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# EVALUATION OF KM-4 CONCRETE PAVEMENT THICKNESS, LEMO VILLAGE ACROSS NORTH BARITO REGENCY

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## ABSTRACT

Roads are transportation infrastructure used by the Indonesian people to carry out daily mobilization activities so that the volume of vehicles that pass through these roads affects their capacity and carrying capacity. Along with developments in North Barito Regency, one of which is the road in Lemo Village, it has become an alternative road to the road section of the capital city of Central Kalimantan Province, Palangka Raya.

Planning for widening the Lemo Village road has the aim of determining the thickness of the rigid pavement which is guided by the Road Pavement Design Manual Number 02/M/BM/2017 and controlled using the Cement Concrete Road Pavement Planning guideline Pd T-14-2003 and then calculates the Budget Plan. on the widening of the Km 4 concrete pavement of Lemo Seberang Village.

In planning the thickness of rigid pavement structures using the Road Pavement Design Manual Number 02/M/BM/2017, the concrete slab = 26.5 cm; LMC foundation layer = 10 cm; Drainage layer = 15 cm and using Cement Concrete Pavement Planning Guidelines Pd T-142003 obtained concrete slab = 25 cm; foundation layer = 10 cm. In addition, for data on field conditions in the form of a concrete slab = 25 cm; layer of concrete K-125 = 10 cm, then the efficient pavement thickness is taken, namely the Cement Concrete Pavement Planning Guidelines Pd T-14-2003 which is more efficient than field conditions. And also in writing this final project, it also discusses the Budget Plan for the widening of the KM 4 concrete pavement, Lemo Seberang Village, North Barito Regency.

**Keywords**: Road Pavement Design Manual Number 02/M/BM/2017, Guidelines for Planning Cement Concrete Road Pavement Pd T-14-2003, Budget Plan

## 1. PRELIMINARY

North Barito is one of the districts in the province of Central Kalimantan. North Barito itself has an area of8,300 km². North Barito has a village in the Teweh Tengah area, a village about 20 km from the district capital, Muara Teweh.

The traffic on the Lemo village road connects the various villages in the Central Teweh Region, and the more advanced the development, the Lemo village road eventually becomes a pass through to the road segment to the provincial capital of Central Kalimantan, Palangka Raya. With that, the road widening was made which aims to facilitate vehicle traffic that passes using the road to the capital city of Palangka Raya Province.

Pavement widening must be carried out by determining whether the pavement widening is one-sided or two-sided, taking into account the available road space (Rumija). Pavement widening work will be carried out using concrete pavement.

## 2. LITERATURE REVIEW

Road pavement is divided into 4 (four) parts, namely:

1. Flexible Pavement
2. Rigid Pavement
3. Composite Pavement
4. Paving Block

The pavement structure consists of several layers, namely:

1. Surface Coating
2. Foundation Layer
3. Bottom Foundation
4. Subgrade

Road classification is divided into:

1. Classification by road function
2. Classification based on coaching authority
3. Classification based on axle load

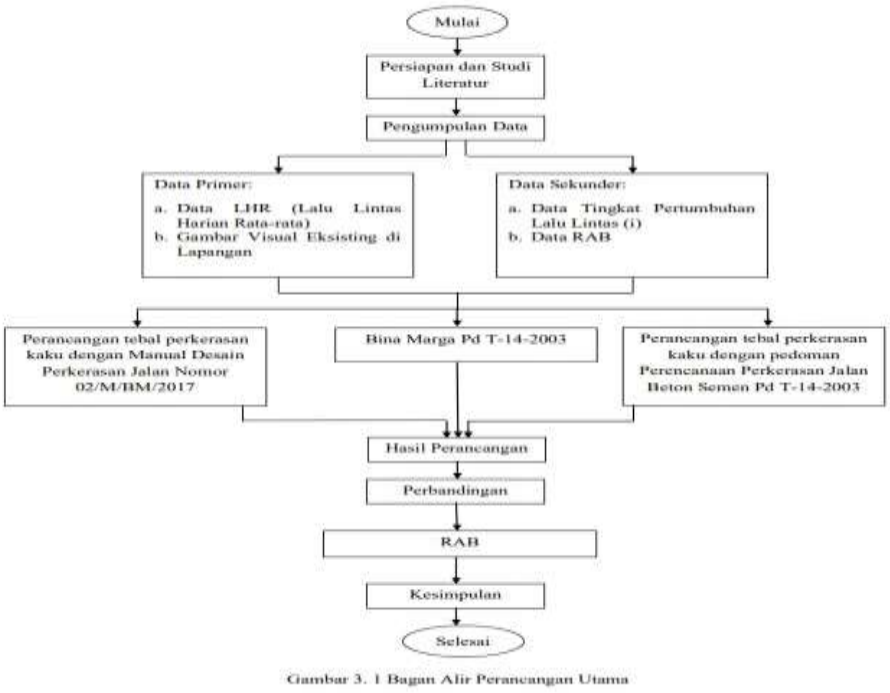
Calculation of Pavement Thickness with Road Pavement Design Manual No. 02/M/BM/2017

Based on the procedures contained in the Design Guidelines for Rigid Pavement ThicknessRoad Pavement Design Manual Number 02/M/BM/2017 Ministry of Public Works Directorate General of Highways 2017.

As for the calculation steps, determining the CBR assessment of the subgrade, for the distribution of commercial vehicles and the type/load of the axle, selecting the type of connection, type and thickness of the subbase, effective CBR, selecting the load safety factor, determining the shoulder of the road, selecting the tensile and compressive strength of the concrete. age of 28 days, and estimate the thickness of the concrete slab. Then determine the repetition of permits followed by analysis of fatigue and erosion. if the erosion damage as well as the fatigue damage is less than 100%, determine the design thickness.

Complementary buildings and road equipment that will be designed are the design of markings, lighting, drainage systems and box culverts.

## 3. RESEARCH METHODS




Gambar 3. 1 Bagan Alir Perancangan Utama

**Image 1.**Main Design Flowchart

## 4. RESULTS AND DISCUSSION

1. Average Daily Traffic Data Analysis (LHR)

**Table 1**LHR data

| Jenis Kendaraan | Lalu lintas Harian (1 hari) Muara Teweh - Lemo | | Jumlah | LHR TAHUN (356 HARI ) KENDARAAN PER TAHUN |
|---|---|---|---|---|
| | kanan | kiri | | |
| Sepeda Motor, Sekuter, Roda 3 | 1817 | 1223 | 3040 | 1082240 |
| Sedan, Wagon, Angkot, Pick-up | 54 | 28 | 82 | 29192 |
| Bus Kecil | 0 | 0 | 0 | 0 |
| Bus Besar | 0 | 0 | 0 | 0 |
| Truk Ringan 2 Sumbu | 4 | 2 | 6 | 2136 |
| Truk Sedang 2 Sumbu | 1 | 0 | 1 | 356 |
| Truk 3 Sumbu | 0 | 1 | 1 | 356 |
| Truk Gandeng | 0 | 0 | 0 | 0 |
| Truk 5 Sumbu Trailer | 0 | 0 | 0 | 0 |
| Total | | | 3130 | 1114280 |

*Source: Calculation Results*

2. CBR Data Analysis

- Normal Method

| No | Titik | STA | CBR (%) |
|---|---|---|---|
| 1 | 1 | 0 + 000 | 4,5 |
| 2 | 2 | 0 + 100 | 3,3 |
| 3 | 3 | 0 + 200 | 3,2 |
| 4 | 4 | 0 + 300 | 3,0 |
| 5 | 5 | 0 + 400 | 3,3 |
| 6 | 6 | 0 + 500 | 3,6 |
| 7 | 7 | 0 + 600 | 3,6 |
| 8 | 8 | 0 + 700 | 2,6 |
| 9 | 9 | 0 + 800 | 2,0 |
| 10 | 10 | 0 + 900 | 2,9 |
| 11 | 11 | 1 + 000 | 3,3 |
| 12 | 12 | 1 + 100 | 2,2 |
| Jumlah | | | 37,5 |

**Table 2**Field CBR Data

*Source: Calculation Results*

From Table 4.2 it can be calculated the average CBR value and standard deviation from the data obtained as follows:

Average CBR = 3.1%

Standard deviation = 0.7%

f value:

f = 1.645 (95% probability), for toll roads or expressways.

f = 1,282 (90% probability), for collector and arterial roads.

f = 0.842 (80% probability), for local roads and small roads.

The value of n at CBR < 6% = 12. The calculation of the CBR characteristics is as follows:

Characteristic CBR = mean CBR – fx standard deviation

CBR characteristics = 3.1 – 1.282 x 0.7

CBR characteristics = 2.2%

- Percentile Method

The CBR values are sorted from the same or greater number and in percentage as in Table 4.3 below:

**Table 3**Subgrade CBR Percentage Data

| No | CBR (%) | JUMLAH SAMA & LEBIH BESAR | PERSEN SAMA ATAU LEBIH BESAR (%) |
|---|---|---|---|
| 1 | 2,0 | 12 | 100,00 |
| 2 | 2,2 | 11 | 91,67 |
| 3 | 2,6 | 10 | 83,33 |
| 4 | 2,8 | 9 | 75,00 |
| 5 | 2,9 | 8 | 66,67 |
| 6 | 3,2 | 7 | 58,33 |
| 7 | 3,2 | 6 | 50,00 |
| 8 | 3,3 | 6 | 50,00 |
| 9 | 3,3 | 6 | 50,00 |
| 10 | 3,3 | 6 | 50,00 |
| 11 | 3,6 | 2 | 16,67 |
| 12 | 4,5 | 1 | 8,33 |

*Source: Calculation Results*

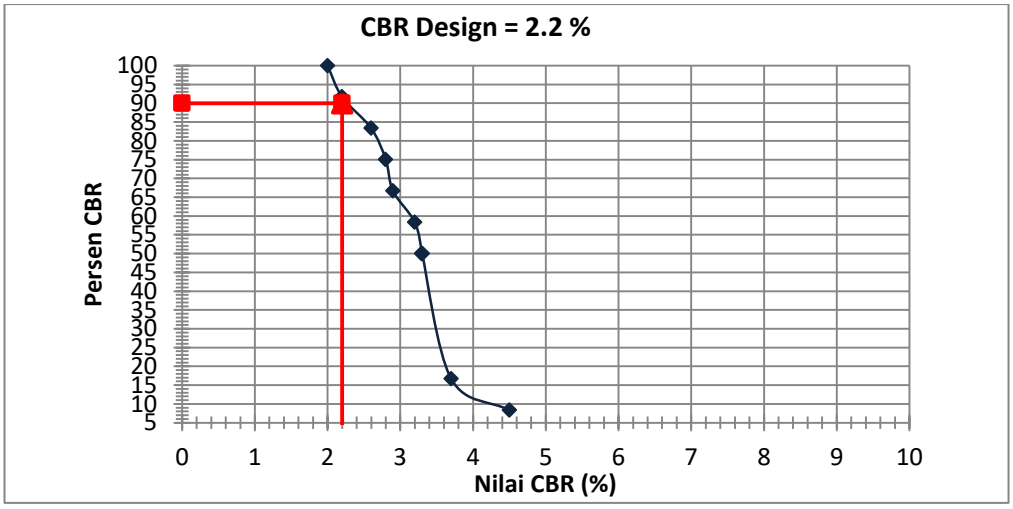



**Figure 2**Graph of CBR Subgrade Value Relationship in a Graphical Way

From table 3, the CBR value is taken by calculating using Microsoft excel with the PERCENTILE function, the characteristic result is 2.2%. And also in the graph of Figure 2 also obtained CBR with a value of 2.2%.

**I. Design With Road Pavement Design Manual Number 02/M/BM/2017**

1. Planned Age

It is planned within 40 years based on the Road Pavement Design Manual No. 02/M/BM/2017.

2. Traffic Growth Factor

The traffic growth factor for the Kalimantan region for secondary roads is 3.5%.

3. Subgrade CBR

With the normal method and the subgrade CBR percentage method, it was obtained 2.2%.

4. Rigid Pavement Thickness Design

Determination of rigid pavement structure is determined based on the calculation of the repetition of the axle of commercial vehicles. Which is adjusted to the pavement tableNo. 02/M/BM/2017.

Table 4 Traffic Load Based on Number of Axle Groups of Heavy Vehicles

| Jenis Kendaraan | Jml. Kel. Sumbu (bh) | LHR 2020 (bh) | Kel. Sumbu 2020 (bh) | Jml. Kel. Sumbu 2020 - 2060 (bh) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 = 2 x 3 | 5 = 4 x 365 x 0,5 x 1 x R |
| (5B) | 2 | 0 | 0 | 0,00 |
| (6A) | 2 | 6 | 12 | 88200,53 |
| (6B) | 2 | 1 | 2 | 14700,09 |
| (7A2) | 2 | 1 | 2 | 14700,09 |
| (7C2A) | 3 | 0 | 0 | 0,00 |
| Kumulatif Kel. Sumbu Kend. Berat 2020 - 2060 | | | | 117.601 |

*Source: Calculation Results*

From the cumulative results of the heavy vehicle axes in Table 4 above, the cumulative results are obtained as follows.

Table 5 Rigid Pavement for Roads with Heavy Traffic Load

| Struktur Perkerasan | R1 | R2 | R3 | R4 | R5 |
|---|---|---|---|---|---|
| Kelompok sumbu kendaraan berat (*overloaded*) (10E6) | < 4.3 | < 8.6 | < 25.8 | < 43 | < 86 |
| Dowel dan bahu beton | Ya | | | | |
| STRUKTUR PERKERASAN (mm) | | | | | |
| Tebal pelat beton | 265 | 275 | 285 | 295 | 305 |
| Lapis Fondasi LMC | 100 | | | | |
| Lapis Drainase (dapat mengalir dengan baik) | 150 | | | | |

*Source: Road Pavement Design Manual No. 02/M/BM/2017*

## II. Calculation of Pavement Thickness Using Guidelines Pd T-14-2003

Plan data

1. CBR : 2.2%
2. Concrete quality : Tried K-250, K-300, K-350, K-400
3. Sub foundation material : CBK
4. Friction coefficient (μ) : 1.8 (cement stabilization)
5. Roadside : Yes
6. Ruji (dowel) : Yes

Cement concrete pavement is planned for 1 lane 2 way road for secondary road. Planning includes Conjoined Concrete Pavement with Reinforcement (BBDT).

a. Traffic Analysis

The steps for calculating the number of axes can be seen from Table 6 below:

| Jenis Kendaraan | Konfigurasi Beban Sumbu (ton) | | | | Jml. Kend. (bh) | Jml. Sumbu Per Kend. (bh) | Jml. Sumbu (bh) | STRT | | STRG | | STdRG | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RD | RB | RGD | RGB | | | | BS (ton) | JS (bh) | BS (ton) | JS (bh) | BS (ton) | JS (bh) |
| 1 | 2 | | | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Mobil Penumpang | 1 | 1 | | | 3486 | | | | | | | | |
| | | | | | | | | 4 | 0 | | | | |
| Bus Besar | 5 | 8 | | | 0 | 2 | 0 | 5 | 0 | 8 | 0 | | |
| Truk Ringan 2 As | 2 | 4 | | | 6 | 2 | 12 | 2 | 6 | | | | |
| | | | | | | | | 4 | 6 | | | | |
| Truk Sedang 2 As | 5 | 8 | | | 1 | 2 | 2 | 5 | 1 | 8 | 1 | | |
| Truk Besar 3 As | 6 | 14 | | | 1 | 2 | 2 | 6 | 1 | | | 14 | 1 |
| Truk Semitrailer | 6 | 14 | | 14 | 0 | 3 | 0 | 6 | 0 | | | 14 | 0 |
| | | | | | | | | | | | | 14 | 0 |
| Total | | | | | | | 16 | | 14 | | 1 | | 1 |

Table 6 Calculation of the Number of Axes by Type and Load

*Source: Calculation Results*

The vehicle traffic growth factor (R) can be determined using the following formula:

$$R = \frac{(1+\mathrm{i})^{40} - 1}{i}$$

$$R = \frac{(1+3.5\%)^{40} - 1}{3.5\%}$$

$$R = 84.55$$

Number of Commercial Vehicle Axis (JSKN) during the plan life of 40 years

$$JSKN = JSKNH \times 365 \times R$$

$$= 16 \times 365 \times 84{,}55$$

$$= 493{,}773.62$$

$$JSKN\ rencana = JSKNH \times C$$

$$= 493{,}773{,}62 \times 0{,}45$$

$$= 222{,}198{,}13$$

b. Calculation of Axis Repetition that occurs

Table 7 Calculation of Axis Repetition

| Jenis Sumbu | Beban Sumbu (ton) | Jumlah Sumbu | Proporsi Beban | Proporsi Sumbu | Lalu Lintas Rencana | Repetisi yang Terjadi |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 = 4 x 5 x 6 |
| STRT | 6,00 | 1,00 | 0,07 | 0,88 | 493773,62 | 30860,85 |
| | 5,00 | 1,00 | 0,07 | 0,88 | 493773,62 | 30860,85 |
| | 4,00 | 6,00 | 0,43 | 0,88 | 493773,62 | 185165,11 |
| | 2,00 | 6,00 | 0,43 | 0,88 | 493773,62 | 185165,11 |
| Total | | 14,00 | 1,00 | | | |
| STRG | 8,00 | 1,00 | 1,00 | 0,06 | 493773,62 | 30860,85 |
| Total | | 1,00 | 1,00 | | | |
| STdRG | 14,00 | 1,00 | 1,00 | 0,06 | 493773,62 | 30860,85 |
| Total | | 1,00 | 1,00 | | | |
| Kumulatif | | | | | | 493773,62 |

*Source: Calculation Results*

c. Plate Thickness Calculation

Based on the CBR of the subgrade obtained from the previous calculation, using the graph method, it is obtainedFor subgrade which has a CBR of 2.2%, a 100 mm CBK foundation thickness is used.

And according to the safety factor table, it is known that the magnitude of the load safety factor for arterial roads is 1.1.

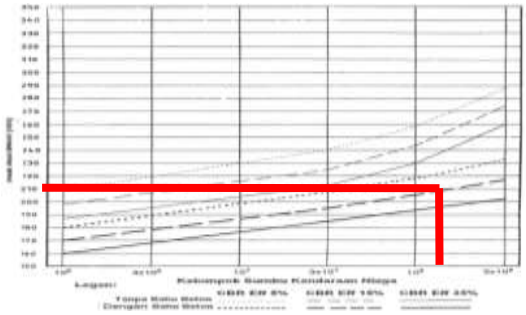
Withempirical formula, the flexural tensile strength of concrete with K-300 quality is:

$$f_{cf} = K \times \sqrt{fc'}$$

$$f_{cf} = 0{,}75 \times \sqrt{250 \times 0{,}083}$$

$f_{cf} = 3{,}42 Mpa$

The minimum thickness value of the concrete slab that will be used in this plan is shown in Figure 3 below.



*Source: Cement Concrete Road Pavement Planning Pd T-14-2003*

Figure 3 Planning Graph fcf = 4.25 MPa, Traffic outside the City, with Ruji, FKB = 1.1

From the graph above, it can be concluded that the minimum thickness of the concrete slab is 210 mm with a planned JSKN of 1.21x108.

Determining the fatigue and erosion analysis can be done by using the permissible load repetition nomogram (Fatigue Factor) and the allowable load repetition nomogram (Erosion Factor).

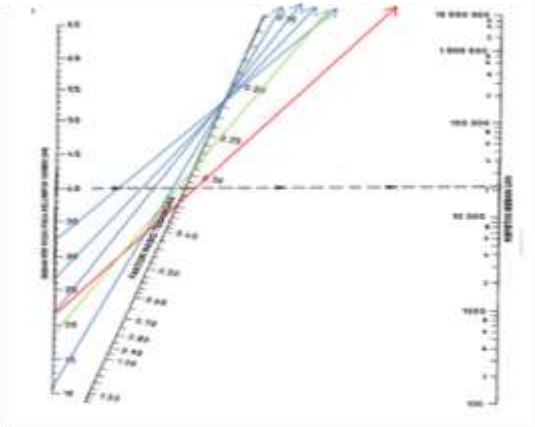


Figure 4. Analysis of Fatigue and Permit Loads Based on Stress Ratio with or Without Reinforcement

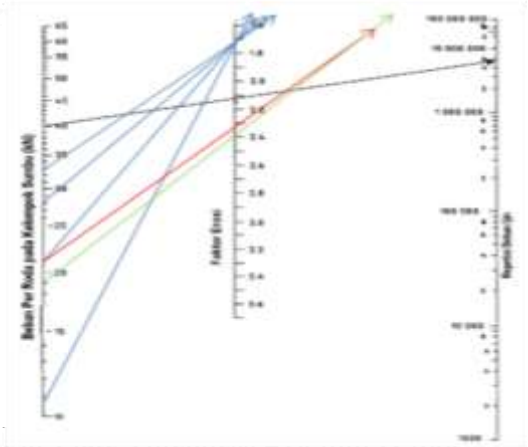


Figure 5 Erosion Analysis and Number of Repetition of Permit Loads Based on Erosion Factors with

Table 8 Fatigue and Erosion Analysis of 210 mm thick slab with concrete quality K-250

| Jenis Sumbu | Beban Sumbu ton (kN) | Beban Rencana Per Roda (kN) | Repetisi yang Terjadi | Faktor Tegangan dan Erosi | Analisa Fatik | | Analisa Erosi | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Repetisi Ijin | Persen Rusak (%) | Repetisi Ijin | Persen Rusak (%) |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 = 4 x "100" / 6 | 8 | 9 = 4 x "100" / 8 |
| STRT | 6 (60) | 33,00 | 30860,85 | TE = 0.8 | TT | 0 | TT | 0 |
| | 5 (50) | 27,50 | 30860,85 | FE = 1.71 | TT | 0 | TT | 0 |
| | 4 (40) | 22,00 | 185165,11 | FRT = 0.21 | TT | 0 | TT | 0 |
| | 2 (20) | 11,00 | 185165,11 | | TT | 0 | TT | 0 |
| STRG | 8 (80) | 22,00 | 30860,85 | TE = 1.27 | TT | 0 | TT | 0 |
| | | | | FE = 2.31 | | | | |
| | | | | FRT = 0.34 | | | | |
| STdRG | 14 (140) | 19,25 | 30860,85 | TE = 1.08 | TT | 0 | TT | 0 |
| | | | | FE = 2.39 | | | | |
| | | | | FRT = 0.29 | | | | |
| Total (%) | | | | | 0 | | 0 | |

*Source: Calculation Results*

For analysis results K-250, K-300, K-350, K-400, with plate thicknesses of 150 mm, 200mm, 210 mm, 250mm, 300mm, and 350mm can be seen in Table 9 below:

Table 9 Calculation Results of Fatigue and Erosion Analysis

| Tebal Pelat (mm) | Mutu Beton | Analisa Fatik (%) | Cek | Analisa Erosi (%) | Cek |
|---|---|---|---|---|---|
| 150 | K-250 | 97,06 | < 100% | 9,26 | > 100% |
| | K-300 | 22,63 | < 100% | 9,26 | > 100% |
| | K-350 | 6,94 | < 100% | 9,26 | > 100% |
| | K-400 | 0,03 | < 100% | 9,26 | > 100% |
| 200 | K-250 | 0 | < 100% | 0 | < 100% |
| | K-300 | 0 | < 100% | 0 | < 100% |
| | K-350 | 0 | < 100% | 0 | < 100% |
| | K-400 | 0 | < 100% | 0 | < 100% |
| 210 | K-250 | 0 | < 100% | 0 | < 100% |
| | K-300 | 0 | < 100% | 0 | < 100% |
| | K-350 | 0 | < 100% | 0 | < 100% |
| | K-400 | 0 | < 100% | 0 | < 100% |
| 250 | K-250 | 0 | < 100% | 0 | < 100% |
| | K-300 | 0 | < 100% | 0 | < 100% |
| | K-350 | 0 | < 100% | 0 | < 100% |
| | K-400 | 0 | < 100% | 0 | < 100% |
| 300 | K-250 | 0 | < 100% | 0 | < 100% |
| | K-300 | 0 | < 100% | 0 | < 100% |
| | K-350 | 0 | < 100% | 0 | < 100% |
| | K-400 | 0 | < 100% | 0 | < 100% |
| 350 | K-250 | 0 | < 100% | 0 | < 100% |
| | K-300 | 0 | < 100% | 0 | < 100% |
| | K-350 | 0 | < 100% | 0 | < 100% |
| | K-400 | 0 | < 100% | 0 | < 100% |

With analysis of fatigue and erosion at Pd T-14-2003, the value of fatigue and erosion that is closest to 100% is obtained at 200 mm thick slab, and the quality of concrete K-250 with 0% fatigue value and 0% erosion. But by using the method of Design Manual No. 02/M/BM/2017 obtained 265 mm thick slab. And used, 200 mm thick slab with concrete quality K-250. A cross-section of the road can be seen in the following figure:

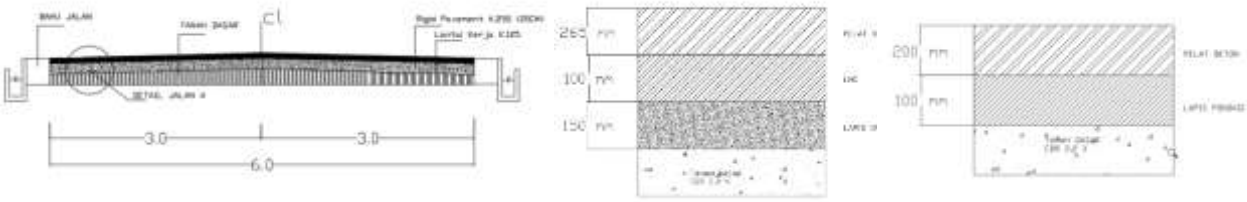



Figure 6. Cross-section of the road,Thickness of Rigid Pavement with Road Pavement Design Manual 2017 and Thickness of Rigid Pavement with Pd-T-14-2003

d. Calculation of Continuing Pavement with Reinforcement

a) Plate Thickness = 200 mm
b) Foundation Width = 4 x 3 m
c) Plate Length = 5 m
d) Steel clearance tensile strength = 240 MPa
e) Gravity = 9.81 m/s
f) Concrete quality = k-250

Transverse Reinforcement

$$As\ perlu = \frac{\mu.\,L.\,M.\,g.\,h}{2.fs}$$

$$As\ perlu = \frac{1{,}8 \times 12 \times 2.400 \times 9{,}81 \times 0{,}200}{2 \times 240}$$

$As\ perlu$ =211.90 mm2/m'

Minimum axles are obtained from the SNI-2002 guide

$$As_{min} = 0{,}1\% \times 200 \times 1.000$$

$As_{min}$ =200 mm2/m' < = 211.90 mm2/m'$As_{perlu}$

Number of Reinforcements

$$\frac{1}{4}\pi.\emptyset^2.n = As_{min}$$

$$\frac{1}{4}\pi.12^2.n = 211{,}90\ mm^2$$

$$n = 1{,}87\ buah \rightarrow digunakan\ n = 2\ buah$$

Distance between reinforcement

$$S = \frac{{}^1/_4.\pi.\emptyset^2.1.000}{As_{perlu}}$$

$$S = \frac{1/4 . \pi . 12^2 . 1.000}{211{,}90} = 533{,}74\ mm$$

Then use reinforcement$Ø12 - 450\ mm$

Elongated Reinforcement

$$As\ perlu = \frac{\mu . L . M . g . h}{2 . fs}$$

$$As\ perlu = \frac{1{,}8 \times 5 \times 2.400 \times 9{,}81 \times 0{,}200}{2 \times 240}$$

$$As\ perlu = \ 88{,}29\ mm^2/m$$

Minimum axles are obtained from the SNI-2002 guide

$$As_{min} = 0{,}1\% \ \times 200 \times 1.000$$

$$As_{min} = \ 200\ mm^2/m \ > \ As\ perlu = 88{,}29\ mm^2/m$$

Number of Reinforcements

$$\frac{1}{4}\pi . Ø^2 . n = As_{min}$$

$$\frac{1}{4}\pi . 12^2 . n = 200\ mm^2$$

$$n \ = \ 1{,}77\ buah \ \rightarrow digunakan\ n = 2\ buah$$

Distance between reinforcement

$$S = \frac{1/4 . \pi . Ø^2 . 1.000}{As_{perlu}}$$

$$S = \frac{1/4 . \pi . 12^2 . 1.000}{200} = 1.280{,}98\ mm$$

Maka dipakai tulangan $Ø12 - 225$ mm

e. Dowel Planning

the selection of tie rods or dowels can be determined based on the thickness of the plate with a CBR of 2.2 is 200 mm, a dowel diameter of 33 mm is required, with a length (L) of 450 mm and the distance (s) between the dowels is 300 mm. Sketch of the transverse shrinkage and expansion joints with Dowels in the following figure:

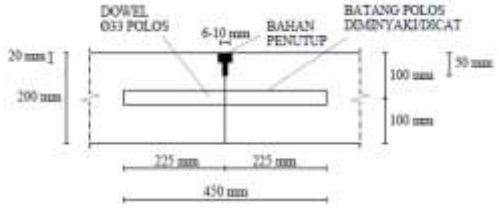



Figure 4.8 Image of Transverse Shrinkage Connection with Dowel

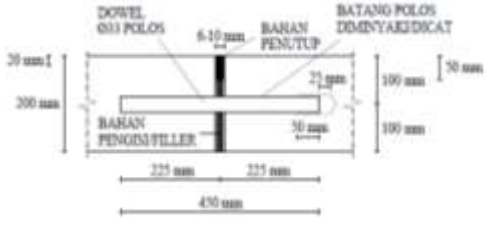



Figure 4.9 Image of Expanded Connection with Dowel

f. Tie Bar Planning

For Tie Bar planning, the tie bar diameter D16 is taken with a length of 1000 mm and a maximum distance of 750 mm. Tie Bar sketch for 200 mm plate thickness can be seen in the following figure:

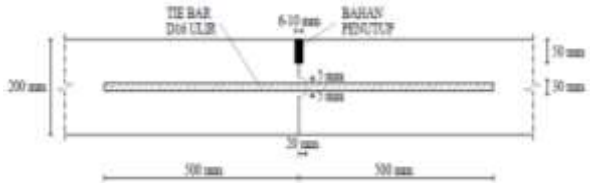


Figure 4.10 Connection with Tie Bar for 200 mm . Plate Thickness

## III. Calculation of the Draft Budget

1. Basic Unit Price (HSD) of Labor.

The basic unit price (HSD) of labor or also the basic unit price of wages is the amount of costs required to employ workers in accordance with the expertise and number of workers. For the basic unit price (HSD) of labor in this calculation, it is based on the basic data of North Barito Regency in 2019.

| HARGA DASAR SATUAN UPAH | | | | |
|---|---|---|---|---|
| NO | URAIAN | SATUAN | HARGA YG DIGUNAKAN (Rp.) | HARGA SATUAN (Rp.) |
| 1 | PEKERJA | JAM | 19.642,86 | Rp 137.500,00 |
| 2 | TUKANG | JAM | 23.571,43 | Rp 165.000,00 |
| 3 | MANDOR | JAM | 27.107,14 | Rp 189.750,00 |
| 4 | OPERATOR | JAM | 55.000,00 | Rp 385.000,00 |
| 5 | PEMBANTU OPERATOR | JAM | 23.571,43 | Rp 165.000,00 |
| 6 | SOPIR / DRIVER | JAM | 39.285,71 | Rp 275.000,00 |
| 7 | PEMBANTU SUPIR/ DRIVER | JAM | 39.285,71 | Rp 165.000,00 |
| 8 | MEKANIK | JAM | 23.571,43 | Rp 330.000,00 |
| 9 | PEMBANTU MEKANIK | JAM | 47.142,86 | Rp 165.000,00 |
| 10 | KEPALA TUKANG | JAM | 25.142,86 | Rp 176.000,00 |
| 11 | OPERATOR ALAT RINGAN | JAM | 39.285,71 | Rp 275.000,00 |
| 12 | PEMBANTU OPERATOR ALAT RINGAN. | JAM | 23.571,43 | Rp 165.000,00 |

Figure 4.11 Basic Price in 2019 North Barito Regency

2. Basic Unit Price (HSD) Tool.

Basic Unit Price (HSD) of tools is the amount of costs incurred on the components of tool costs which include definite costs or operating costs per certain unit of time, to produce one unit of measurement for a particular job.

| HARGA SATUAN DASAR ALAT. | | | | | |
|---|---|---|---|---|---|
| NO. | JENIS ALAT | KODE ALAT | SATUAN | HARGA SATUAN (Rp.) | JUMLAH HARGA (Rp.) |
| 1 | BULLDOZER 100-150 HP | E04 | JAM | 250.000 | 250.000 |
| 2 | DUMP TRUCK 3.5 TON | E08 | JAM | 238.837,14 | 238.837,14 |
| 3 | EXCAVATOR 80-140 HP | E10 | JAM | 27,7884 | 27,7884 |
| 4 | CONCRETE VIBRATOR | E20 | JAM | 59.292,48 | 80.961,61 |
| 5 | CONDRETE MIXER (250) | E47 | JAM | 112.941,71 | 154.217,60 |
| 6 | WANTER TANKER | E23 | JAM | 364.239,17 | 364.239,17 |

Figure 4.12 List of Project Base Unit Prices

3. Basic Unit Price (HSD) of Material

The basic unit price of the material has factors that affect the price of the material, namely the quality, quantity and location of origin of the material. And the basic unit data of materials in this analysis calculation serves as a control over the contractor's bid price

| HARGA SATUAN DASAR BAHAN | | | | | |
|---|---|---|---|---|---|
| NO. | URAIAN | KODE | SATUAN | HARGA SATUAN (Rp.) | KETERANGAN |
| 1 | PASIR PASANG (SEDANG ) | M01B | M3 | 373.900,00 | LOKASI PEKERJA |
| 2 | PASIR BETON (KASAR) | M01A | M3 | 373.900,00 | LOKASI PEKERJA |
| 3 | KERIKIL SUNGAI/KERIKIL GUNUNG | M06.a | M3 | 398.300,00 | LOKASI PEKERJA |
| 4 | BAHAN TANAH TIMBUNAN | M08 | M3 | 42.000,00 | LOKASI PEKERJA |
| 5 | BAHAN PILIHAN | M09 | M3 | 52.500,00 | LOKASI PEKERJA |
| 6 | SEMEN/PC (50KG) | M12 | ZAK | 84.000,00 | LOKASI PEKERJA |
| 7 | SEMEN/PC (KG) | M12 | KG | 1.680,00 | LOKASI PEKERJA |
| 8 | BESI BETON | M13 | KG | 15.205,00 | LOKASI PEKERJA |
| 9 | KAWAN BETON (BENDRAT) | M14 | KG | 20.900,00 | LOKASI PEKERJA |
| 10 | PAKU KAYU | M18 | KG | 33.000,00 | LOKASI PEKERJA |
| 11 | PAKU ULIN | M166 | KG | 1.375.000,00 | LOKASI PEKERJA |
| 12 | PAPAN BEKISTING | M19 | M3 | 8.635,00 | LOKASI PEKERJA |
| 13 | BENSIN / PERTALITE | M20 | LITER | 11.550,00 | LOKASI PEKERJA |
| 14 | SOLAR DEX | M21 | LITER | 33.000,00 | LOKASI PEKERJA |
| 15 | MINYAK PELUMAS / OLIE | M22 | LITER | 44.000,00 | LOKASI PEKERJA |
| 16 | PIPA PVC 1" | (-) | BTG | 2.500,00 | LOKASI PEKERJA |

Figure 4.13 Unit Price of Materials

4. Calculation of Work Volume

**1. Excavation / Floor Work.**

V = Length of road x Width of road x Thickness of excavation

= 373 x 4.50 x 0.50

= 83.90 m3

**2. Cement Concrete Pavement Works**

V = Length of road x Width of road x Thickness of slab

= 373 x 4.50 x 0.50

= 83.90 m3

**3. PVC pipe procurement work 1” length 4 m**

$=\frac{370}{5} x\ 12\ x\ 0{,}30 : 4$

= 66.60 btg

**4. Reinforcement/Reinforcement Works**

For the volume of reinforcement is in table 4.14

PEMBESIAN DOWEL (RIGID LEBAR 4,5 M)

| KODE | BENTUK | Ó | a | b | c | L | N | Kg/M | Berat (Kg) |
|---|---|---|---|---|---|---|---|---|---|
| D1 | | 19 | 0,5 | | | 0,5 | 6 | 2,23 | 6,69 |
| D2 | | 10 | 2,05 | | | 2,05 | 8 | 0,617 | 10,12 |
| D3 | | 8 | 0,10 x 2 | 0,10 x 2 | 0,05 x 2 | 0,5 | 12 | 0,395 | 2,37 |
| | | | | | | | | JUMLAH | 19,18 |
| | | | | | | | | JUMLAH 2 SEGMEN | 38,36 |

PEMBESIAN TIE BAR (RIGID LEBAR 5 M)

| KODE | BENTUK | Ó | a | b | c | L | N | Kg/M | Berat (Kg) |
|---|---|---|---|---|---|---|---|---|---|
| D1 | | 12 | 0,6 | | | 0,6 | 14 | 0,887 | 7,45 |
| D2 | | 10 | 4,3 | | | 4,3 | 8 | 4,3 | 21,22 |
| D3 | | 8 | 0,10 x 2 | 0,10 x 2 | 0,05 x 2 | 0,5 | 12 | 0,395 | 5,53 |
| | | | | | | | | JUMLAH | 34,20 |

5. Budget Plan Recapitulation

The recapitulation of the cost budget plan is part of the calculation of the cost budget plan which functions to recap the results of the unit price analysis calculations.

**REKAPITULASI**

**PERKIRAAN HARGA PEKERJAAN**

| | |
|---|---|
| **Program** | **: Pembangunan Jalan dan Jembatan** |
| **Kegiatan** | **: Pembangunan Jalan** |
| **Pekerjaan** | **: Pelebaran Jalan Negara KM. 4 - Ds. Lemo Seberang** |
| **Lokasi pekerjaan** | **: Kecamatan Teweh Baru** |

| No. Divisi | Uraian | Jumlah Harga Pekerjaan (Rupiah) |
|---|---|---|
| 1 | Umum | 36.732.327,14 |
| 2 | Drainase | |
| 3 | Pekerjaan Tanah Dan Geosintetik | 27.297.648,86 |
| 4 | Pelebaran Preventif | |
| 5 | Pekerasan Berbutir Dan Perkerasan Beton Semen | |
| 6 | Perkerasan Aspal | |
| 7 | Struktur | 2.367.829.706,86 |
| 8 | Rehabilitasi Jembatan | |
| 9 | Pekerjaan Harian Dan Pekerjaan Lain-Lain | 7.644.000,00 |
| 10 | Pekerjaan Pemeliharaan Kinerja | |
| (A) | Jumlah Harga Pekerjaan ( *termasuk Biaya Umum dan Keuntungan* ) | 4.527.272.727,27 |
| (B) | Pajak Pertambahan Nilai ( PPN ) = 10% x (A) | 452.727.272,73 |
| (C) | JUMLAH TOTAL HARGA PEKERJAAN = (A) + (B) | **4.980.000.000,00** |
| Terbilang : | *" EMPAT MILYAR SEMBILAN RATUS DELAPAN PULUH JUTA RUPIAH "* | |

Figure 4.13 Job Price Recapitulation 4.15

## CONCLUSION

Average Daily Traffic Data (LHR). For the State Road section Km 4 - Ds Lemo Seberang along ± 2,800.00 m in 2020 based on the cumulative axis group, namely as many as 25,739,854 pieces (twenty five thousand seven hundred thirty nine eight five four). And the field CBR data obtained from the DCP (Dynamic Cone Penetrometer) test using 2 methods, namely:

a. Normal method get 2.2%
b. The percentile method gets 2.2%

The design of the pavement thickness using the road pavement design manual no. 02/M/BM/2017 with a design age of 40 years produces the following data.

a. Concrete slab = 26.5 cm
b. LMC foundation layer = 10 cm
c. Drainage layer = 15 cm

And for the Cement Concrete Road Pavement Planning method Pd T-14-2003, namely

a. Concrete slab = 20 cm
b. Foundation layer = 10 cm

And for the thickness of the pavement in the field, namely:

a. Concrete slab = 25 cm
b. Concrete layer k-125 = 10 cm

From the two methods above, a more efficient pavement thickness is taken, which is the result of the calculation of the concrete pavement planning method Pd T-14-2003 with a subgrade CBR of 2.2%. And for the type of rigid pavement that is used is the type of pavement with BBDT (CONTINUOUS CONCRETE PAVEMENT WITH REINFORCEMENT).

After calculating the pavement thickness planning, the author also calculatesPlanThe Cost Budget uses the 2019 Work Unit Price Analysis (AHSP) and the North Barito Regency Basic Price. And from the calculation of the budget plan, it only calculates the job description from division 1 (general) division 3 (earth work), division 7 (structure), and division 8 (returning conditions and minor work). So that the total cost of Rp. 4,980,000,000.00 (four billion nine hundred and eighty million rupiah).

### Suggestion

In planning for road pavement widening, accuracy is needed in analyzing the data that will be used, especially in calculating the average daily traffic as a cumulative standard load that will be used. to be more effective and efficient. If it can be updated

every year because every year the difference in the population using vehicles has a clear increase.

Traffic flow effects adjusted according to the 2017 pavement design manual.

**BIBLIOGRAPHY**

Ministry of Public Works, Directorate General of Highways. 2017. Road Pavement Design Manual 02/M/BM/2017. Jakarta.

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