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ANALYSIS OF IMPROVEMENT ROAD PALIMANAN – KRAMAT SECTION CIREBON REGENCY

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ABSTRACT

Cirebon Regency has a good potential of both in trading and service. So, the roads should contribute to support the driving to comfort for road users. Palimanan – Kramat road is one of the access roads to Regency Cirebon. Along the way Palimanan - Kramat majority to be a place of business. Along Palimanan – Kramat road is a lot of structural damage such as potholes, cracked lengthwise and there is also almost the entire surface of the asphalt peeling. All this happened was possible because the line was often traversed by vehicles such as dump trucks which overload. The purpose of this study is to solve the damage to the road by means of the overlay. The method which is used in this study is a survey method in the location of the Overlay Palimanan – Kramat Road. Analysis of the data which is used are the Summary of Traffic Volume, Volume Peak Hour Traffic, Highway Capacity Analysis, Traffic Growth, Calculation of Pavement Thickness. The results of the study explained that the capacity of the vehicle on roads this time is at 1450 pcu/h, the degree of saturation of 0.3 into the current level of service B that is stable, high capacity most vehicles via this road for 378 pcu/hour. From these results, the road quite smoothly enough so that it can be concluded that the vehicles passing dominated by heavy vehicles with a load of overload which caused damage to the road and the re-layer thickness of 11 cm. Therefore, to note the level of vehicle load so as not to overload the structure of the pavement.

Keywords: Road Pavement, Capacity of Road, Road Pavement Structure, Capacity of Vehicles

I. INTRODUCTION

1.1. Background

Cirebon Regency is a regency potential in trade and services. So that road in the district of Cirebon has to participate and support the driving comfort for road users. Palimanan road - Kramat is one of the access roads to Cirebon. Along the Way Palimanan - Kramat majority to be a place of business. There are markets, restaurants, mini market, schools, manufacturers granite and others.

This road also becomes an alternative route for road users of directions Brass or Central Java who want to go to Jakarta or Bandung without going through the north coast. By passing the sea Sindang - Caracas then passes Mandirancan - Source and direction Source - Majalengka. Then the track conditions Palimanan - this Kramat - should be good to road users can shorten the distance on the go.

Along roads Palimanan - Kramat is a lot of structural damage such as potholes, cracked lengthwise and there is also almost the entire surface of the asphalt peeling. All this happened was possible because the line was often traversed by vehicles such as dump trucks laden overload. Based on the aforementioned problems the authors are interested in creating a thesis entitled "**Analysis of Improvement Road Section Palimanan - Kramat Cirebon Regency**".

1.2. Limitations

This Thesis, Writer focus problems on Road Improvement Analysis on Palimanan – Kramat Road.

1.3. Problem Formulation

The problem that exists today is a pavement suffered considerable damage. For that we need to know:

1. How is thick extra layer which needed?

1.4. Research Objective

Pavement structures Improving these roads so that traffic flow more smoothly and safely, so, that it can generate growth in the surrounding area. Also, addressing road damage by doing an overlay.

1.5. Usefulness Research

1. For consideration in evaluating damage assessment locations.
2. Expected to be a recommendation to the Government of Cirebon to improve roads in the area in question.

1.6. Research Locations

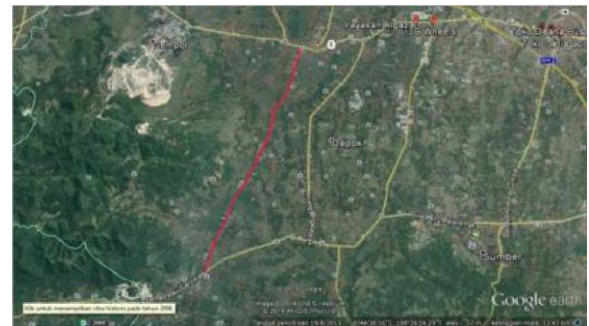


Figure1. Research Sites

Palimanan - Kramat Road has a functional length of 7.3 km. These segments across four (4) villages namely Balad and Panongan village located in Palimanan District, then Kepuh village and Dukupuntang village in the Dukupuntang District.

II. LITERATURE REVIEW

2.1. Types and Pavement Layer Function

Type surface layer should be waterproof and have high stability to support the weight of the wheels during the service. Common types of surfaces used in Indonesia is as follows:

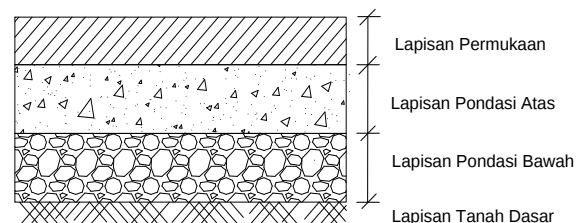


Figure 2. Soil Layer

A. Surface Course

This surface layer is a layer that lies on top and are directly related to load on it.

B. Base Course

Layer located between layers of pavement sub-base and base course surface layer called Base Course.

C. Sub-base Course

Pavement layer located between the upper base course and subgrade this works as follows:

1. As part of the construction of pavement to spread the load wheels to the subgrade.
2. Achieving efficient use of material. Under the foundation materials are relatively inexpensive compared to the pavement on it.
3. Reducing thick layer on it is relatively expensive.
4. Penetrate layer, so that the ground water is not accumulated in the foundation.
5. First layer, so that the work can proceed smoothly. If done at the optimum water content and water content constant cultivated during the life of the plan. This can be accomplished by drainage a qualified fitting.

E. Cross Section

The road cross section are pieces of a street perpendicular to the axis of the road which shows the structure of the road sections concerned in the transverse direction, Profile Road consists of parts section as follows:

1. Line of traffic,
2. median and lane edge,
3. shoulder of the road,
4. walking trails,
5. Drainage,
6. Slope.

The cross section can be seen in the following figure (Figure 2.3.):

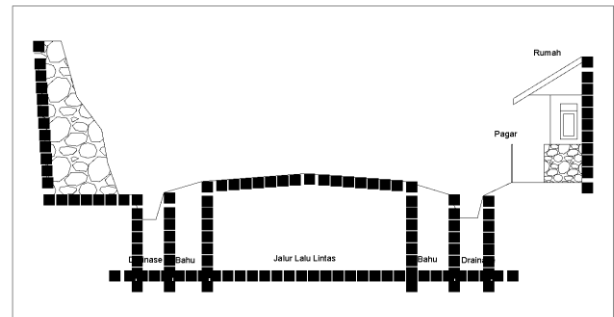


Figure 3. Cross-section shape Crossing Pieces

F. Performance Pavement

Pavement Performance includes three (3) things, are as follows:

1. Security can be determined by the amount of friction as a result of contact between the tire and the road surface.
2. Being pavement, with respect to the physical condition of the road as the crack - crack, wave, and others - others.

2.2. Types and Causes Damage Flexible Pavement

Handling pavement construction whether it is maintenance, support, enhancement or rehabilitation can be done well after the damage incurred on the pavement. The magnitude of the effect of a damage and subsequent handling steps depends on the evaluation by the observer

The road receives vehicle wheel load over and over - again during his ministry which lasted for many - years each time passed the load, resulting in a deflection either coated the surface and the layer below it. If the load it will experience excessive wear resulting and total crack damage.

Deflection coating on the structure caused by the elastic deformation, plastic deformation or consolidation on the base layer or foundation soil. The elastic deformation is temporary deformation that occurs when under and will be restored to normal after no load. Elastic deformation in rock/soil layer the pavement caused by compression of air in it at the time of receiving the load. On a purely elastic deformation of the shape will be as before despite the imposition of repeating - again.



Figure 4. Miscellaneous the deformation

Consolidation deformation occurs when the load raises the pressure is so great that the air and water in the pore - pore squeezed out, but, grain - grain ground does not move and just move closer to one another. This deformation allows not cause damage to the road when the traffic load evenly split evenly so that the pavement down anyway.

2.3. Pavement

Pavement road construction is built on sub-grade, which serves to support the traffic load. The history of the pavement structure can be grouped into two categories, namely:

A. Flexible Pavement

Flexible pavement is a pavement that uses materials that are pliable asphalt belt, especially during the summer. Mix asphalt and aggregate stocked up the street at a high temperature (100°C).

B. Rigid Pavement

Rigid pavement is a pavement that uses materials that are rigid cement belt. Rigid pavement slab concrete form with or without reinforcement on subgrade with or without sub-base layer. Traffic load is passed down concrete plate.

2.4. Criteria Pavement Planning

- A. Passenger Car Unit or pcu is the unit number of vehicles in terms of the capacity of the road, where passenger cars are set to have one unit of pcu.
- B. The flexible Pavement tier component analysis method has been approved by the National Standards Council (DSN) Indonesia became Indonesian National

Standard (SNI) with the number: SKBI 2.3.26.1987 / SNI 03-1732- 1989 "Planning Procedures Highway Pavement Thickness Bending with Component Analysis Method (MAK) ".

- C. Regional factors Regional factors (FR) is a correction factor with respect to differences in the condition with the experimental conditions AASTHO Road Test and adapted to the circumstances in Indonesia. Regional factors are influenced by the shape of alignment, the percentage of heavy vehicles and stops as well as the flatness.
- D. The surface index value index is the surface flatness/fineness and robustness of the surface concerned with the level of service for the traffic passing by.
- E. Index Tebal Perkerasan (ITP) pavement thickness index value is obtained from the monogram by using values that are already known, namely LER during the life of the plan, the value of DDT and FR obtained.
- F. Coefficient Relative Strength (a) The coefficient of the relative strengths of each material and its usefulness as the surface layer, the foundation and the foundation under correlational determined according to the value Marshall Test (for materials with bitumen), compressive strength (for material stabilized with cement or lime), or CBR (for the sub base layer materials). If tool Marshall Test is not available, then the strength (stability) of paving material can be measured in other ways such as Hubbard Field, and Smith Tri axial.
- G. Determining Index Tebal Perkerasan (ITP) existing or the power of the old road.
- H. Component Analysis Pavement Calculation of this planning is based on the relative strength of each layer of pavement long term, where the determination of pavement thickness is expressed by ITP (Index Tebal

Perkerasan), with the following formula:

$ITP = a_1D_1 + a_2D_2 + A_3d_3$ Where: ITP = Index Tebal Perkerasan a_1, a_2, a_3 = coefficient of relative strength of pavement materials.

D_1, D_2, D_3 = thickness of each pavement (cm).

Number 1, 2 and 3 respectively for the surface layer, the foundation layer and base course.

III. RESEARCH METHODOLOGY

3.1. Research Method

In writing this report author did a survey in the study location directly on Overlay Palimanan - Kramat Roads with quantitative methods supported by relevant data. In this case, the condition survey has done visually supported by the theory - the theory of this and from various literature references related to the focus of the problem as well as data - data taken from several sources and the results of the review field.

3.2. Data Collection Method

The method used in the writing of this thesis is as follows:

A. Field Research

Namely direct observation in the field to obtain data and information by means of:

1. Observation of seeing and observing and recording directly in the field to get the data and accurate information.
2. Asking questions to related parties on matters relating to the subject matter.
3. Documentation.

B. Library Research

Namely data collection - theoretically relevant data through the resources related to the principal language.

C. Types and Sources of Data

1. Primary Data

Data obtained directly from the field in the form of interviews, identification and documentation.

2. Secondary Data

Data obtained from the offices/agencies related material Thesis study.

IV. DISCUSSION

4.1. Recapitulation Traffic Volume

Traffic volume is the number of vehicles passing through a certain cross-section at a certain cross-section segment on a particular road segment in units of time traffic certain. Volume average - average is calculated according to the number of vehicles which one - unit of time.

In Palimanan – Kramat road, research done by calculating a density of vehicles passing over the eight (8) hours at the start of Monday May 30, 2016 until the day of the week of June 12, 2016 or for 14 days, in which recording is classified to 3 (three) types of vehicles, namely:

No.	Type Vehicle	Category	Coefficient Factor
1	Motorcycles (MC)	Motorized two-wheeled or three	0.5
2	Light Vehicle (LV)	Private cars, urban transport, pick-ups, mini buses, and other similar	1
3	Vehicle Weight (HV)	Truck great, Box the greater cars, buses, water tankers and more like	1.3

Table 1. Type of vehicle

Classification of these vehicles simply adapted to vehicles passing through Palimanan – Kramat road. This classification is then converted into a passenger car unit (PCU) and add up each - each department so as to produce the volume of each - each direction of movement. The survey was conducted with a view to knowing the volume of traffic that comes with every hour at Palimanan - this Kramat road. Also, to find out how the movement patterns that occur on Palimanan - Kramat road and today is the most high-volume traffic.

Summary of the results of traffic volume survey that was conducted for 8 (eight) hours per day for 2 (two) weeks can be seen in the following table:

Rekapitulasi Volume Lalu Lintas							
Arah Pergerakan	Hari / Tanggal						
	Jumlah Volume (SMP/Hari)						
	Senin 30/05/2016	Selasa 31/05/2016	Rabu 01/06/2016	Kamis 02/06/2016	Jum'at 03/06/2016	Sabtu 04/06/2016	Minggu 05/06/2016
Palimanan – Kramat	726	822	837	725	944	861	884
Kramat – Palimanan	979	806	873	764	856	856	860
Jumlah Volume Lalu Lintas	1705	1628	1710	1489	1800	1717	1744

Survey done from 06:00 to 14:00

Table 2. Summary of Vehicle Volume Week One

Rekapitulasi Volume Lalu Lintas							
Arah Pergerakan	Hari / Tanggal						
	Jumlah Volume (SMP/Hari)						
	Senin 06/05/2016	Selasa 07/05/2016	Rabu 08/05/2016	Kamis 09/05/2016	Jum'at 10/05/2016	Sabtu 11/05/2016	Minggu 12/05/2016
Palimanan – Kramat	677	777	884	884	820	808	882
Kramat – Palimanan	1010	925	839	897	899	919	864
Jumlah Volume Lalu Lintas	1687	1702	1723	1781	1719	1727	1746

Survey conducted from 06.00 - 14:00

Table 3. Summary of Vehicle Volume Week Two

Rekapitulasi Volume Lalu Lintas							
Arah Pergerakan	Hari / Tanggal						
	Jumlah Volume (SMP/Hari)						
	Senin	Selasa	Rabu	Kamis	Jum'at	Sabtu	Minggu
Palimanan – Kramat	702	800	861	805	882	835	883
Kramat – Palimanan	995	866	856	831	878	888	862
Jumlah Volume Lalu Lintas	1697	1666	1717	1636	1760	1723	1745

surveys conducted from 06:00 - 14:00

Table 4. Summary of Vehicle Average Volume Per Two Weeks

4.2. Peak Hour Traffic Volume

Peak hour traffic volume can be determined after observing each - each day. It can be seen at any hour of peak traffic flow is needed when it will be planning a road section because by knowing the highest volume, the highway designers can create a highway design appropriate to the circumstances on the ground. So, the level of service a road section will be good.

The volume of traffic at peak hours can be seen by the following table:

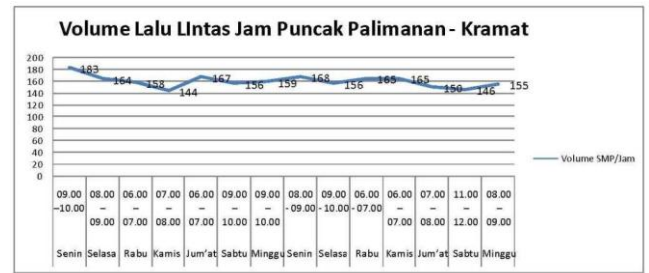
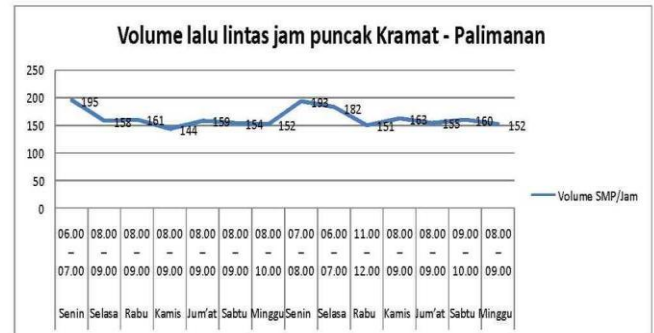


Figure 1. Peak hour traffic volume Kramat – Palimanan



Graph 2. peak hour traffic volume Kramat - Palimanan

Based on traffic volume charts above are taken from the data traffic volume hours peak conducted over two (2) weeks, it can be seen that the peak hours for the direction of movement of Palimanan - Kramat be on Monday, dated May 30, 2016 (first Week) is 09.00 - 10.00WIB of 183 pcu/hour, while for directions movement Kramat - Palimanan peak hours the vehicle is on Monday, dated May 30, 2016 (the first week), i.e. 06.00 - 07.00WIB of 195 pcu/hour.

4.3. Analysis of Highway Capacity

A. Calculation Analysis of Road Capacity based on your results of this research conducted at Palimanan – Kramat road for 2 (two) weeks which begins on Monday, May 30, 2016, until Sunday, June 12th, 2016, it acquired the data as follows:

- Road type

1 Track; 1 lane; 2 directions do not share (2/2 UD)

- Geometric Condition

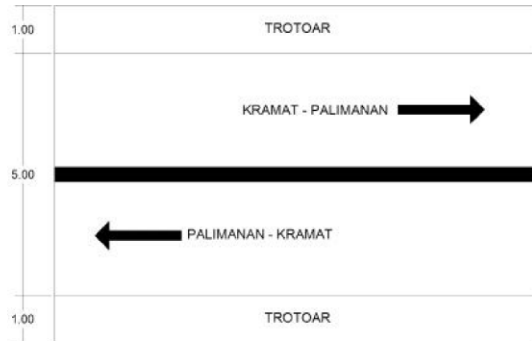


Figure 5. Sketch Location

Based on analysis of the location activities road geometric description study on Palimanan – Kramat road is as follows:

Jalan	Lebar Jalan (m)	Panjang Fungsional (m)	Tipe Alinyemen	Kelurusan	Lebar Bahu (m)	Perkerasan
Palimanan – Kramat	5	7300	Dataran rendah	Lurus	1	Perkerasan lentur

Table 5. Capacity Roads
Palimanan - Kramat

Highway capacity is space traversed by vehicles, whose magnitude depends on many factors including the effective width of the road used for traffic (MKJI 1997).

Calculation capacity of the road to the road outside the city is done by using the formula:
 $C = C_0 \times FCW \times FCSF \times FCSP$

Known:

C_0 = Basic capacity (pcu/hour)

FCW = Factor width adjustment path

$FCSP$ = Factor adjustment separation directions

$FCSF$ = Factor adjustment side friction

Road type 1 track 1 lane 2 direction not to share it with the type of alignment is hilly so the capacity is basically = 2900 pcu / hour total two-way

FCW = factor width adjustment path road type 1 track 1 lane 2 directions no share has wide lanes 5 M so that $FCW = 0.56$, $FCSP$ = adjustment factor dividing direction Q direction palimanan - Kramat = 183 pcu/hour, Q direction Kramat - palimanan = 195 pcu/hour, Q total = $183 + 195 = 378$ pcu/hour.

$$\frac{183}{Q_{total}} \times 100\% = \frac{183}{378} \times 100\% = 48.4\% = 50\%$$

$$\frac{195}{Q_{total}} \times 100\% = \frac{195}{378} \times 100\% = 51.6\% = 50\%$$

Thus, SP: 50% - 50%

For roads in the city, type of road 1 lane 2 directions with SP 50% - 50% = 1.00, FCSF = adjustment factor side barriers on this road use with a wide shoulder - flatten 1 meter, having activity roadside being with type 1 track 1 line 2 directions, so, $FCSF = 0.95$.

Based on the data that already exist can be calculated from amount of capacity from road as follows:

$$C = C_0 \times FCW \times FCSP \times FCSF \times FCCS$$

$$C = 2.900 \times 0.56 \times 1.00 \times 0.94 \times 0.95$$

$$C = 1450 \text{ pcu/hour}$$

So, known that the capacity of the vehicle on Roads Palimanan - Kramat is set at 1450 pcu/hour.

B. Calculation of Degree of Saturation

Degree is the ratio of traffic volume to capacity. The calculation of the degree of saturation can be calculated by the formula:

$$DS = Q / C$$

Where:

DS = Degree of Saturation / degree of saturation (pcu/hour)

Q = Flow of traffic (pcu/hour)

C = Capacity (pcu/hour)

From the survey results in to the volume of traffic = 378 pcu/hour/track.

$$DS = \frac{Q}{C}$$

$$DS = \frac{378}{1450}$$

$$DS = 0.26 \text{ or } 0.3$$

So, the calculation of the existing traffic conditions for Palimanan - Kramat road has a degree of saturation is 0.3 which is included in the service level B with a stable flow conditions.

4.4. Traffic Growth

In traffic volume growth was influenced by developments in traffic per year, number of vehicles per year can be seen in the following table:

Jenis Kendaraan	Tahun				
	2010	2011	2012	2013	2014
Roda 2	1.209	1.603	1.809	2.107	2.606
Sedan, jeep dan sejenisnya	968	1.026	1.246	2.089	2.356
Bus, Truk dan sejenisnya	118	176	249	298	347
Kendaraan umum semua jenis	1607	1897	1951	2267	2589
Jumlah	3902	4708	5255	6761	7898

Source: CBS Source Regency 2014

Table 6. Number of motor vehicles

The motor vehicle multitude of data above, it can be in the predicted growth of the average per year in the Sumber Regency of 8%.

Prediction of traffic volume growth can be searched by the formula:

$$Q = VJP \times (1 + i)^n$$

Q = Flow of total traffic (pcu/hour)

VJP = Volume of hours of planning
(In the passenger car unit)

i = Traffic Development

(Source: BPS Sumber Regency)

n = Age of plan

VJP = 378 pcu/hour

n = 10 year

i = 8% / year

$$Q = 378 (1 + 0.08)^{10}$$

$$Q_{10th} = 816.07 = 817 \text{ pcu/hour}$$

Degree Burnout

$$DS = \frac{Q}{c}$$

$$DS = \frac{817}{1450}$$

$$D = 0.563 = 0.57$$

So, the ten (10) years to come precisely in 2026 the degree of saturation of traffic volume reached 0.57.

4.5. Calculation of Pavement Thickness

A. Supporting Data

1. Carrying capacity of the land: 4 (ASSUMPTIONS)
2. Traffic growth (i) : (8%) = 0.08

3. Age of plan (n): 10 years

B. Annual Average Daily Traffic Plan

Determination of the average daily traffic load - average shown in the calculations.

$$LEP = 378 \text{ pcu/hour}$$

$$LEA = 817 \text{ pcu/hour}$$

$$LET = \frac{LEA + LEP}{2} = \frac{817 + 378}{2} = 597.5 \text{ pcu/hour}$$

$$LER = LET \times FP$$

$$FP = \frac{N}{10} = \frac{10}{10} = 1$$

$$= 598 \times 1 = 598 \text{ pcu/hour}$$

C. Regional Factors

Regional factors determined by the influence of the form of alignment (slope and bend), the percentage of heavy vehicles and stops, as well as climate (rainfall). Number of Regional Factor (FR) can be determined by referring to the "Table Regional factors", Calculation factors - factors that affect the value of regional factors are as follows:

1. Percentage of Heavy Vehicles

On Average Daily Traffic - Average Palimanan - Kramat road are: Vehicle weight = 156 pcu/hour.

The formula to get the percentage of heavy vehicles passing through this road are:

$$\text{Presentase kendaraan berat} = \frac{\sum \text{kendaraan berat}}{\sum \text{kendaraan}} \times 100$$

$$= \frac{156}{378} \times 100$$

$$= 41.26\% = 41\%$$

Thus, the percentage of heavy vehicles > 30%

3. Final Surface Index

Value of Index street level plan at the end of design life can be known index level at the End of the General Plan (IPt) by looking for the value and classification of roads in the table is appropriate for LER value (Lintas Ekuivalen Rencana) that has been calculated.

With the column LER noted that the numbers entered into the group < 1000, (LER = 598), with local roads classification index values obtained final pavement design life: $IP_t = 1.5$ to 2.0 is used for planning $IP_t = 2.0$,

4. Determining of Index Tebal Perkerasan (ITP)

Stages and relining calculation results are described as follows:

A. Determining of Index Tebal Perkerasan Plan (ITP)

Analysis of the results of the calculation to determine the index of pavement plan (ITP) is known as follows:

Palimanan – Kramat Road	
Carrying Capacity of Land (DDT)	4
Lintas Ekvivalen Rencana (LER)	598 pcu/day/track
Factor Regional (FR)	1.5
Index Perkerasan Awal (IP_0)	3.9 to 3.5
Index Perkerasan Akhir (IP_t)	2.0

Table 7. Determination of Parameter ITP Palimanan – Kramat road

Soil bearing capacity is assumed to be 4 then showed:

$$- IP_0 = 3.9 - 3.5 \quad ITP = 10.7 \quad ITP = 12$$

B. Determination of Pavement

To determine of pavement thickness that can be from a list of relative path coefficient as follows: (used IP_0 3.9 -3.5).

- Base layer: 0.28
- Sub-base layer: 0.12

ITPexist Palimanan - Kramat road

$$\text{Surface} = 65\% \times 10 \times 0.35 = 2.28$$

$$\text{Base layer} = 63\% \times 20 \times 0.28 = 3.53$$

$$\text{Sub-base layer} = 60\% \times 25 \times 0.12 = 1.8$$

$$ITP_{\text{pada}} = 7.6$$

Thus, from the calculation on the Index Tebal Perkerasan existing (ITP_{pada}) is 8 cm.

C. Determine of Thickness Overlay at Old Pavement.

Index Tebal Perkerasan exists (ITP_{exist}) is calculated using the formula:

$$ITP_{\text{pada}} = \text{Nilai Kondisi Perkerasan Jalan} \times \text{Tebal Perkerasan} \times \text{Koef. Bahan}$$

Based on the results of field surveys, visually level of damage to roads on Palimanan - Kramat road obtained value of the presentation:

Surface layer : 65%

Base layer : 63%

Sub-base layer : 60%

Coefficient visits on the table "Relative Strength coefficient" materials used on Palimanan – Kramat road is:

Surface layer: 0.35.

D. Determining Index Pavement Thickness Need (ITPneed)

Index of Pavement Thickness Need (ITP_{need}) is calculated using the following formula:

$$\begin{aligned} ITP_{\text{need}} &= ITP - ITP_{\text{need}} \\ &= 12 - 8 \\ &= 4 \end{aligned}$$

E. Calculation of Thick Extra Layer

Thick additional layer is calculated using the following formula:

$$T_{\text{max}} = \frac{ITP_{\text{perlu}}}{\text{Koef. kekuatan relatif}} = \frac{4}{0.35} = 11.42 \text{ cm} = 11 \text{ cm}$$

Thick layer from the calculation above, Palimanan – Kramat road additional pavement layers using Laston MS 590 with a thickness of AC-WC = 5 cm and AC-BASE = 6 cm.

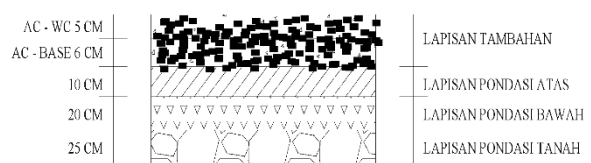


Figure 6. Sketch piece Transverse Road

V. CONCLUSIONS AND RECOMMENDATIONS

Universitas Swadaya Gunung Jati (UNSWAGATI).

5.1. Conclusions

1. Based on the analysis results Palimanan – Kramat road known that the capacity of the vehicles on the road today is at 1450 pcu/h, the degree of saturation of 0.3 into the current level of service B is stable.
2. The highest capacity vehicles via this road for 378 pcu/hour. From these results roads, smoothly enough so that it can be concluded that the vehicles passing dominated by heavy vehicles with a load of overload which caused damage to the road.
3. From the calculation results can be re-layer 11cm thick.

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5.2. Recommendations

1. It should be re-examined long-term improvement for several years later because analysis of urgent nature and are included in short-term increase.
2. To further note that the vehicle load level as not to burden the structure of the pavement.
3. To overcome the sizable financing then added in thick layers can be done by way of 7 cm using the AC - Base and 4 cm using the AC - WC.

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