International Journal Of Sustainable Development (IJSD) – UM Jember
2020, Vol. 01, No. 01, 12-17 | ISSN: 2745-4576, e-ISSN: In press

Study of the Thickness of Road Restrictions Using 2013 Building and Road Drainage Methods*

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ABSTRACT

Flexible pavement is one of the pavements that generally uses a mixture of materials originating as a surface layer and a grained material as the layer underneath. So that the pavement layer has flexibility / flexibility that can create vehicle comfort when passing on it. It is necessary to conduct a more intensive study in its application and also take into account economically, according to local conditions, level of need, implementation capacity and other technical requirements, so that the planned road construction is optimal. Drainage which comes from English (drainage) means to drain, drain, remove, or divert water. In the field of civil engineering, in general, drainage can be defined as an action to reduce excess water, which comes from rain, seepage, or excess irrigation water from an area / land, so that the function of the area / land is not disturbed. Drainage is also defined as an effort to control groundwater quality in terms of sanitation. So, it concerns not only surface water but also groundwater. Based on the data that has been processed using the Bina Marga method in 2013, it can be seen that there are several things that experience significant differences. It is known that ESA 20 years = 3,922,232 uses a pavement thickness of HRS WC 3 cm, HRS Base 3.5 cm, LPA class A 37.5 cm while for the duct dimensions the values of b are 0.6 m and h 0.6 m.

Keywords: Degree of Saturation / Capacity, Flexible Pavement, Bina Marga 2013 Method, Drainage.

1. Introduction

In this increasingly advanced and developing era, the needs of the community will continue to increase, both people who live in rural areas and people in urban areas who both have the need to move from one place to another, to support these needs / activities is the highway. Roads are infrastructure that plays an important role in traffic flow, so that during the service life of the road, efforts are made to avoid problems related to road damage [1] [2]. Road infrastructure that is burdened by high and repetitive traffic volumes will cause a deterioration in road quality, both structurally and functionally which is damaged. The city of Jember continues to develop every year, referring to the aspects of community life which consist of economic, social, political, or regional. With these developments, of course, the need for transportation continues to increase, this will greatly affect transportation facilities and infrastructure [3].

Jalan Raya Gumitir is one of the roads in Jember City which is included in the category of primary arterial roads, which is located in Garahan District. As one of the roads that connects Jember Regency to Banyuwangi Regency. with an average intensity of vehicles passing through these roads are intercity buses between provinces and other heavy vehicles. Therefore, the road conditions will quickly experience damage due to vehicle loads [4]. One way to overcome the thickness of the pavement is not easily damaged and can be used for a relatively long time, it is necessary to conduct a case study to obtain the best pavement thickness [5] [6]. In connection with an effective and efficient method for planning pavement thickness in order to obtain economical results, but still refers to comfort, safety, and safety for motorists. In the pavement thickness planning, many methods can be used for this planning. But in this planning only use the 2013 Bina Marga Method [7] [8].

2. Basic Theory

2.1 Transportation

The definition of transportation or transportation is the transfer of goods and people from their place of origin to their destination [9] [10]. The process of transportation is a movement from the place of origin, where the activity starts, to the destination, where the activity ends.

2.2 Elements of Transportation

a. Humans: Humans act as subjects or actors of transportation who will take advantage of the mode of transportation to carry out their activities, humans also act as regulators of the transportation system so that it can still be used in accordance with its functions and benefits.
b. Goods: Goods are the object of transportation, delivery of goods to several places for marketing reasons really requires a mode of transportation, not only for marketing but also for traffic mobility which is intended to improve human welfare.
c. Vehicles: Vehicles as a means or mode of transportation play an important role in delivering and moving objects of transportation from one place to another.
d. Road: The road is an important element in transportation, the road becomes the route through which the mode of transportation is passed, the road will connect a place with its place in order to facilitate the process of transportation and mobility.
e. Organization: A system definitely needs an organization that regulates and works to ensure that a system runs smoothly without any disturbances or problems in it, in Indonesia, the party that has the authority as a transportation regulatory organization whether land, sea or air is the Ministry of Transportation. Republic of Indonesia.

2.3 Highway Service Level

In road evaluation research, there are several parameters that must be examined such as road alignment, pavement thickness, road capacity volume and the level of service provided by the road. Jalan Raya Gumitir Jember Regency is categorized as a primary collector road, so the road provisions on the road according to the Minister of Transportation Regulation No.KM.14 of 2006 concerning Traffic Management and Engineering are as follows:

Table 1. Traffic Management and Engineering

Level Service	Operational Characteristics Street
A	• Free Flow • Average travel speed ≥ 80 km / hour • V / C ratio ≤ 0.6 • Load factor in the pan = 0
B	• Current is stable • Average travel speed decreased to ≥ 40 km / hour • V / C ratio ≤ 0.7 • Load factor ≤ 0.1
C	• Current is stable • The average travel speed drops to ≥ 30 km / hour • V / C ratio ≤ 0.8 • Load factor ≤ 0.3
D	• Approaching unstable current • The average travel speed drops to ≥ 25 km / hour • V / C ratio ≤ 0.9 • Load factor ≤ 0.7

Traffic Calculation for Planning Period General formula = LHR (n) = LHR (0) * (1 + I) With traffic development (I) =% plan age year (n) = year In this case Σ vehicle year n = Σ vehicle year * (1 + i) n.

2.4 Flexible Pavement Construction (Flexible Pavement)

The pavement construction consists of layers, namely subgrade and road pavement.

2.5 Capacity and Road Saturation Degree

Road capacity MKJI (1997: 36) is defined as the maximum flow through a point on the road that can be maintained per hour under certain conditions. For two-lane two-way roads, the capacity is determined for two-way flow (two-way combination), but for multi-lane roads, the currents are separated per direction and the capacity is determined per lane. Here's the formula for finding capacity.

$$\mathbf{C = C_O \times FC_W \times FC_{SP} \times FC_{SF} \times FC_{CS}}$$

With:

C = Capacity
Co = Basic Capasity
FC_W = Traffic Lane Width Adjustment Factor
FC_{SP} = Direction separator adjustment factor
FCSF = Capacity adjustment factor for side and curb / curb friction
FCS = Capacity adjustment factor for city size (total population).

While the calculation of the degree of saturation can be calculated by the formula:

$$\mathbf{DS = Q_{smp} / C}$$

With:

C : Capacity
DS : Degree of Saturation
Q_{smp} : Vehicle Volume.

2.6 2013 Highways Method Pavement Thickness Plan

In calculating flexible pavement using the Bina Marga 2013 method, the steps are as follows:

Determination of Design Age (UR) = year of Vehicle Classification and Standard VDF Value Calculating ESA 20, with traffic growth (i) Calculating the traffic growth multiplier (R) Value of the Multi Traffic Multiplier (TM) = 1.8 - 2.0 Determining the Lane Distribution Factor (DL) Calculation of CESA4, CESA5 and 20 years ESA Selection of Pavement Type Solution Design 2 Foundation Minimum road Design flexible pavement minimum cost option Thickness of pavement layer ACWC, ACBC, CTB and LPA (hardened structure).

2.7 Drainage

Drainage which comes from English (drainage) means to drain, drain, remove, or divert water. In the field of civil engineering, in general drainage can be defined as an action to reduce excess water, which comes from rain, seepage, or excess irrigation water from an area / land, so that the function of the area / land is not disturbed. Drainage is also defined as an effort to control groundwater quality in terms of sanitation. So, it concerns not only surface water but also ground water.

3. Result and Discussion

3.1 Research Location Data

Research location this final project was carried out at Jalan Raya Gumitir KM.231- KM.233, Jember Regency which is a class I highway (province). Traffic conditions on the Gumitir highway there are many heavy vehicles (trucks, trailer trucks, trailers / semitrailers), Bus). This is because the location of this study is a road link between Jember regencies - Banyuwangi and Bali. Thus, the traffic conditions are dominated by freight transport. In this study, I will evaluate or recalculate the thickness of flexible

pavement using the 2013 Bina Marga method [6]. On the Gumitir highway, it has a road width of = 6.70 meters with a shoulder width of 1.00 to 1.50 meters. By comparing the results of the calculation (analysis) in these two methods, it is hoped that it will give a technical picture of the thickness of the hardness [8].

3.2 Traffic Survey Result Data

Vehicle volume data (LHR) is taken 2 days (weekdays & weekends) from direct observation on Jalan Gumitir, Jember Regency at 06.00 to 06.00 WIB (24 hours), the following results are obtained:

Table 2. Hourly Traffic Volume Data

No	Transportation Type	Direction		Amount
		Jember	Banyu wangi	
1	Motorcyle, 3 Wheel, Vespa	6770	6406	13176
2	Light Vehicles, Private Cars, Pick Ups, Box Cars, Delivery Cars	4112	4227	8339
3	Bus	155	244	399
4	Truck 2 As	408	656	1064
5	Truck 3 As	511	153	664
6	Trailers Trucks, Semi/Trailers	251	260	511
7	Non-Motorized Vehicles	15	20	35
Amount		7687	7679	155661

No	Transportation Type	Direction		Amount
		Jember	Banyu wangi	
1	Transportation Type	6770	6406	13176
2	Motorcyle, 3 Wheel, Vespa	4112	4227	8339
3	Bus	155	244	399
4	Truck 2 As	408	656	1064
5	Truck 3 As	511	153	664
6	Research Flow	80	66	146
7	Trailer Trucks, semi/ Trailers	26	14	40
Amount		12062	11766	23828

3.3 Capacity and Degree of Saturation

The calculation of capacity uses equations and steps according to the manual MKJI as follows:

C = Co X Fcw X FCsp X FCsf X FCcs
Co = 2900
FCw = 0,91
FCsp = 1,00
FCsf = 1,00
FCcs = 0,94
C = 2480 smp/hours

Based on the above calculations, it is obtained that the capacity of the Gumitir highway in Jember Regency is 2480 smp / hour.

3.4 Degree Of Saturation, DS

The degree of saturation is the ratio of the volume value (flow value) of traffic to its capacity. This is a description of whether a road flow has a problem or not, based on the assumption that if the road section is closer to its capacity, the ease of movement will be limited. Based on the definition of degree of saturation, DS is calculated as follows:

Q = 472,513
C = 2480
DS = Q/C
= 0,190529 smp/hour

So that by entering the value of road volume and capacity into the degree of saturation formula, the value of the degree of saturation is obtained: 0.190529 pcu / hour.

3.5 Road Service Level

After obtaining the value of the degree of saturation (DS), then based on the service level table with DS = 0.190529 the observed roads belong to the service level category A (DS = 0.00 - 0.19).

From the results of the traffic volume calculation above, it can be concluded that the Rogojampi Highway towards Blimbingsari Airport is included in the service level category A has the following characteristics:

a) Free flow conditions at high speed.
b) Low traffic volume.
c) Road users can choose the desired speed without obstacles.

3.6 Calculation of the Bina Marga Method 2013

Calculation of flexible pavement using the 2013 Bina Marga method, the steps are as follows:

- Determination of the Design Life (UR) = 20 years of Vehicle Classification and Standard VDF Value
- Calculate ESA 20, with traffic growth (i) = 5%
- Calculating the traffic growth multiplier (R)
- Value of Multi Traffic Multiplier (TM) = 1.8 - 2.0
- Determining the Lane Distribution Factor (DL)
- Calculation of CESA4, CESA5 and ESA 20 years of Selection of Pavement Type
- Minimum Path Foundation Design 2 Solution
- Minimum cost option bending pavement design
- Pavement thickness of ACWC, ACBC, CTB and LPA (pavement structure)

In planning the drainage network and channels, first we have to know the maximum discharge design with a certain birthday and the researcher plans the maximum discharge for 5 years, from this discharge the dimensions of the channel can be planned. For the dimensions of the channel using a square channel, among others:

The bottom channel width (b) is the width at the bottom of the channel = 0.6 m.

The depth of flow (h) is the vertical distance from the lowest point on a channel section to the free surface and for the value of h the economic section = b / 2 = 0.6 m. Finding the values of b and h is done by trial and error. The peak width (T) is the cross-sectional width of the channel on the free surface, because the channel is square, so the value of T = b = 0.6 m.

In this thesis research, for planning analysis, observation and calculation using the 2013 Highways Method towards existing data, the compilers can draw some conclusions as follows:

Performance conditions on the highway class I (province) KM.231 - KM.233, Garahan District, Jember Regency based on a survey of 2 days weekdays and weekends obtained traffic volume in 2018 = 640.67 vehicles / hour, obtained DS = 0.190529 pcu / vehicle / hour with service level (A), namely the condition of high speed flow and low traffic volume. The driver can choose the speed he wants without a hitch. Meanwhile, for forecasting traffic conditions with the assumption i = 5%, it is obtained that Q = 1699.885 vehicles / hour with DS in 2038, namely 0.685438 with the service level (C) is that the zone must be stable, the driver is limited in choosing his speed.

To determine the drainage discharge, a general formula is used, namely

A = The base section of the channel = 0.36 m2

V = Flow rate in line = 0.045 m / s

Q = V x A

= 0,045 x 0,36

= 0,016 m3/sec

For the calculation of flexible pavement thickness, the Bina Marga 2013 method

HRS WC = 3 cm

HRS Base = 3,5 cm LPA Class A = 37,5 cm

The results for channel dimensions b = 0.6 m and h = 0.6 m are planned for 2 km from KM 231-233 with a drainage gradient value of 12% using cemented masonry materials.

4. Conclusion

Based on the above conclusions, the compilers will convey some suggestions and hopes that they can be used as input (references) in order to improve road performance on the Gumitir highway, Garahan District, Jember Regency, especially KM.231 - KM.233. The compiler's suggestions are as follows:

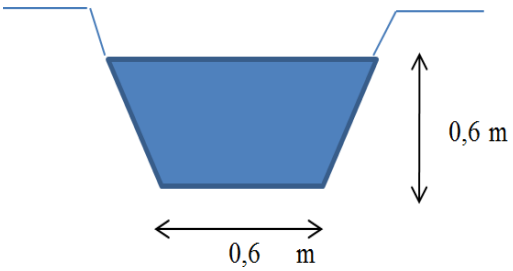

Figure 1. The compiler's suggestions

It is necessary to recalculate the thickness of the pavement using the Bina Marga 2013 method. This is because there are heavy vehicles on this route (Java-Bali). The need for enforcement of regulations for transport loads (tonnage) on heavy vehicles on the Gumitir highway, especially KM.231- KM. 233.The local government needs to carry out supervision that keeps the drainage environment clean regularly and continuously.

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