	-	-	-

Note:
Level of difficulty:
1 – small – medium contractor;
2 – big contractor with sufficient resource
3 – need special skills and skilled labors – *Burtu* /*Burda* specialist contractor.

Source: (Road Pavement Design Manual of Directorate General of Bina Marga, 2017)

3.1.4 Determining The Pavement Foundation Design

The California Bearing Ratio (CBR) value of subgrade used in this research was the minimum value of 6 %. Table 8 illustrates that the minimum road foundation design chart was obtained with a subgrade CBR value of 6% and the traffic value on the planned lane of 8.016.521 ESA5, so the subgrade strength class was SG6 and no subgrade improvement was required for flexible pavements.

Table 8. Minimum road foundation design chart

Subgrade CBR (%)	Subgrade Power Class	Foundation Structure Description	Flexible Pavement			Stiff Pavement
			Traffic load on planned lanes with a plan lifespan of 40 years (million ESA5)			Cement Stabilization [6]
			<2	2-4	>4	
			Minimum thickness of subgrade repairment			
≥6	SG6	Soil repairment can take the form of cement stabilization or selected embankment material (according to the requirements of General Specification, Division 3 – Soil Work) (compaction layer ≤200 mm thick lush)	No repairment needed			
5	SG5		-	-	100	300
4	SG4		100	150	200	
3	SG3		150	200	300	
2.5	SG2.5		175	250	350	
Expansive soil (expansion potential of >5%			400	500	600	Applies the same provision as that of the flexible pavement foundations
Pavement on soft soil[2]	SGI[3]	Support layer [4][5]	1000	1100	1200	
Peat soils with HRS or DBST for minor highway pavements (minimum value - other provisions apply)		-or- support layer and geogrid[4][5]	650	750	850	
		Grained support layer[4][5]	1000	1250	1500	

(1) The design must consider all critical points, additional conditions may apply.
(2) Characterized by low field density and CBR.
(3) Using the in situ CBR value, because the immersed CBR value is irrelevant.
(4) The surface of the support layer above SG1 soil and peat is assumed to have a carrying capacity equivalent to a CBR value of 2.5%. Therefore, the SG2.5 soil repairment condition applies. Example: for planned traffic> 4 million ESA, SG1 soil requires a support layer of 1200 mm thick to achieve a bearing capacity equivalent to SG2.5 and further 350 mm need to be added to make it equal to SG6.
(5) The thickness of the support layer can be reduced by 300 mm if the original soil is compacted under dry conditions.

Source: (Road Pavement Design Manual of Directorate General of Bina Marga, 2017)

3.1.5 Determining The Pavement Structure

The alternative design of flexible pavement structures suitable for traffic on the planned lane 8.016.521 ESA5 was the design chart - 3B Flexible pavement design - Asphalt with Grained Foundations. The following table shows the Flexible pavement design in Design Chart 3B :

Table 9. Flexible Pavement Design – Asphalt with Grained Foundation

Design Chart-3B. Flexible Asphalt Pavement Design with Grained Foundation Layers

(As an alternative to Chart Designs-3 and 3A)

	PAVEMENT STRUCTURE								
	FFF1	FFF2	FFF3	FFF4	FFF5	FFF6	FFF7	FFF8	FFF9
Solution Chosen					See Note 2				
Cumulative 20 year axle load on the plan lane (10^6 ESA 5)	<2	≥2 - 4	>4 - 7	>7 - 10	>10 – 20	>20 - 30	>30 - 50	>50 – 100	>100 - 200
THICKNESS OF PAVEMENT LAYER (mm)									
AC WC	40	40	40	40	40	40	40	40	40
AC BC	60	60	60	60	60	60	60	60	60
AC Base	0	70	80	105	145	160	180	210	245
LPA Class A		400	300	300	300	300	300	300	300
Note		1		2		3			

Design Chart-3B Notes:

1. FFF1 or FFF2 should take precedence over the FFF1 and FFF2 (Chart Design-3A) solutions or in situations where HRS has the potential to undergo routing.
2. CTB pavements (Design Chart - 3) and stiff pavement options can be more cost-effective, but will not be practical if the required resources are not available.
3. For flexible pavement design with loads> 10 million CESA5, Chart Design - 3 is preferred. Chart Design - 3B is used if the CTB is difficult to implement. The FFF5 - FFF9 solutions can be more practical than the Chart Design - 3 or 4 solutions for construction situations such as: (i) stiff pavement or CTB can become impractical on widening the existing flexible pavement, or (ii) on soil with potential for consolidation, or (iii) non-uniform movement (in the case of stiff pavement) or, (iv) if the contractor's resources are not available.
4. The minimum thickness of the aggregate foundation layer listed in Design Charts -3 and 3A is required to ensure adequate drainage so as to limit the loss of pavement strength in the wet season. These conditions apply to all design charts except Design Chart - 3B.
5. LFA thickness based on Design Chart - 3B can be reduced for subgrades with higher bearing capacity and pavement structures can drain water well (m≥1 factor). See Design Chart 3C.
6. All CBRs were values after being immersed for 4 days.

Source: (Road Pavement Design Manual of Directorate General of Bina Marga, 2017)

Based on Table 9, the FFF4 pavement structure with the thickness of the pavement layer to be used in the Planning of Pavement Thickness for the Pekanbaru-Dumai Toll Road is listed in Figure 2 below:

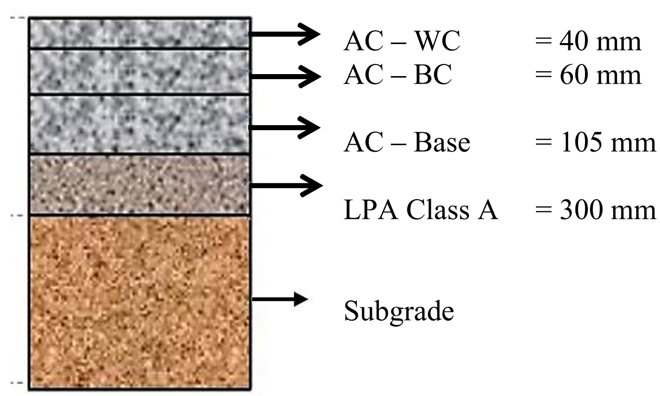

Figure 2. Road Pavement Thickness Sketch

Source : Author's Process,2020

3.2 Overlay Method

There were 2 overlay methods used in the Trans Sumatera Toll Road, Pekanbaru-Dumai Section 4A Construction: direct single asphalt finisher with 9.2 meters of width and double direct asphalt finisher with 5.1 meters and 4.1 meters of width. Table 10 shows the comparison of two AC-WC overlay methods at STA 56+400 - 58+400:

Table 10. Comparison of Overlay Methods

No.	Heavy Equipments	WORK DURATION (hours)		PRODUCTION CAPACITY (tons/hour)	
		Direct Single Overlay	Direct Double Overlay	Single Direct Overlay	Double Direct Overlay
1.	Asphalt Finisher	6	13	153,677	66,190
2.	Pneumatic Tire Roller	18	42	47,908	20,960
3.	Tandem Roller	16	36	55,680	24,360

** without taking into account the distance of the AMP to the location and the inhibiting factors of asphalt work*
Source : Author's Process,2020

Based on Table 10, it can be seen that direct method had faster work duration than the indirect method. In terms of overlay and solidification, the direct method required 6 hours of overlay work using the asphalt finisher, while the indirect method needed 13 hours. The Pneumatic Tire Roller needed 18 hours of duration for the direct method and 42 hours of duration for the indirect method. Meanwhile, the Tandem Roller needed 16 hours of duration for the direct method and 36 hours of duration for the indirect method. The Asphalt Finisher's production capacity for the direct single overlay method was greater than that of the double overlay. The Asphalt Finisher's production capacity for the direct single overlay method was 153,677 tons/hour, while the capacity for double overlaay was 66,190 tons/hour. The Pneumatic Tire Roller's production capacity for the direct single overlay method was 47,908 tons/hour, while the capacity for double overlaay was 20,960 tons/hour. The Tandem Roller's production capacity for the direct single overlay method was 55,680 tons/hour, while the capacity for double overlaay was 24,360 tons/hour.

3.3 Field Density Method

The field density of the Pekanbaru – Dumai Toll Road Construction was carried out at least 1 x 24 hours with asphalt overlaying and pavement. This study uses the Asphalt Concrete Wearing Course as a test object. Table 11 shows the AC WC pavement comparison (core drill) at STA 56+400 – 58+400 :

Table 11. Comparison of The Two Overlay Methods

NO	LOCATION		OVERLAY METHOD	DENSITY RESULT %	AVERAGE DENSITY %
	STA	L/R			
1.	56+400 – 57+400	R1	Direct Double Overlay Method	99.5%	99.2%
2.	56+400 – 57+400	R2	Direct Double Overlay Method	99.5%	
3.	56+400 – 57+400	L1	Direct Double Overlay Method	92.2%	
4.	56+400 – 57+400	L2	Direct Double Overlay Method	98.8%	
5.	57+500 – 58+400	R	Direct Single Overlay Method	98.9%	98.7%
6.	57+500 – 58+400	L	Direct Single Overlay Method	98.5%	

Source : Author's Process,2020

Table 11 illustrates that the density of the double overlay method on the STA 56+400 – 57+500 R1 was 99.5 %; STA 56+400 – 57+500 R2 was 99.5 %; STA 56+400 – 57+500 L1 was 99.2%; STA 56+400 – 57+500 L2 was 98.8%. Meanwhile, the density of the single overlay method on the STA 57+500 – 58+400 R was 98.9 % and the STA 57+500 – 58+400 L was 98.5%. The results showed that the double overlay of asphalt finisher produced higher density compared to the single overlay of asphalt finisher.

4. Conclusion

From the analysis, it can be concluded that :

1. The pavement thickness of the Trans Sumatera Toll Road, Pekanbaru-Dumai Section for the lifespan of 20 years and planning using the 2017 Road Pavement Design Manual will be as follows: the thicknesses of the Aggregate Base of 300 mm, AC-Base of 105 mm, AC-BC of 60 mm and AC-WC of 40 mm.
2. The Asphalt Concrete Wearing Course Density at STA 56+400 – 57+500 R1 was 99.5 %, at STA 56+400 – 57+500 R2 was 99.5 %, at STA 56+400 – 57+500 L1 was 99.2%, at STA 56+400 – 57+500 L2 was 98.8%, at STA 57+500 – 58+400 R was 98.9 %, and STA 57+500 – 58+400 L was 98.5%.
3. The comparison of Asphalt Concrete Wearing Course overlay methods in terms of coredrill test results, work duration and heavy equipment productivity were:
   a. The use of Asphalt Finisher with 9.2 m of width resulted in a production capacity of 153,677 tons / hour, a work duration of 6 hours and a field density of 98.9% and 98.5%.
   b. The use of Asphalt Finisher with 5.1 m and 4.1 m of widths resulted in a production capacity of 66,190 tons / hour, a work duration of 13 hours and a field density of 99.5%, 99.5%, 99.2% and 98.9%.
   c. The use of Pneumatic Tire Roller with 9.2 m width resulted in a production capacity of 47,908 tons / hour, work duration of 18 hours and a field density of 98.9% and 98.5%.
   d. The use of Pneumatic Tire Roller with with 5.1 m and 4.1 m of widths resulted in a production capacity of 20,960 tons / hour, work duration of 42 hours and a field density of 99.5%, 99.5%, 99.2% and 98.8%.
   e. The use of Tandem Roller with 9.2 m of widths resulted in a production capacity of 55,680 tons / hour, a work duration of 16 hours and a field density of 98.9% and 98.5%.
   f. The use of Tandem Roller with 5.1 m and 4.1 m of widths resulted in a production capacity of 24,360 tons / hour, work duration of 36 hours and a field density of 99.5%, 99.5%, 99.2% and 98.8%.
4. The direct single overlay was a more effective method for the Asphalt Concrete Wearing Course in terms of overlay productivity. However, the direct double overlay was more effective in terms of density.

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