EVALUATION OF FLEXIBLE PAVEMENT STRUCTURE USING AASHTO 1993 AND 2017 HIGHWAY DESIGN METHODS FOR ROAD DEVELOPMENT IN KARO REGENCY

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ABSTRACT

The development of road infrastructure is essential to support regional economic activities and improve accessibility, particularly in agricultural areas such as Karo Regency. This study aims to evaluate flexible pavement design for the Kutabangun–Kutakendit road section at STA 0+000 to STA 2+000 in Pola Tebu Village by applying and comparing the AASHTO 1993 method and the 2017 Revised Highways Pavement Design Manual. The analysis focuses on determining the appropriate pavement layer thickness to ensure structural performance and durability under traffic loads. The results indicate that the 2017 Revised Highways method produces a surface layer thickness of 100 mm, a base layer of 400 mm, and an embankment thickness of 175 mm, while the AASHTO 1993 method results in a surface layer thickness of 110 mm, a base layer of 230 mm, a subbase layer of 260 mm, and an embankment thickness of 100 mm. The comparison shows differences in structural composition and layer distribution between the two methods, which can be used as a technical reference in selecting an efficient and reliable pavement design to support long-term road performance and regional development.

Keywords: flexible pavement, AASHTO 1993, pavement design, highway engineering, infrastructure development

1. INTRODUCTION

Karo Regency is located in the Province North Sumatra including A large and bustling regency . The population of Karo Regency is increasing. with rapidly in years later This . Karo Regency is located on the plains tall in height between 600 to 1,400 meters above sea level surface valuable sea strategic For sector agriculture . As a strategic area for economy public can seen level economy resident specifically Karo people do not in accordance with Natural Resources owned . Many factors influence problems in Karo Regency , namely source Power human , condition geographical , narrow field work , care and protection to Karo society , and the difficulties access

infrastructure the road that expected .

According to (Bela et al. , 2018), the road highway is paths the land above surface earth made by humans with shapes , sizes and types the construction so that can used For distribute Then crossing of people , animals and vehicles carrying goods from something place to place other with easy and fast . Construction development infrastructure road is something that goes hand in hand with the progress of the modern era and the ideas of humans who use it , because road very much means important for man so that can reach desired goals aimed at .

Types of pavement road There is a number of that is Paving Flexible pavement, rigid pavement and pavement composite , which combines pavement rigid and hardened flexible . Especially in rigid pavement is made from good cement concrete bony or without reinforcement and often Lots used on sections roads that carry traffic volume cross vehicle heavy the high as well as common experience flood .

Liang Melas Datas is areas that have Several villages and hamlets located in the Karo Regency , North Sumatra Province , District Tigabinanga . Liang Melas Datas Road which connects Kutabangun-Kutakendit Village own activities every the day with marketing results harvest agriculture to the market. Decline land on infrastructure road as well as existing narrow path along road Kutabangun-Kutakendit is contributing factors no as appropriate sustainability function road , decline land on the road body Kutabangun-Kutakendit Lots caused by by condition natural with some example rainfall very heavy rain .

Many methods used For set thick pavement flexible road namely AASHTO 1993 Pavement Design Manual method , method analysis 1987 components , 2017 Revised Bina Marga method and method others . In writing This used The 2017 Highway Pavement Design Manual method and the 1993 AASHTO Pavement Design Manual method are is method pavement For pavement road new with load parameters axle standard equivalent (ESAL).

2. LITERATURE REVIEW

DEFINITION OF HIGHWAY

The road is one of the infrastructure transportation land in form whatever , including all part road including building complements and complements which is intended For for Then cross . The highway is something means infrastructure useful cross For passed vehicle from one region to another. Network road highway is fundamental infrastructure in the section transportation specifically For balance goods and services . Existence road highway very important needed improvement rate growth economy while with increasing needs infrastructure transportation can reach regions rural Where is source production results agriculture .

Development Power fit or the number of connected vehicle volumes to cities between Province and its limitations sources of funds in the development process infrastructure road highway as well as Not yet maximum operation facility infrastructure existing roads are the main ones in Indonesia and in all countries , especially countries that are in category growing . With connect section road new or improvement is very necessary in connection with addition cargo road highway of course it is very necessary

method effectiveness and efficiency in planning or in design so that obtained efficient and economical results , but with fulfil Terms and Conditions safety users road and no damage environment .

In the discussion This compilation review library intended For reviewer return libraries related to design development section roads , especially in matter This is Construction Design of the Kutabangun - Kutakendit Road Section . Foundation review This obtained from references related books and Highways regulations regarding Road Design . As for necessary conditions noticed in calculation design improvement section road Kutabangun - Kutakendit is condition pavement road .

2.2 ROAD CLASSIFICATION ACCORDING TO ROAD CLASS

Classification according to class road continuous improvement in ability For in accept burden Then cross , made on the load axis heaviest (MST) in ton units . And classification according to class the road and its conditions as well as relation to classification according to function road can specified in the table below This .

Table 1 Road Classification According to Class , Function , Dimension vehicles and cargo axis (RSNI T-14-2004)

Class Road	Function Road	Dimensions maximum and load axis heaviest (MST) vehicle motorized must accommodated		
		Wide (mm)	Long (mm)	MST (mm)
I	Arteries	2500	18000	> 10
II		2500	18000	10
IIIA		2500	18000	8
IIA	Collector	2500	18000	8
IIIB		2500	12000	8
IIIC	Local	2100	9000	8

2.3 TYPES OF HIGHWAY PAVEMENT CONSTRUCTION

Paving road is construction infrastructure built on top of layer land base (Subgrade). Function main pavement is spread burden wheel to the surface area land more basic wide compared to wide contact wheels and pavement , so that reduce voltage maximum that occurs on the ground base , namely at the pressure at which the soil base No experience deformation excessive during the service period pavement . System pavement must designed durable , so that No experience premature damage due to influence environment (water, oxidation , influence temperature). With thus give comfort during the service period road those . Types Paving road can differentiated on :

1. Construction pavement flexible pavement or pavement asphalt pavement, in general consists of from the surface layer asphalt located above the base layer and base layer lower granular spread on top land base .
2. Construction pavement rigid pavement or pavement concrete (concrete pavement), often used on the streets main and airport . On the pavement flexible consists of from a number of primary components such as surface layers , foundation layers top and foundation layers bottom , pavement rigid consists of from land base , foundation layer bottom and plate Portland cement concrete , with and without reinforcement .
3. Construction pavement composite or composite pavement is pavement combination between pavement Portland cement concrete and

pavement asphalt . Pavement consists of from concrete layers asphalt (asphalt concrete, AC) which is on top pavement Portland cement concrete or treated base course .

2.4 BASIC CONCEPT OF FLEXIBLE PAVEMENT

In a way general pavement flexible consists of from three layer main that is :

1) Layer surface course
2) Layer foundation top (base course)
3) Foundation layer subbase course

Following are the paving details flexible

Figure 1 Structure Paving Layer Paving Flexible

Layer surface (Surface Course) is consists of from the wear layer (wearing course) and binder course. Layer wear out must have durability , water resistance , flatness , and roughness . Therefore , the coating This must arranged from mixture paved hot mix, graded congested .

LFA Class A is layer foundation on part from pavement located below layer surface . LFA Class A loaded right above the foundation layer below , or when without LFA Class A, then location directly above land base . The foundation layer is very supportive burden heavy axle therefore layer foundation including part important pavement .

LFA Class B (Subbase Course) is a layer leveled between land base and foundation layer . In typical , foundation layer material lower self from granular material compacted or stabilized soil layers with added materials special . Foundation layer material subbase in general planned more low the quality than with material layer foundation (base). In some something events , layers foundation lower treated and mixed with cement , asphalt , lime , fly ash for add its strength . According to SNI-1732-1989-F and Pt T-01-2002-B , various types material with CBR ≥ 20% and index plasticity (PI) ≤ 10, ie more material Good than land basic , can used as layer foundation lower .

soil layer base is land have thickness special compacted . Subgrade functioning as a base/ foundation road , consisting of from material in excavation and embankment compacted with depth certain below base structure pavement . The more tall stiffness paving , then distribution pressure wheel to land base become more shrink . Because of this that , depth land base can varies and depends in size amount load and type pavement . Seen from advance land original , layer of soil base can described as below This :

a. Surface land original namely Repair land basis (if required) or capping layer (if required) needed)
b. Heap namely pile compacted at the design CBR
c. Excavation, namely repair land base or layer channel (if needed)

2.5 ASPHALT PAVEMENT METHOD OF BINA MARGA REVISION 2017

2017 Revision of the Directorate General of Highways Pavement Design Manual (MDP) is method more Lots used in Indonesia because it includes change structure presentation For make things easier understanding users and additions repair manual content . In the process of achieving calculation pavement flexible The 2017 revised Bina Marga method was carried out stages as following :

a. Determination age design is time Where expected pavement have ability

service before done work rehabilitation and ability the service Already end .

Influencing design parameters in age service overall from pavement is total load amount Then cross . Therefore That in depiction age design pavement concluded with term burden Then cross total design .

Past volume analysis cross defined as many rate transportation that passes through something road in observation with duration unit time (day , hour, or minutes). Traffic average daily is the traffic volume average cross in One day . Traffic average daily annual volume (ADR), namely the volume of traffic cross daily income earned with calculation average value of the number rate transportation during One year duration .

LHRT =

Rate volume analysis vehicle done with review direct or survey conducted by the Ministry Public Works and Housing People; Directorate General of Highways 2017:

- Survey review direct to field rate Then cross can done with period time at least 7 days in accordance with guidelines survey review direct to field Traffic rate (Pd T-19-2004-B).
- Results survey review direct to field rate vehicle Then cross previously .
- Assumption value on a road with rate vehicle Then cross low .

b. Equivalent Crossing is calculation influence burden equivalent that takes into account influence burden Then cross from various type configuration and size load , in form amount equivalent from something standard selected load . Calculation Equivalent based on burden axis can done in accordance provisions of SNI Pd T-05-2005-B , namely use formula :

Axis (STRT) = 1 x

Axis (STRG) = 0.086 x

Types of Equivalent Crosses as as follows :

- Equivalent Crossing The Beginning (LEP) is amount cross equivalent when beginning road built (early determination age design) and can counted with formula as following :
  LEP =
- Equivalent Axis (LEA) is size rate Then cross vehicle equivalent when moment end determination age design and can achieved when use formula as following :
  LEA =
- Equivalent Line (LET) namely amount rate Then cross average equivalent in age planning and can counted with formula as following :
  Center Equivalent Line) =
- Equivalent Crossing The plan (LER) is size rate Then cross equivalent the plan used in planning and analysis in calculation below This :
  LER = LET . (Adjustment Factor)

c. Index Surface at the beginning age design (IPo) is measurement ability serviceability of a construction road highway in accordance results review direct to field condition road , as following example damage like cracks , grooves , holes , roughness surface and others.

d. Layer Coefficient (a) is connection empirical between SN for something structure pavement with thick layer , which states ability relatively from a material so that can functioning as One component structural from its

hardening . In the guidelines planning thick pavement bending Pd. T-01-2002-B, coefficient strength relatively determined from AASHTO charts .

e. Pavement Thickness Index (is something determining value thickness of the pavement layer and written in equality following :

f. Determining the Type of Pavement namely in determination pavement that will be used can done based on rate Then cross , age design and situation land base road . Determination of pavement materials can be analyzed in the table below This .

Table 2 Determination Structure Pavement (Ministry of Public Works and Public Housing, Directorate General of Highways, 2017)

Structure Paving	Desig	ESA 20 years million)			
		0-0.5	0.1-4	4-10	10-3(
Rigid pavement for rate vehicle solid (above) land with CBR ≥ 2.5%)	4	-	-	2	2
Rigid pavement for rate vehicle loose (area remote and left behind)	4A	-	1.2	-	-
AC-WC modification or modified high school with CTB (ESA to the power of 5)	3	-	-	-	2
AC with CTB (ESA to the power of 5)	3	-	-	-	2
AC thickness ≥100 mm on the foundation layer grained (ESA ^{5})	3 B	-	-	1.2	2
Thin AC or HRS on the foundation layer grainy	3A	-	1.2	-	-
Burda or Burtu for LPA Class A or help original	5	3	3	-	-
Soil Cement foundation layer	6	1	1	-	-
Work without close (japat , jalan gravel)	7	1	-	-	-

g. Pavement Thickness Plan Design can calculated on pavement flexible determined in accordance CESAL value determination age design with thick plan composition pavement with choose chart 3b design method of Bina Marga Revision 2017.

Table 3 Composition Plan 3 B : Design Plan pavement flexible (Bina Marga 2017)

	Composition Paving		
	FFF $_{1}$	FFF $_{2}$	FFF $_{3}$
Determination Results			
Cumulative burden 20 year axis on the lane plan (10 ^{6} CESA $_{5}$)	< 2	≥2-4	>4-7
Thickness of Composition Layer Paving			
AC-WC	40	40	40
AC-BC	60	60	60
AC Base	0	70	80
LPA Class A	400	300	300
Notes	1		2

2.6 PAVEMENT LAYER THICKNESS DESIGN USING AASHTO 1993 METHOD

AASHTO 1993 method is something method common design used in determine thick pavement flexible road . AAHSTO 1993 method in in principle is method design in accordance in method empirical with use parameter size according to standard in design among them (Department Public Works , 2005).

a. Traffic is data and reference rate Then the route used in design construction thick pavement .
b. Structural Number (SN) is function than layer thickness of coefficient layer n (cefficient layer). The formula for Structural Number is got it described :
$SN = a_1 . D_1 + a_2 . D_2 . m_2 + a_3 . D_3 . m_3$
c. Traffic Plan (W_{18}) is many amount rate vehicles that must be applied in something direction with something track For determine design . Directional Distribution (DA) can counted in every direction amounted to 0.5 (50%) but there are also between 0.3 - 0.7. Traffic plan (W_{18}) can analyzed in equality description This :
$W_{18} = DA . DL . ESAL\ Design$
$ESAL\ Design = LER . R . 365 . ESA$
d. Equivalent Number (E) is mark Equivalent (E) in every part burden axle axis on each vehicle transportation .
e. Reliability is business that can count degrees degree of certainty at the stage design in ensure types alternative design can endure in accordance term planned time (age design).

Table 4 Submission level reliability For many kinds of classification road (Anai et al., 2019)

Road Classification	Reliability Level Submission	
	Urban	Rural
Toll road	85 - 99.9	80 - 99.9
Arteries	80 – 90	75 - 95
Collector	80 – 95	75 - 95
Local/ Environmental	50 – 80	50 - 80

f. Serviceability is mark ability service beginning For pavement flexible . Recommendation Po value = 4.2 and Pt value = 2.5 for road main , Pt value = 2.0 for the final volume cross low in accordance with provision according to AASHTO 1993.
g. The number of Lane Design is something track rate vehicles on the road road with cross-section rate vehicle Then cross .
h. The Layer Coefficient states connection empirical between SN for something pavement with thickness layer , which states relative ability of a material to function as something structural components of its hardening .
i. Resilient Modulus (Mr) is reject measuring capacity and layer foundation granular on detention deformation results from burden repeatedly . In some type land , when voltage rises, then characteristic the voltages No get linear results .
j. Pavement Thickness have condition thickness layer minimum pavement is shown in description This .

Table 5pavement layer thickness (inch) (Anai et. Al., 2019)

ESAL Design Traffic	Thickness of Asphalt Concrete
< 10000	1 inch (2.5 cm)
< 100000	1.5 inches (4 cm)
> 100000	2 inches (5 cm)

3. RESEARCH METHODS

STUDY LOCATION AND ROAD CLASS

Initial process part in carry out writing study This is process stage form in collection data references and calculations , in this process designed process stages required implemented For objective efficiency in design This is the location of the planning study. construction on the Kutabangun-Kutakendit Liang Melas Datas Road , Karo Regency , has begun from Kutabangun Village , Suka Julu Village, Kutambaru Village, Kuta Mbelin Village and ends in Kutakendit Village .

3.2 DATA ACCUMULATION UNION

In the completion process stage problem road at the location studies construction of this road section needed accurate calculations with data accumulated throughout reject measure the data used in the solution problem . The following This stages design data accumulation study This can implemented with use method following This .

a. Literature Study namely data accumulation process method can done with stages examine book reference .
b. Data accumulation can carry out survey direct to location projects and data accumulation from institution related .

In planning pavement structure on the Kutabangun-Kutakendit Liang Melas Datas Road Section , Karo Regency , which is located at the point Pola Tebu Intersection - Pola Tebu Village STA 0+000 - 2+000.

3.3 ENGINEERING DESIGNER

Secondary data can taken from authorized agency For can used in analyze the parameters to be used in planning of the Kutabangun-Kutakendit Road Section Liang Melas Datas Karo Regency , namely design thickness of pavement layer flexible with use Highway Pavement Design Manual Method Revised 2017 and AASHTO Method 1993.

4. RESULTS AND DISCUSSION

DATA ANALYSIS

From the analysis process and data obtained from field then the data for the Development Planning for the Kutabangun-Kutakendit Road Section at the Pola Tebu Village Point STA 0+000 - 2+000 is .

a. Road Status : Regency
b. Road Class : Class III B
c. Road Function : Collector
d. Road Length : 2 km
e. Speed Plan : 60 km/h
f. Road Type : 1 lane , 2 lanes , 2 directions
g. Pavement Width : 3.5 m
h. Road Shoulder Width : 1 m
i. Slope Road: 4% (Body) & 6 % (Shoulders)
j. Terrain Type : Hill
k. Age Roadmap : 20 Years
l. Pavement Type Plan : Lapen (Manual)
m. Plan Implementation : 2 years

4.2 PAVEMENT THICKNESS CALCULATION USING THE 2017 BINA MARGA METHOD

Structural layer thickness analysis pavement in design This is thick pavement flexible pavement with using procedure namely :

a. Daily Traffic Data road Kutabangun-Kutakendit can seen in description This .

Table 1Traffic Data for the Kutabangun-Kutakendit Road Section

Type Vehicle	VLHR
Vehicle light 2 tons	60
Pick Up	24
2 axle truck	16
Total	100

past data cross above determination Road Class is obtained on pressure Guardhouse the heaviest from plan type vehicles passing through road the namely 2 axle trucks can counted as following :

Load for STRT = 1 x = 3.37 tons

From the results calculation obtained heaviest axle load of 3.37 tons then in accordance table 2.1 then can concluded Road Class is Class III B and Collector Road Function .

b. Calculation Equivalent based on burden axis can counted with SNI Pd T-05-2005-B , namely use formula :

- Vehicle Light 2 tons

  I (Axis Load) = 2000 x 50 % = 1000

  E_1 = 1 x = 0.18

  E_2 = 1 x = 0.18

  E_{total} = 0.36

- Small Truck T1 2L 8.3 tons

  I_1 (Axis Load) = 8300 x 34 % = 2822

  I_2 (Axis Load) = 8300 x 66 % = 5478

  E_1 = 1 x = 0.52

  E_2 = 0.086 x = 0.05

  E_{total} = 0.57

- 2 Axle Truck (T1.2H) 18.2 Tons

  I_1 (Axle Load) = 18200 x 34 % = 6188

  I_2 (Axle Load) = 18200 x 66 % = 12012

  E_1 = 1 x = 1.14

  E_2 = 0.086 x = 0.12

  E_{total} = 1.26

c. Determining the Traffic Rate Growth Factor (R) can counted from equality with use formula :

Table 2Traffic Growth Factors

Vehicle Type	Traffic Growth	Beginning of Paving	Age 10th Plan	Age 20th Plan
Vehicle Light	1.00 %	60% x 3000 = 1800	1800 x (1+0.01) ^{10} = 1988.31	1800 x (1+0.01) ^{20} = 2196.34
Small Truck (T1, 2L)	1.00 %	24% x 3000 = 720	720 x (1+0.01) ^{10} = 795.32	720 x s(1+0.01) ^{20} = 878.53
2 Axle Truck (T1, 2H)	1.00 %	16% x 3000 = 480	480 x (1+0.01) ^{10} = 530.84	480 x (1+0.01) ^{20} = 585.69
Total		3000	3323.84	3660.56

d. Equivalent Crossing The onset (LEP) can be analyzed with description following .

- For Transportation Light

  LEP = 1988.31 x 1.00 x 0.36 = 715.79

- For Small Trucks

  LEP = 795.32 x 1.00 x 0.36 = 453.33

- For 2 Axle Trucks

  LEP = 530.21 x 1.00 x 1.26 = 668.06

  Total LEP = 1837.18

e. Equivalent Axis (LEA) can be analyzed with description following .

- For Vehicle Light

  LEA = 2196.34 x 1.00 x 0.36

= 790.68

- For Small Trucks

  LEA = 878.53 x 1.00 x 0.57

  = 500.76

- For 2 Axle Trucks

  LEA = 585.69 x 1.00 x 1.26

  = 737.96

  LEA_{total} = 2029.40

f. Equivalent Traverse (LET) can be analyzed with description following .

   LET = = 1922.29

g. Equivalent Crossing Plan (LER)

   LER = 1933.29 x 2 = 3866

h. Cumulative value burden equivalent standard axis age design analysis with description following .

- For ESA $_5$ (2022-2042) calculations on pick up vehicles are as following .

  ESA_{20} = (878, 53 . 1) . 365 . 0, 5 . 1 . 1

  = 160331.72

- For ESA $_5$ (2022-2042) calculations on vehicles 2 axle truck is as following .

  ESA_{20} = (585, 69 . 7,4) . 365 0, 5 . 1 . 1

  = 790974.34

  Total CESAL = 951306.06

  = 0.95 Million

i. Determining Foundation Design can done as following .

Table 4.3 3CBR values base method graphic

CBR	Same numbers or more big	% The same or more big	
2.33	11	11/11*100% =	100
2.62	10	10/11*100% =	90.9
2.95	9	9/11*100% =	81.8
3.11	8	8/11*100% =	72.7
4.27	7	7/11*100% =	63.6
4.62	6	6/11*100% =	54.5
5.27	5	5/11*100% =	45.5
5.53	4	4/11*100% =	36.4
6.27	3	3/11*100% =	27.3
7.34	2	2/11*100% =	18.2
9.34	1	1/11*100% =	9.1

Based on the table above , obtained chart relationship between CBR (%) and the same percentage or more large (%) that can seen as following .

Figure 1 CBR Graph

From the graph above, the CBR Criteria is obtained . is 2.62% and CESAL5 0.95 million then you get it results solution design foundation in table 2.2 , namely pile 175 mm option .

j. Determining Pavement Thickness Bina Marga 2017 method , namely based on results CESAL $_5$ calculation with value of 0.95 million can specified in table 2.3 of the 3B Pavement design scheme Flexible Asphalt with using Granular Layer that is :

   AC-WC = 4 0.00 mm

   AC-BC = 6 0.00 mm

   AC-Base = 0.00 mm

   LPA Class A = 40.00 mm



AC-WC = 40 mm
AC-BC = 60 mm
LFA Class A = 400 mm
Heap Option = 175 mm

Figure 4.2 2Details of the 2017 Bina Marga Method

4.3 AASHTO 1993 METHOD

Calculation thick pavement flexible AASHTO 1993 method can describe with stages below This .

a. In obtaining the Reliability Value

according to AASHTO 1993 value Standard Deviation (So) is required for Flexible Pavement is 0.35 and the value reliability For road urban is as following between 80-95, for design this is taken 85 .

b. Searching for Serviceability Value is big services received from the system the subsequent paving felt by the user road . The value of serviceability is number For become magnitude determinant level service functional by a system pavement structure road . With thus obtained mark :

Po = 4.2

Pt = 2.0

So the result of ΔPSI is Po-Pt = 4.20 - 2.00

= 2.20

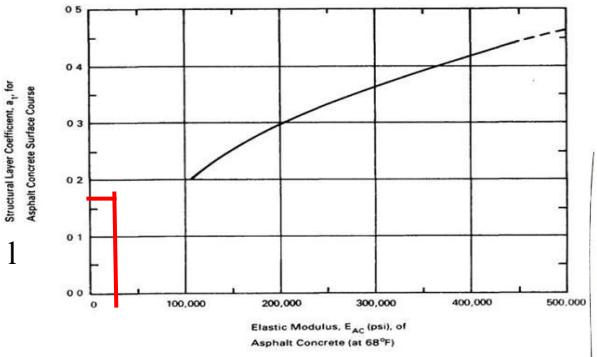
c. Resilient Modulus (MR) of soil base can determined as following

➢ MR on the ground basis

MR = 1500 , 00 . CBR of soil base

= 1500 , 00 . 2.62 %

= 3930 Psi



1

Figure 3 Chart Connection LFA KLS A Coefficient

➢ MR for foundation layer below CBR 90%

Figure 4 Chart Connection LFA KLS A Coefficient

➢ MR for foundation layer below CBR 60%

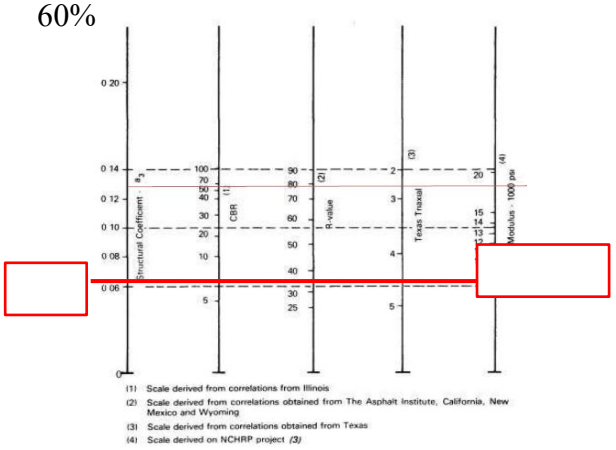


Figure 5 Chart LFA KLS B Relationship

Based on analysis Chart the so obtained determination mark coefficient strength relatively layer (a) with :

➢ $a_1 = 0.20$

➢ $a_2 = 0.134$

➢ $a_3 = 0.13$

d. For get SN value through stages elastic modulus number in each layer with moreover formerly known , then determination SN value in analysis seen in the following nomogram image .

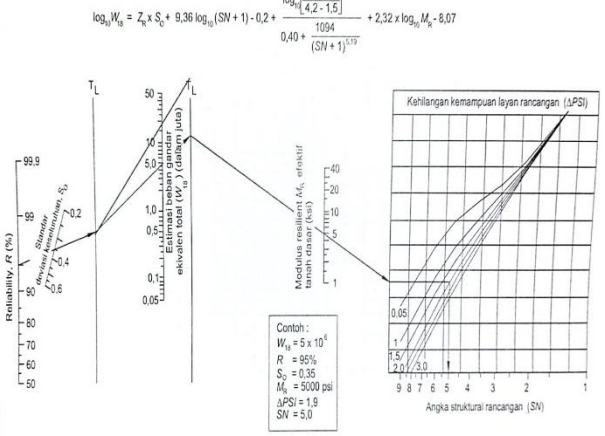


Figure 6 Nomogram Chart in determine pavement SN flexible (AASHTO 1993)

In the results analysis the nomogram graph above so can determined SN numbers are :

- SN1 = 0.90
- SN2 = 2.10
- SN3 = 1.70

e. Calculation thick pavement analysis with equality following :
SN = a_1 . D_2 . M_1 + a_3 . D_3 . M_2
m1 = 1
m2 = 1

- $D_1 \geq$ = = 4.5 inches = 11 cm
- SN_1 = a1 * $D_1 \geq SN_1$ = 0.20*4.5 = 0.90 (OK)
- D2 ≥ = = 8.95 inches = 23 cm
- $SN_1 + SN_2 \geq SN_2$ = 2.10 - 0.90 = SNI + SN2 = 2.10
- D3 ≥ D_3 = = 10 inches = 26 cm

Based on the above calculation is obtained thickness of pavement layer that is :
D_1 = 11 0 mm
D_2 = 23 0 mm
D_3 = 26 0 mm

4.4 COMPARISON OF RESULTS OF AASHTO AND BINA MARGA 2017 METHOD

Layer Type	Highways Revision 2017	AASHTO 1993
Layer Surface	100 mm	110 mm
LFA Class A	400 mm	230 mm
LFA Class B	-	260 mm
embankment Choice	175 mm	100 mm
Total	**675 mm**	**700 mm**

5. CONCLUSION AND SUGGESTIONS

FINAL CONCLUSION

Based on results analysis design , can be obtained results design development section road Kutabangun-Kutakendit that is :

1. Design analysis thick layer pavement flexible road Kutabangun-Kutakendit Liang Melas Datas Karo Regency which is located at the Pola Tebu Village point STA 0+000 - 2+000 which was carried out use The 2017 Revised Highway Pavement Design Manual Method is layer the surface obtained thickness of 100 mm, LFA class A is obtained thickness 400 mm, and embankment the choice obtained is 175 mm.
2. Calculation results thickness of pavement layer flexible road Kutabangun-Kutakendit Liang Melas Datas Karo Regency which is located at the Pola Tebu Village point STA 0+000 - 2+000 with use AASHTO 1993 method , namely layer the surface obtained thickness 110 mm, LFA class A obtained thickness 230 mm, LFA class B obtained thickness 260 mm, and embankment the choice obtained is 100 mm.

Suggestion

As for suggestions for evaluation Planning for the Development of the Kutabangun-Kutakendit Liang Melas Road Section in Karo Regency is :

1. Can be held research advanced about land road Kutabangun-Kutakendit Liang Melas Datas Karo Regency , especially those located in Pola Tebu Village for accuracy type hardening and thickness pavement .
2. For achievement resilience construction road in accordance age design so attempted implemented maintenance in a way periodically , for can anticipate damage structure pavement before age design . With thus road can functioning in accordance age design .

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