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Comparison of Road Overlay Layer Thickness Using the Components Analysis Method and Deflection Analysis Method on Roads Limbangan – Malangbong

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Abstract---*Highway is one of the transportation infrastructure in Indonesia which is often used to support economic activities, especially on provincial roads. However, often on provincial roads there are damages to road pavements which disrupt motorists' comfort. Limbangan - Malangbong road segment is a road with provincial road status. So that road construction can serve traffic flow according to the age of the plan, it is necessary to have a good pavement plan, because then the pavement construction is capable of carrying the burden of vehicles passing on it. This study aims to compare flexible pavement designs using component analysis methods and deflection analysis method. From the analysis results, the overlay thickness with the component analysis method is 8 cm and the backward deflection method is 4 cm. It was also concluded that the results of CBR testing from STA 0 + 100 to 4 + 070 were majority below 6% which means that the land needs to be compaction first.*

Keywords---*Provincial Road, Overlay, Component Analysis Method, Reverse Deflection Method.*

I. INTRODUCTION

Limbangan - Malangbong road section is a road with the status of a provincial road, where this road is used for inter-city lanes, which are dominated by heavy vehicles such as buses and freight trucks. The Limbangan - Malangbong road section is 11 km long, and has a width of 7 m. In this study the road that was reviewed for 2 km from sta 0 + 005 to sta 2 + 000.

In this study a comparison was made between the method of planning the pavement thickness method SKBI Analysis Component 1987 and Reverse Deformation Method. To find out which pavement is thicker than the two methods above. The data obtained is secondary data

II. LITERATURE REVIEW

Flexible pavement or asphalt pavement is a pavement with asphalt as the binding material. In general, flexible pavements consist of a layer of asphalt surface which is above the upper foundation layer and bottom foundation layer which is spread over the subgrade.

According to Sukirman (1999), flexible pavement is composed of four main layers, namely: the surface layer (surface course), upper foundation layer (base course), bottom foundation layer (subbase course), subgrade layer (subgrade).

According to Guntoro (2014) Flexible pavement construction is pavement that uses asphalt as a binding material. The pavement layers are bearable and cause a load of subgrade traffic. A flexible pavement structure usually

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consists of several layers of material, where each layer will receive a load from the layer above it, continue and spread the load to the layer below it. So the lower the layer structure, the lower the load held.

In the Guidelines for Thick Layered Planning Add Bending Pavement with Deflection Analysis Method Pd. T-05-2005-B (2005) stated that the definition of overlay is an additional pavement layer installed above the existing pavement construction with the aim of increasing the strength of the existing pavement structure in order to serve the planned traffic during the period will come.

Benkelman Beam is a tool used to measure back deflection, direct deflection and pavement turning points that illustrate the strength of the pavement structure (Bina Marga, 2005). The use of this tool is very effective for determining the strength of the structure without causing damage to the road surface. From the test results, the maximum return deflection value, turning point deflection and deflection concave (SNI 2416, 2011) will be obtained.

III. METHOD

III.I. SKBI 1987 Component Analysis Method

The following are the parameters needed to design a pavement thickness plan using the 1987 SKBI Analysis Component Method.

- Traffic Plans

  The traffic data is searched, namely: Track Number and Vehicle Distribution Coefficient (C), Equivalent Numbers (E) Vehicle Axis Load, Average Daily Traffic and Cross Equivalent Formulas.

- Baseline Carrying Capacity (DDT) and CBR

  Use correlation charts to find DDT values.

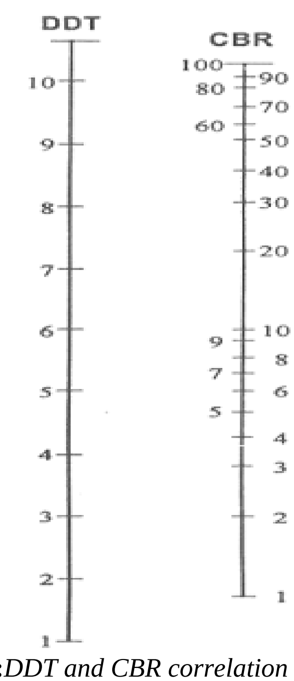

Figure-1:*DDT and CBR correlation graph.*

- Regional factors

  Regional factors are only influenced by alignment (slope and bend), percentage of heavy vehicles and climate (rainfall).

- Surface Index (IP)

  The following are the IP values along with their understanding:

  IP = 1.0 Stating the road surface is in a state of severe damage so it is very disturbing
  vehicle traffic.

  IP = 1.5 Declares the lowest possible service level (uninterrupted road).

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IP = 2.0 Declares low service levels for roads that are still sufficient.
IP = 2.5 Stating the road surface which is still quite stable and good.

- Pavement Thickness Index (ITP)
  To find the Pavement Thickness Index (ITP) value using a Nomogram according to the IP and IPO values (in the IP nomogram indicated by IPt), which can be seen in the following figure.

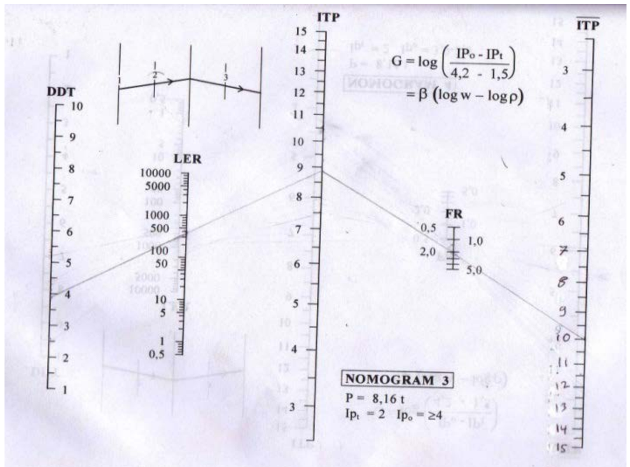

Figure-2.*ITP Nomogram no 3 (P = 8.16 t ; Ipt =2 ; Ipo ≥ 4).*

III.II.Deflection Analysis Method (Pd-T-05-2005-B)

The Pd-T-05-2005-B method is an overlay thickness guideline that establishes rules and procedures for calculating flexible pavement layer thickness based on the strength of the pavement structure illustrated by deflection values. In this method, traffic analysis is defined as Cumulative Equivalent Standard Axles (CESA). To find out the value of CESA can be done using the following formula.

$$\mathbf{CESA} = \sum_{\mathbf{Tractor-Trailer}}^{\mathbf{MP}} \mathbf{m\ x\ 365\ x\ E\ x\ C\ x\ N}$$

Information:
CESA = Equivalent accumulation of standard axle loads
m = Number of each type of vehicle
365 = Number of days in one year
E = Equivalent vehicle axle load
C = Vehicle distribution coefficient
N = Relationship age plan with traffic development.

The deflection value used in planning is the return deflection value obtained from the Benkelman Beam test results and must be corrected by groundwater factor, temperature and test load. The formula used is:

$$\mathbf{d_b = (d_3 - d_1)x\ Ft\ x\ Cax\ FK_{B-BB}}$$

d1 = Deflection when the load is at the starting point of measurement (mm)
d3 = Deflection when the load is at a distance of 6 meters from the measurement point (mm)
Ft = Factor of deflection adjustment to standard temperature (35º C)
Ca = Groundwater influence factor
FK B-BB = Correction factor for test load beam beam

The calculation of the overlay layer thickness carried out at each test point will provide a more accurate design result, another way that remains in accordance with the rules is by dividing the segments based on considering the

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uniformity of deflection. To determine the deflection uniformity factor, the following formula is used.

$$\mathbf{FK} = \frac{\mathbf{S}}{\mathbf{d_R}}\mathbf{x100} < FKpermit$$

Information:
FK = Deflection uniformity factor (%)
FK permit = Allowable uniformity factor
dR = Average deflection on a section of road = 0% - 10%;
Uniformity is very good = 11% - 20%;
Good uniformity = 21% - 30%;
Uniformity is quite good The amount of deflection which represents a sub-section or section of the road is adjusted to the function or class of roads and is determined using the following formula.

$$D_{plan} = 22.208\ x\ CESA^{-0.2307}$$

Information:
Drencana = Deflection plan (mm)
CESA = Equivalent standard axle load accumulation (ESA)

The size of the added layer thickness is determined using the following formula.

$$\mathbf{Ho} = \frac{\mathbf{ln}\ (\mathbf{1.0364})\mathbf{x}\ \mathbf{ln}(\mathbf{Dsbl\ ov})\mathbf{x}\ \mathbf{ln}(\mathbf{Stl\ ov})}{\mathbf{0.0597}}$$

Information:
Ho = Added layer thickness before correction
Dsbl ov = Deflection before overlay or Representative
Dstl ov = deflection after added layers or drafts

IV. RESULT AND ANALYSIS

IV.I. SKBI 1987 Component Analysis Method

The results of the thick layer thickness calculation obtained using the component analysis method, namely:

- Thickness of overlay layer with asphalt type LASTON (concrete asphalt) = 8 cm
- The thickness of the foundation layer with the UPPER LASTON (concrete asphalt) type (existing data) = 15 cm.
- The thickness of the bottom foundation layer with SIRTU (rock sand) class A (existing data) = 30 cm.

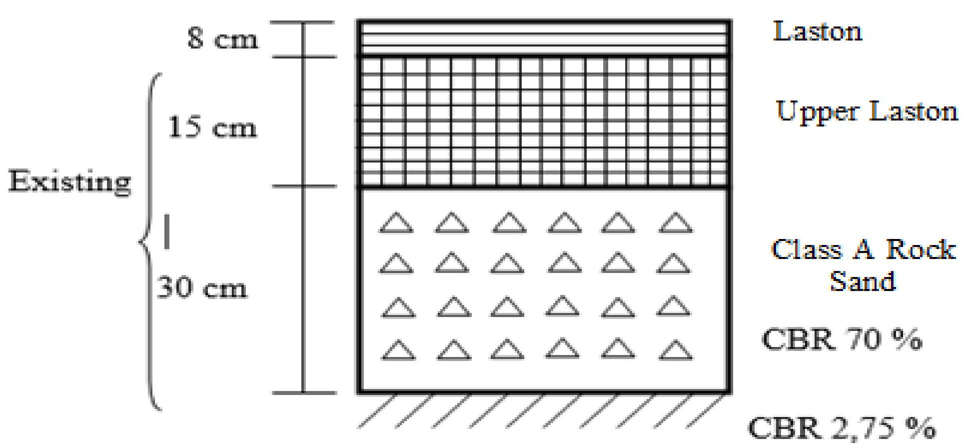

Figure-3. *The overlay layer thickness results from the calculation of the component analysis method.*

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IV.II. Deflection Analysis Method (Pd-T-05-2005-B)

Deflection analysis is carried out by dividing the road into several segments, where in this study the road segment is divided into 2 segments I, namely sta 0 + 005 to 0 + 800 and segment II namely sta 0 + 800 to 2+000. Segment division is based on the uniformity of deflection data indicated by the deflection uniformity factor (FK).

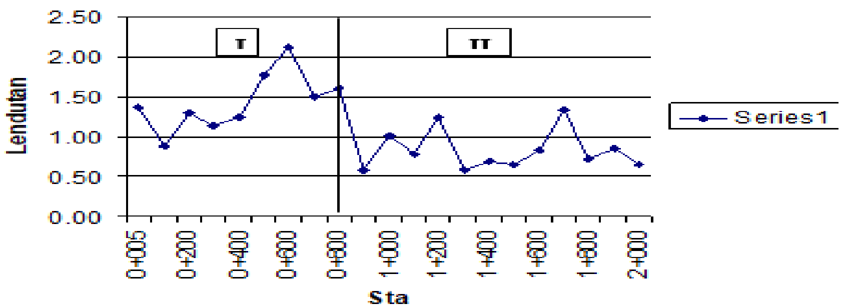

Figure-4.*Deflection graph from the calculation of Benkelmen Beam.*

From the graph, the FKpermit value for segment I is 26.43% and segment II is 30%. This figure shows that the road deflection is quite uniform, so no special handling is needed.

The results of the calculation of the added layer thickness are obtained using the backward deflection method, namely:

- The thickness of the overlay layer with the type of asphalt LASTON (concrete asphalt) = 3.57 cm (rounded up to 4 cm).
- The thickness of the foundation layer with the UPPER LASTON (concrete asphalt) type (existing data) = 15 cm.
- The thickness of the bottom foundation layer with SIRTU (rock sand) class A (existing data) = 30 cm.

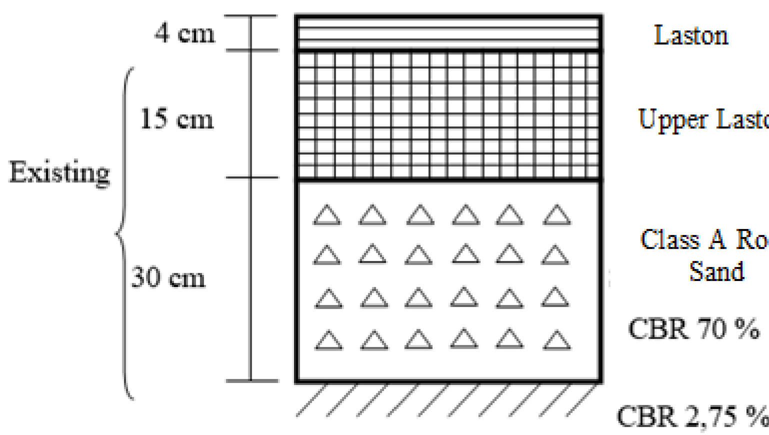

Figure 5:*The overlay layer thickness is the result of the countdown method.*

V. CONCLUSION

From the results obtained, it can be seen that there are differences in the overlay layer thickness of the two methods. This difference can be caused by several factors as follows:

1. *Calculation method*

   To determine the final thickness of the pavement, the component analysis method uses analytical methods, while the deflection method uses the graphical method.

2. *Calculation parameters*

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No	Component Analysis Method	Deflection Analysis Method
a.	Using CBR to find the value of soil carrying capacity.	Using the temperature of each existing pavement layer, to determine the return deflection value at each point.
b.	Using FR as a correction factor for environmental conditions.	Use the standard deviation value to determine the return deflection value for each section.
c.	Using IP values in determining the condition of road strength.	In searching for the value of pavement thickness, a graph of intersection is used between the deflection before the added layer (Dpermit), and deflection after the added layer (Y).
d.	Using the value of the relative strength coefficient, for the value of the strength of the material used.	

3. *How to collect data (Jabarullah et al., 2019)*
   a. Component Analysis Method.
      i. Test Pitch was conducted to find out the thickness of each existing pavement layer.
      ii. CBR values are obtained from DCP tests in the field.
      iii. Traffic counting is done for 3 days, during peak hours.

b. Backlash Method
   i. Use deflection test to find out the remaining age strength of the plan from the road.
   ii. Retrieves temperature data on the surface layer.
   iii. Traffic counting is done for 3 days, each of 8 hours.

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