ROAD IMPROVEMENT DESIGN ANALYSIS ON PANGLESERAN – CIBATU ROAD SECTION

Ali Akbar Hanafiyah, Utamy Sukmayu Saputri
Civil Engineering Departement, Nusa Putra University, Sukabumi, INDONESIA
E-mail: ali.akbar_ts17@nusaputra.ac.id, utamy.sukmayu@nusaputra.ac.id

ABSTRACT

Highways are an important means for people to reach their destination. The main function of the road is as a service provider of traffic movement, making it easier for people to reach their destination, distributing goods quickly safely, comfortably, and economically. The road is not always in good condition, even a lot of damage to the pavement before the age of the road plan is reached. There are many cases of early damage to roads in Sukabumi Regency that are found during road improvement/construction activities. Road Section: Pangleseran – Cibatu is one of them that will be carried out Road Improvement/Construction in 2022. Because this road section already exists, it will only be implemented overlay/additional layer only. In search of additional pavement thickness used component analysis method SKBI 2.3.26.1987. Based on the results of the analysis for the road section: Pangleseran - Cbatu obtained thick pavement additional layers for the age of the plan 5 years with a thickness of 10 cm, while for the age of the plan 10 years is with a thickness of 14 cm. Type of pavement for road section: Pangleseran - Cibatu is cement concrete. As for the causative factors of road damage is due to the level of heavy vehicles ≥ 8 tons increased, and drainage systems are clogged due to sediment and closed disposal by the surrounding community.

Keywords: path; road improvement, SKBI 2.3.26.1987 pavement thickness.

INTRODUCTION

The development of highways is one of the things that always go hand in hand with technological advances and the results of human thinking. Therefore, the road is an important facility for people to reach their destination. The main function of the highway is to serve the movement of traffic, making it easier for people to achieve the destination and distribution of goods quickly, safely, comfortably and economically (Meynita Tri Nuryanti, 2011). However, road conditions are not always in good condition when passed by the user. This happens in the condition of the road in Sukabumi regency precisely on the pangleseran – Cibatu section, which is found a lot of damage early before the age of the road plan is reached.

Road upgrades are to improve the standard of service of existing roads either making the surface layer smooth, such as paving roads that are not yet on asphalt, or adding a layer of penetration (LAPEN), or adding a structural layer to strengthen the pavement, or widening the existing pavement layer (Dirjen Bina Marga, SK No.77/KPTS/Db/1990).

Based on data obtained in 2018 this road section has an average daily traffic that is not so dense that it is used laston wear-coated construction (AC-WC) with a maximum thickness of 4.00 cm. proposed improvements, used in traffic data in 2021.

In the study to determine the thickness of pavement is used SKBI method 2.3.26.1987, because in general this method is only used for new roads and on road improvement/construction.

A well-planned road is calculated based on the rules used. This road pavement thickness planning rule is binding, so it should not be ignored. Calculations with standard formulas, standards and in accordance with the situation at the road location. Site review is important to determine the behavior of the subgrade as a place for calculating LPA and LPB. Careful calculations and able to answer any problems in the field. The road geometry is planned according to standard standards. (Paikun.P. et.al, 2021; Paikun.P, et.al, 2021; Muharam.R, 2019; Syaiful.S, Akbardin.J, 2020; Syaiful.S, Lasmana.L, 2020 Syaiful.S, 2021).

PROBLEM FORMULATION

Based on the background described, the following problems are formulated:

1. Construction of pavement layer and thick pavement what is appropriate on the road: pangleseran – Cibatu with average daily traffic conditions (LHR) in 2021?

2. What factors affect road damage before the service life is completed in road improvement activities on the road: Pangleseran-Cibatu?

RESEARCH OBJECTIVES

The objectives of this study are:

1. Get thick pavement and road construction suitable for road improvement plan on the road: Pangleseran - Cibatu.

2. Know the factors that affect road damage before the service life is completed on road improvement activities on the road: Pangleseran – Cibatu.

ROAD UPGRADE

Road improvement is the activity of improving the quality of the road, usually a redevelopment of the pavement that is carried out repeatedly in a certain time interval, which aims to maintain the condition of the road according to planning during the service period. The scope of activities are:

1. Asphalt Reset

2. Resurfacing (*Overlay*)

3. drainage repair and manufacturing

4. Mixed Jobs

In road improvement, among others, using hot asphalt mixture. Hot asphalt mixture is a mixture consisting of a combination of aggregates mixed with asphalt. This mixed layer is intended to obtain a surface layer on pavement (Dirjen Bina Marga, SK No.77/KPTS/Db/1990).

TYPES OF ASPHALT MIXTURES

There are several asphalt mixtures, including:

1. Latasir (thin layer asphalt sand / sand sheet) class A and B

   This layer is a layer of asphalt road surface cover whose thickness for Class A Latasir (SS-A) is 1.5 cm consisting of a mixture of fine aggregate or sand and hard asphalt mixed, spread and then compacted in a hot state at a certain temperature. Latasir A and B have a thickness of generally 1.5 cm and 2.00 cm and have a tolerance thickness of ± 2.00 cm. Latasir is widely used for planning district or city roads with not very high traffic levels.

2. Lataston (Thin Layer of Concrete Asphalt/HRS)

   Lataston is a layer consisting of layers of wear (latastos lapis aur / HRC-WC) made of aggregates that are graded senjang and semi senjang with the dominance of sand and hard asphalt mixed. Then spread out and compacted in a hot state at a certain temperature.

K1 (LIST OF MAIN SECTIONS OF DISTRICT ROADS

K1 is an inventory of the main list of district road networks and road surface conditions in general.

1. Survey
   Surveys are conducted to periodically collect information about the characteristics, and use of the entire road network.
2. Road Condition Survey (S1)

This survey is conducted annually on the entire 'steady' or 'good/medium' road network to update inventory data/ road conditions (input on 1A/1D tasks) and assist the process of road filtration in maintenance programs.

3. Road Section Screening Survey (S2)
   The survey was conducted on one-third of the road network which is 'unstable' or 'severely damaged' each year. This activity combines from the collection of road inventory data as well as information on road conditions and road photos sufficient for the possibility of conducting a general assessment of the benefits and average costs of road improvement.

4. Calibrating Vehicle Odometers by Form (S3)
   Calibration of vehicle odometer is adjustment of survey vehicle odometer number.

5. Speed Survey (S4)
   Speed survey is conducted on all roads that are open to 4-wheeled motor vehicles that have been conducted S2 survey, to help assess road surface conditions.

6. Traffic Survey (S5)
   Traffic calculations performed on all roads that are open to 4-wheeled motor vehicles have been conducted S2 survey, and at least cover 20% of the 'steady' road network every year. This traffic data is used to estimate the benefits of a road upgrade and to determine appropriate design standards. This survey is required on average to be 5 km of road section.

7. Population Survey (S7)
   This survey is located within the village which is required for roads and bridges that are closed to 4-wheeled motor vehicles throughout or part of the year. Which is where the existing traffic is not a good measure for potential users of the upgraded road.

8. Traffic Barrier Survey (S8)
   This survey is needed to determine the types, causes, and effects of road access barriers on roads that are not open to 4-wheelers, either partially or throughout the year.

9. LHR (Average Daily Traffic)
   Average Daily Traffic (LHR) is the average number of 4-wheeled motor vehicles recorded 24 hours a day for both majors. LHR calculation as follows:

Average Daily Traffic Starts (LHRp).

$$LHRp = LHRs \times (1 \times i1)(1 \times i_1)^n \tag{1}$$

Final Average Daily Traffic (LHR_A)

$$LHR_A = LHR_P \times (1 \times i_2)^n \tag{2}$$

Equivalent trajectory formulas
Initial Equivalent Trajectory (LEP)

$$LEP = \sum_{j=mp}^{n} LHR_{Pj} \times C \times E \text{ Cross End Equivalent (LEA)} \tag{3}$$

$$LEA = \sum_{j=mp}^{n} LHR_{Aj} \times C \times E \text{ Cross Middle Ekivalent (LET)} \tag{4}$$

$$(LET) = \frac{LEP + LEA}{2} \tag{5}$$

Cross Ekivalent Plan (LER) $LER = LET \times F_p \tag{6}$

$$F_p = \frac{n_2}{10} \tag{7}$$

Information:
i_1 : Construction traffic growth
i_2 : Service life traffic growth
J   : Types of vehicles
    n^1 : Construction Period
    n^2 : Plan age
    C   : Vehicle distribution coefficient
E   : Vehicle axis load equivalent number
    F_P : Adjustment factors

The coefficient of distribution of vehicles is a vehicle that crosses the planned path, be it light or heavy vehicles. This coefficient is determined according to the table below.

Table 1. Vehicle Distribution Coefficient

Number of Lanes	Light Vehicles		Heavy Vehicles	
	1 direction	**2 direction**	**1 direction**	**2 direction**
1 Lane	1,00	1,00	1,00	1,00
2 Lane	0,60	0,50	0,70	0,50
3 Lane	0,40	0,40	0,50	0,475
4 Lane	-	0,30	-	0,45
5 Lane	-	0,25	-	0,425
6 Lane	-	0,20	-	0,40

(Source: Road Bending Pavement Thick Planning Instructions with SKBI Component Analysis Method 2.3.26.1987, page 9)

From the table can be seen that light vehicles weighing a total of < 5 tons, for example: passenger cars, pick ups, delivery cars. As for heavy vehicles that total ≥ 5 tons, such as: buses, trucks, semi trailers, trailers.

For equivalence (E) numbers divided into several groups with the load group of public transportation is determined by the formula as follows:

$$\text{E. Single Axis} = \left(\frac{\text{single load in Kg}}{8160}\right)^4 \tag{8}$$

$$\text{E. Dual Axis} = 00,086 \left(\frac{\text{single load in Kg}}{8160}\right)^4 \tag{9}$$

Table 2. Vehicle Axis Equivalent Number (E)

Axis Load		Equivalent Number	
Kg	**Lb**	**Single Axis**	**Dual Axis**
1000	2205	0.0002	-
2000	4409	0.0036	0.0003
3000	6614	0.0183	0.0016
4000	8818	0.0577	0.0050
5000	11023	0.1410	0.0121
6000	13228	0.2923	0.0251
7000	15432	0.5415	0.0466
8000	17637	0.9238	0.0749
8160	18000	1.0000	0.0860
9000	19841	1.4798	0.1273

10000	22046	2.2555	0.1940
11000	24251	3.3022	0.2840
12000	26455	4.6770	0.4022
13000	28660	6.4419	0.5540
14000	30864	8.6647	0.7452
15000	33069	11.4184	0.9820
16000	35276	14.7815	1.2712

(Source: Road Pavement Thick Planning Instructions with SKBI Component Analysis Method 2.3.26.1987, page 10)

Planning Thick Pavement
Component Analysis Methods
In this method it is necessary to understand some terms as follows:
Land Carrying Capacity

The carrying capacity of the land in the construction of pavement will not be separated from the properties of the basic land. The nature of the soil depends on the texture, density, moisture content, as well as environmental conditions. High density soils experience a small volume change in case of changes in moisture content and have a greater carrying capacity when compared to similar soils with lower density levels. Land carrying capacity value on highway pavement planning is expressed with value California Bearing Ratio (CBR).

The price of BASIC LAND CBR is a value that states the quality of the ground compared to the standard material in the form of broken stone with a value of CBR 100% in carrying the traffic load. Land carrying capacity and CBR pointer parameters are commonly used base ground carrying capacity pointer parameters. Here's a graph of the correlation between land carrying capacity and CBR.

This guideline is used modulus resilien (MR) as the basic land parameter for planning. The correlation of California Bearing Ratio (CBR) with Modulus Resilien is as follows:

$$\text{Resilien Modulus (psi)} = 1500 \times CBR \tag{10}$$
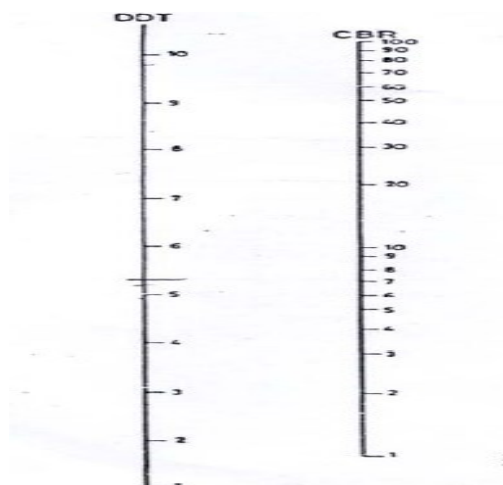$$\text{Resilien Modulus (MPa)} = 10 \times CBR \tag{11}$$

Figure 1. CBR and Land carrying capacity Correlation Graph

Regional Factors (FR)

FR is useful to pay attention to the different road conditions between one road and another. Technical considerations in planning such as groundwater level, speed difference, alinymen shape as well as the weight of the vehicle $\geq$ 13 tons, vehicles that stop, as well as climatic conditions include average

rainfall per year. Local environmental conditions greatly affect the pavement layer of the road and ground base:

a. Effect on pavement construction and eel material components of pavement coating.

b. Weathering material
c. Decrease in comfort level from pavement
d. Surface Index Indeks Permukaan
Surface index is the value of surface flatness related to the level of traffic service passing through.

IP = 1,0	It is stated that the road surface is in a state of severe damage so it is very disturbing vehicle traffic.
IP = 1,5	Is a low level of service that is still running / unbroken.
IP = 2,0	It is a low level of service for a steady (stable; always reliable for 4-wheeled vehicles throughout the year).
IP = 2,5	It is stated the road surface is still quite stable and good.

Relative Strength Coefficient (a)

Each material and its usefulness used for road pavement planning such as surface layer, foundation, bottom foundation, has a relative strength coefficient (a) that is determined correlationally according to marshall test value (for materials with asphalt), compressive strength (for materials stabilized with cement or lime), or CBR (for bottom foundation layer materials).

Table 3. Coefficient of Material Strength

Coefficient of Relative Strength			Strength of Materials			Types of Materials
a1	a2	a3	MS Kg	Kt Kg/cm	CBR %	
0.40			744			Laston
0.35			590			
0.32			454			
0.30			340			
0.35			744			Lasbutag
0.31			590			
0.28			454			
0.26			340			
0.30			340			HRA
0.26			340			Macadam Asphalt
0.25						Lapen (Mechanical)
0.20						Lapen Manual
	0.28		590			Laston Upper
	0.26		454			
	0.24		340			
	0.23					Lapen (Mechanical)
	0.19					Lapen (Manual)
	0.15		22			Stabilization of Soil with Cement
	0.13		18			

0.15	22		Stabilization of Soil with Lime
0.13	18		
0.14		100	Macadam Foundation (Wet)
0.12		60	Macadam Foundation (Dry)
0.14		100	Broken Stone (Class A)
0.13		80	Broken Stone (Class B)
0.12		60	Broken Stone (Class C)
	0.13	70	Sirtu Pitrun (Class A)
	0.12	50	Sirtu Pitrun (Class B)
	0.11	30	Sirtu Pitrun (Class C)
	0.10	20	Clay Soil

(Data source: Road Pavement Thick Planning Instructions With SKBI Component Analysis Method 2.3.26.1987)

Minimum boundaries of pavement thickness

Surface Layer

The requirements of Road Pavement Thickness Index for surface layers in accordance with SKBI Component Analysis method 2.3.26.1987 are as follows:

Table 4. Surface Layer Thickness Requirements

ITP	Minimum Thickness (cm)	Material
< 3,00	5	Protective Layer: (Buras/Burtu/Burda)
3,00-6,70	5	Lapen/Aspal Macadam, HRA, Lasbutag, Laston
6,71-7,49	7,5	LApen/Aspal Macadam, HRA, Lasbutag, Laston
7,50-9,99	7,5	Lasbutag, Laston
≥ 10,00	10	Laston

Foundation Layer

For foundation layers, the requirements of thick pavement are as follows:

Table 5. Foundation Layer

ITP	Minimum Thickness (cm)	Material
< 3.00	15	Broken stone, stabilization of soil with cement Stabilization of soil with lime
3.00-7.49	20	Broken stone, stabilization of soil with cement, stabilization of soil with lime
	10	Laston top
7.50-9.99	20	Broken stone, stabilization of soil with cement, stabilization of soil with macadam limestone foundation
	15	
10-12.14	20	Laston Upper
		Broken stone, stabilization of soil with cement, stabilization of soil with limestone foundation
≥ 12.25	25	Macadam, Lapen, Upper Laston
		Broken Stone, stabilization of soil with limestone Foundation Macadam, Lapen, Upper Laston

California Bearing Ratio (CBR)

In road pavement planning is often used empirical ways and commonly known as CBR. This CBR method was developed as a way to assess the strength of the ground ground base road (subgrade).

Here are some types of CBR testing:

CBR Field

CBR field is also called CBR inplace or field inplace with the following uses:

Get the original CBR value in the field according to the condition of the soil at that time. Usually used for thick planning that the basic layer of soil will no longer be compacted.
Control whether the density obtained is in accordance with the desired.

CBR Laboratory

The basic soil condition on the construction of new roads can be native land, landfills or solidified quarries up to 95% of the maximum density. Land carrying capacity is therefore the ability of the soil layer that carries the load after the soil is compacted. Called CBR Laboratory, karekan series of tests conducted in the laboratory and distinguished over 2 kinds, namely CBR laboratory soaking and without soaking.

Figure 2. CBR Laboratory Test Equipment

Strength Testing with CBR

Cbr value determination is commonly used in calculating the strength of the road foundation, namely at penetration of 0.1" and 0.2" for laboratory testing. The calculation formula in determining cbr value is as follows:

$$\text{CBR value on penetration } 0,1" = \frac{A}{3000} \times 100\% \tag{10}$$

$$\text{CBR value on penetration } 0,2" = \frac{B}{3000} \times 100\% \tag{11}$$

information:

A = Dial readings at the time of penetration 0,1"
B = Dial readings at the time of penetration 0,2"

CBR value obtained is the result of the smallest value between the calculation results of both CBR values. The following is a description of cbr values:

Table 6. Description of CBR Value

Description	CBR Value
It's ugly.	0,00 – 3,00
Ugly	3,00 – 7,00
Keep	7,00 – 20,0
Good	20,0 – 50,0
Very Good	>50,0

Dynamic Cone Penetrometer Test (DCP)

DCP is a simple device used on uneven surfaces. DCP devices are economical and can provide an index of the strength of in-situ soil structures quickly. DCP is used to measure soil material resistance or resistance to penetration when the conus of this tool is incorporated into the soil material. The number of blows during testing was recorded against the depth of penetration. DCP consists of a conus at the lower end of the vertical rod. Penetration of a hammer is lifted to a certain height to be dropped until it hits the device and presses the conus, repeatedly to get blows against soil samples. The more difficult the penetrated konus the stronger the soil structure material, the easier the penetrated konus, the less strong the soil material structure.
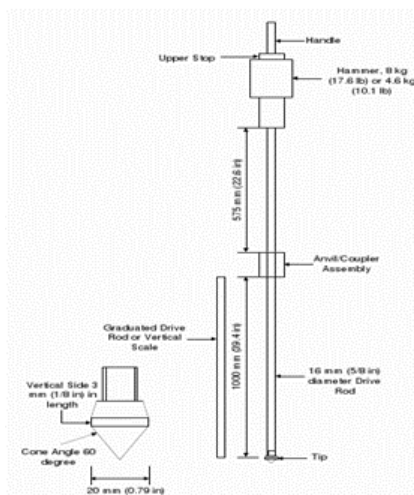

Figure 3. DCP Test Equipment

Traffic Plan Class

The class of traffic plan is a class of vehicle traffic plan that crosses the road that will be researched and is expected to occur after or before the activity of road improvement or maintenance. This class of traffic plan is based on the current condition of four-wheeled vehicle traffic level, the number of residents is now in the area / location of road improvement and maintenance work.

1. Traffic Plan Class Determination
2. Criteria
3. Traffic Plan Class Determination Procedure
4. Vehicle Mix Assessment

Road Damage
Causes Of Road Damage

Traffic Factors

Damage caused by traffic factors is determined by the load of the vehicle, the distribution of the vehicle at the width of the pavement, the repetition of the traffic load.
Non Traffic Factors
Non-traffic factors of road damage are as follows:
Ground strength
Pavement material
Compaction of ground and pavement layers
Development and depreciation factors of basic land
Depth of groundwater
Rainfall
Temperature variations throughout the year

Road Damage Mechanism

Road damage can be explained that vehicles passing through a section of road will be a burden that results in tension and strain on each layer of pavement. Repetitions caused by the load pressure of this vehicle will result in tired cracks in the paved layers, as well as cause deformation on all layers. Weather can cause paved layers to become brittle (sap), making them more susceptible to cracking and disintegration (release).

C.   Types of Road Damage
The type of asphalt damage is divided into 2, namely:

Functional Damage

This damage is related to road damage conditions where the comfort and safety of road users is disrupted and vehicle operational costs increase. These types of damage are:

a. Noise levels increase the friction of the wheels with the road surface.
b. Risk of splashing water when the surface is wet
c. The level of risk of slipping when cornering when the surface is wet
d. The risk of slipping when braking on wet or dry surfaces

Structural Damage

Structural damage is a construction failure in which more than one component is damaged and resulting in pavement no longer bearing the brunt of traffic.

This damage is in the form of cracks, deformities, surface defects, wear, obesity, decrease in utility planting marks.

RESEARCH METHODS

This research was conducted on the district road section precisely on pangleseran road – Cibatu Cikembar subdistrict, starting from the determination of the location of the survey, exploring road conditions, data collection, the process of calculating the thickness of the pavement analysis, and making a research report, the research stage is explained briefly in figure 4.
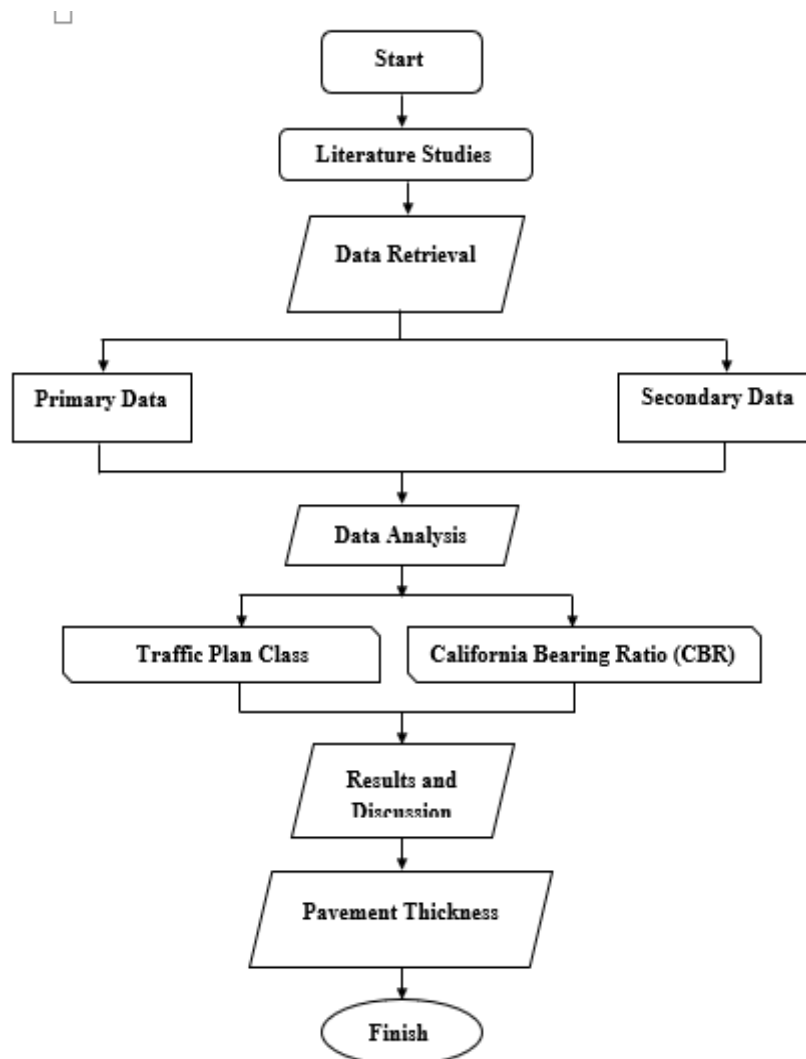
Figure 4. Research Flow Chart

RESULTS AND DISCUSSION
Average Daily Traffic Survey
The average daily traffic for the road: Pangleseran - Cibatu is as follows:

Table 7. Average Daily Traffic Survey Results

Type of Road User	Vehicle Type	Sum	Unit
8	Microbus	2008	Vehicle
9	Pick up	445	Vehicle
10	Medium and Large Buses	137	Vehicle
11	Trucks 4 - 10 tons	562	Vehicle
12	Trucks 6 - 12 tons	63	Vehicle
13	Trucks > 8 tons	69	Vehicle
14	Sedans and Jeeps	1568	Vehicle

California Bearing Ratio (CBR) Field Testing

Field CBR testing conducted with DCP tool is conducted as much as 8 points along the lane of the 7.5 km pavement plan on the road: Pangleseran - Cibatu This test is done to obtain the CBR value needed to know the carrying capacity of the base soil layer.

Table 8. CBR Field Test Results

NO	NUMBER / GROUP OF PUNCHES	DEEP PENETRATION (cm)							
		Km. /STA							
		0+000	0+200	0+400	0+600	0+800	1+000	1+100	1+200
1	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	5	7,2	16,2	16,8	19,8	23,5	16,2	17,4	15,4
3	10	16,2	43,5	40,7	43,0	41,2	38,2	45,2	45,2
4	15	30,5	80,6	69,2	68,1	75,2	59,8	70,5	82,5
5	20	49,0		90,1	87,8	100,0	78,7	91,8	
6	25	79,5					93,2		
7	30	100,0							
8	35								
9	40								
10	45								
	CBR VALUE	6,0%	4,0%	4,50%	4,8%	4,0%	5,5%	4,4%	3,8%

Table 9. CBR Value

BR (%)	Same Or Greater Amount	Percent (%) Same or Greater
3.8	8	100.00
4.0	7	87.50
4.0	-	-
4.4	5	62.50
4.5	4	50.00
4.8	3	37.50
5.5	2	25.00
6.0	1	12.50

Table 9 above is the data used to find the price of California Bearing Ratio (CBR) that represents, then created a chart to get the price of CBR.
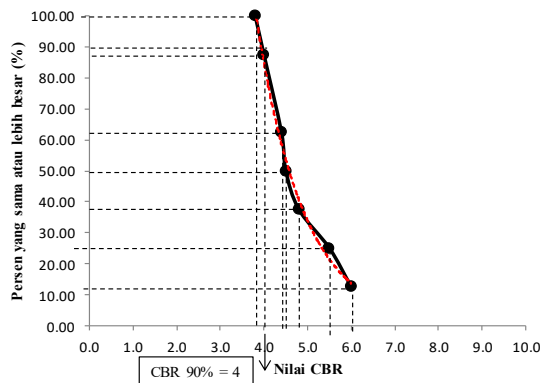
Figure 5. CBR Value Determination Representing

From the graph, it is obtained that the representative CBR price is 4. The representative CBR value is obtained at the percentage figure of 90%.

Analysis of Indonesian Building Construction Standards (SKBI 2.3.26.1987)
Average Daily Traffic Data of Jalan Pangleseran - Cibatu in 2021

Long Road Planning	: 7,5 km
Width of Road Planning	: 5 m
Number of Lanes	: 1 2-way lane
Age Plan	: 5 and 10 Years
Reliability	: 6%
Traffic Development (i) for 5 Years	: 8%
Traffic Development (i) for 10 Years	: 6%
Light Vehicle 2 tons	: 4021 Vehicle
Bus 8 tons	: 137 Vehicle
Truck 8 tons	: 562 Vehicle
Truck 12 ton	: 63 Vehicle
Number of Vehicles/Day	: **4783** Vehicle/day/2 majors

Settlement
Calculating LHR In 5th Year (End of Life Plan) Formula $(1+i)n$

Light Vehicle 2 tons	: 5908,17 Vehicle
Bus 8 tons	: 201,30 Vehicle
Truck 8 tons	: 825,76 Vehicle
Truck 12 tons	: 92,57 Vehicle
Number of Vehicles/Day	: **7027,80** Vehicle/day/2 majors

Calculating LHR In 10th Year (End of Life Plan) Formula $(1+i)n$

Light Vehicle 2 tons	: 7201,00 Vehicle
Bus 8 tons	: 245,35 Vehicle
Truck 8 tons	: 1006,46 Vehicle
Truck 12 tons	: 112, 82 Vehicle
Number of Vehicles/Day	: **8565,62** Vehicle/day/2 majors

Calculating the Equivalent (E) of Each Vehicle

Light Vehicle 2 tons	: 0,0002	+ 0,0002	= 0,0004
Bus 8 tons	: 0,0183	+ 0,1410	= 0,1593
Truck 8 tons	: 0,0183	+ 0,1410	= 0,1593
Truck 12 tons	: 0,0577	+ 0,9238	= 0,9815

Calculating Cross-Equivalent Starters (LEP)

Light Vehicle 2 tons	: 4021	x 1,00	x 0,0004	= 1,6084
Bus 8 tons	: 137	x 1,00	x 0,1593	= 21,8341
Truck 8 tons	: 562	x 1,00	x 0,1593	= 89,5266
Truck 12 tons	: 63	x 1,00	x 0,9815	= 53,0010

Cross Equivalence Starter (LEP)   = **174,7936**

Calculating The Final Cross-Equivalent (LEA)

LEA 5 Years:

Light Vehicle 2 tons	: 5908,17 x 1,00	x 0,0004	= 2,3633
Bus 8 tons	: 201,30 x 1,00	x 0,1593	= 32,0668
Truck 8 tons	: 825,76 x 1,00	x 0,1593	= 131,5439
Truck 12 tons	: 92,57 x 1,00	x 0,9815	= 90,8552

LEA For 5 Years   = **256,8291**

LEA 10 Years:

Light Vehicle 2 tons	: 5908,17 x 1,00	x 0,0004	= 2,8804
Bus 8 tons	: 201,30 x 1,00	x 0,1593	= 39,0836
Truck 8 tons	: 825,76 x 1,00	x 0,1593	= 160,3285
Truck 12 tons	: 92,57 x 1,00	x 0,9815	= 110,7362

LEA For 10 Years   = **313,0287**

Calculating The Middle Equivalent Cross (LET)

LET 5 Years   174,7936 + 256,8291 / 2 = **215,8114**

LET 10 Years   174,7936 + 313,0287 / 2 = **243,9112**

Calculating Plan Equivalence (LER)

FP 5 Years	: 5 / 10	= **0.5**
FP 10 Years	: 10 / 10	= **1.0**
LER 5 Years	: 90.4038 x 0.5	= **215,8114**
LER 10 Years	: 102.1749 x 1.0	= **243,9112**

Search for ITP

CBR Ground Basic	: 4 %
DDT	: 4.3
IP	: 1
FR	: 1.0

LER 5 Years   :   107,9057   **ITP_5**   ($IP_0 = 3.9 – 3.5$)   =   **6.4**

LER 10 Years   :   243,9112   **ITP_{10}**   ($IP_0 = 3.9 – 3.5$)   =   **7.4**

Set Additional Layer Thickness

Laston Lapis Aus (AC-WC)	:	4	Cm	50% x 4 x 0.25	=	**0,5**
Lapen Macadam	:	5	Cm	50% x 5 x 0.26	=	**0,65**
Top Foundation Layer	:	10	Cm	50% x 10 x 0.13	=	**0,65**
Bottom Foundation Layer	:	20	Cm	50% x 20 x 0.12	=	**1,2** +

                                        ITP = **3**

5 Year Plan Age

     $\Delta ITP = ITP_5 - ITP$:   6,4 - 3   = **3,4**

                          3,4 = 0.35 x D1

                          D1 = 3,4 / 0.35   = **10 cm**

10-Year Plan Age

     $\Delta ITP = ITP_{10} - ITP$:   7,8 - 3   = **4,8**

                          4,8 = 0.35 x D1

                          D1 = 4,8 / 0.35   = **14 cm**

From the analysis that has been done to determine the thickness of pavement for additional layers / overlays based on the method of analysis of components SKBI 2.3.26.1987 for the road: Pangleseran - Cibatu with a plan age of 5 years is 10 cm, while for the age of the plan 10 years is 14 cm.

CONCLUSION

From the results of the analysis that has been done to determine the thickness of pavement for additional layers/overlays based on the method of analysis of components SKBI 2.3.26.1987 for the road: Pangleseran - Cibatu with a plan age of 5 years is 10 cm, while for the age of the plan 10 years is 14 cm.

Thickness and type of pavement produced based on analysis SKBI 2.3.26.1987 for the age of the plan 5 years is 10 cm and for the age of the plan 10 years is 14 cm, from the results of the analysis that can be that pangleseran road section - Cibatu is not in accordance with the pavement bending.

Factors that cause road pavement damage for road sections: Pangleseran – Cibatu is due to the mix of heavy vehicles $\geq$ 8 tons increased, while the tonnage of heavy vehicles for district roads maximum 8 tons. Another cause is a drainage system that is clogged by sediment and closed by the community.

REFERENCES

Departemen Pekerjaan Umum Jakarta. Perencanaan Tebal Perkerasan Lentur Jalan Raya dengan Metode Analisa Komponen. SKBI.2.3.26.1987. UDC: 625.73.02.1987. (Indonesian).

Direktorat Jendral Bina Marga. Spesifikasi Umum Pekerjaan Konstruksi Jalan dan Jembatan. (Nomor 02/SE/Db/2018, 20 September 2018). (Indonesian).

Hendarsin, Shirley L. 2000. Penuntun Praktis Perencanaan Teknik Jalan Raya. Bandung: Politeknik Negeri Bandung. (Indonesian). (Indonesian).

Meynita Tri Nuryanti. 2011. Perencanaan Geometrik Dan rencana Anggaran Biaya Ruas Jalan Pandaan-Tapen. Universitas Sebelas Maret. Surakarta. (Indonesian).

Muchtar. 2016. Perencanaan Ulang Tebal Perkerasan Berdasarkan Faktor-Faktor Kerusakan Jalan (Studi Kasus Jalan Lapang – Ujung Barasok, Kecamatan Pahlawan). Fakultas Tekni Universitas Teuku Umar Alue Peunyareng – Meulaboh. (Indonesian).

Paikun Paikun, Reffy W Andriani SP, Faldi Destaman, and Dede Winardi. 2021. "ROAD GEOMETRIC FEASIBILITY IN ROAD SAGARANTEN – TEGALBULEUD KM.BDG 175 + 100" ASTONJADRO: Jurnal Rekayasa SipiL, 10 (1): 117–34. http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO/article/view/4213

Paikun, Elis Suminar, Aldi Irawan, Saiful Bahri. 2021. "DETERMINING ROAD HANDLING ACCORDING TO THE LEVEL OF DAMAGE USING SURFACE DISTRESS INDEX (SDI) METHOD (Case Study on Jl. Merdeka 1 Sukabumi City)" ASTONJADRO: Jurnal Rekayasa SipiL, 10 (1): 135–49. http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO/article/view/4265

Rigi Muharam, 2019. PERENCANAAN TEBAL LAPIS PERKERASAN KAKU PADA RUAS JALAN KAPTEN DASUKI BAKRI, ASTONJADRO: Jurnal Rekayasa SipiL, 8 (2): 57–69. (Indonesian). http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO/article/view/2617

Sendro, Ricky Theo K. Freddy Jansen. 2013. Analisis Tebal Perkerasan Lentur Jalan Baru Menggunakan Manual Desain Perkerasan Jalan (MDP). Vol. 4, No. 12, 725 – 735, 2013. (Indonesian).

Sudarno,dkk. 2018. Analisis Tebal Perkerasan Jalan Raya Magelang-Purworejo Km 8 sampai Km 9 Menggunakan Metode Bina Marga 1987. Vol.02, n.1, p.41 – 46, 2018. (Indonesian). jurnal.untidar.ac.id/index.php/civilengineering/

Syaiful S. & Akbardn J. 2020. Civil Engineering Students' Conceptual Understanding On Centrifugal Force Implementation Through Geometrical Design Of Inter-City Road In Indonesia. International Journal Of Scientific & Technology Research 9 (10), pp 345-349. https://www.ijstr.org/final-print/oct2020/Civil-Engineering-Students-Conceptual-Understanding-On-Centrifugal-Force-Implementation-Through-Geometrical-Design-Of-Inter-city-Road-In-Indonesia.pdf

Syaiful S. & Lasmana L. 2020. Study about level of railway road damage railways with sustainable PCI method, ARPN Journal of Engineering and Applied Science. 15(8): 962-968. http://www.arpnjournals.org/jeas/research_papers/rp_2020/jeas_0420_8184.pdf

Syaiful S. 2020. Analysis on the Addition of Fiber the Strong Bending Mixed Concrete, ARPN Journal of Engineering and Applied Science. 15(6): 724-729. http://www.arpnjournals.org/jeas/research_papers/rp_2020/jeas_0320_8152.pdf

Syaiful S. 2021. Additional Betonmix To Increase The Strength Of Concrete Press. ARPN Journal of Engineering and Applied Science. 16(15): 1583-1589. http://www.arpnjournals.org/jeas/research_papers/rp_2021/jeas_0821_8652.pdf

Triyanto Triyanto, Syaiful Syaiful, Rulhendri Rulhendri, 2019. PERENCANAAN TEBAL LAPIS PERKERASAN KAKU PADA RUAS JALAN KAPTEN DASUKI BAKRI, ASTONJADRO: Jurnal Rekayasa SipiL, 8 (2): 70–79. (Indonesian). http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO/article/view/2628

Udiana, I Made, Andre R, Saudale, Jusuf J. S. Pah.2014. Analisa Faktor Penyebab Kerusakan Jalan (Studi Kasus Ruas Jalan W. J. Lalamentik dan Ruas Jalan Gor Flobamora). Vol. III, No. 1, 13 – 18, 2014. (Indonesian).

Wirnanda, Intan, Renni Anggraini, M. Isya. 2018. Analisis Tingkat Kerusakan Jalan dan Pengaruhnya Terhadap Kecepatan Kendaraan (Studi Kasus: Jalan Blang Bintang Lama dan Jalan Tengku Hasan Dibakoi). Vol. 1. No 3. 617 – 625, 2018. (Indonesian). https://www.researchgate.net/publication/330197518_

Wulansari, Dwi Novi. 2018. Analisis Tebal Perkerasan Lentur Menggunakan Metode Analisa Komponen dan Metode AASHTO pada Ruas Jalan Nagrak Kabupaten Bogor. Vol.3,22 – 31, 2018. (Indonesian). http://journal.uta45jakarta.ac.id/index.php/jkts/issue/view/167/showToc