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ANALYSIS OF THE QUALITY COMPONENTS OF RIGID ROAD PAVEMENTS IN RELATION TO VEHICLE VOLUME USING THE PD T-14-2003 METHOD AND THE SNI 8457 2017 METHOD

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ABSTRACT

Highways are vital infrastructure in supporting land transportation systems, community mobility, and logistics distribution. To ensure safety, comfort, and structural durability, highway pavement design must be based on appropriate technical standards. This study aims to analyze the quality components of rigid highway pavement based on vehicle volume using two methods: Pd T-14-2003 and SNI 8457:2017, with a case study on the pavement project of the Cimanying–Jipu highway section. Primary data was obtained through field observations, while secondary data was obtained from relevant agencies, including traffic volume, vehicle types, and projections of average daily traffic growth. Based on a subgrade CBR value of 26%, both methods resulted in a concrete layer thickness of 20 cm, with concrete quality K-175 (Pd T-14-2003) and K-225 (SNI 8457:2017). Detailed calculations show differences in reinforcement specifications between the two methods. The analysis results indicate that SNI 8457:2017 specifies smaller dowel dimensions but with closer installation spacing, while Pd T-14-2003 requires larger reinforcement dimensions. This study helps provide recommendations for selecting a more economical and effective rigid pavement design method based on traffic conditions and site characteristics.

Keywords: Rigid Pavement, Pd T-14-2003 Method, SNI 8457:2017, Vehicle Volume, Concrete Quality

ABSTRAK

Jalan tol merupakan infrastruktur vital dalam mendukung sistem transportasi darat, mobilitas masyarakat, dan distribusi logistik. Untuk memastikan keselamatan, kenyamanan, dan ketahanan struktural, desain perkerasan jalan tol harus didasarkan pada standar teknis yang sesuai. Penelitian ini bertujuan untuk menganalisis komponen kualitas perkerasan jalan raya kaku berdasarkan volume kendaraan menggunakan dua metode: Pd T-14-2003 dan SNI 8457:2017, dengan studi kasus pada proyek perkerasan jalan raya segmen Cimanying–Jipu. Data primer diperoleh melalui pengamatan lapangan, sedangkan data sekunder diperoleh dari lembaga terkait, termasuk volume lalu lintas, jenis kendaraan, dan proyeksi pertumbuhan lalu lintas harian rata-rata. Berdasarkan nilai CBR lapisan dasar 26%, kedua metode menghasilkan ketebalan lapisan beton 20 cm, dengan kualitas beton K-175 (Pd T-14-2003) dan K-225 (SNI 8457:2017). Perhitungan rinci menunjukkan perbedaan spesifikasi penguatan antara kedua metode. Hasil analisis menunjukkan bahwa SNI 8457:2017 menetapkan dimensi dowel yang lebih kecil tetapi dengan jarak pemasangan yang lebih dekat, sementara Pd T-14-2003 memerlukan dimensi penguatan yang lebih besar. Studi ini membantu memberikan rekomendasi untuk memilih metode desain perkerasan kaku yang lebih ekonomis dan efektif berdasarkan kondisi lalu lintas dan karakteristik lokasi.

Kata Kunci: Metode Pd T-14-2003, Perkerasan Kaku, SNI 8457:2017, Volume Kendaraan, Kualitas Beton

1. INTRODUCTION

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Highways are one of the crucial components in the land transportation system, playing a strategic role in supporting public mobility and logistics distribution (Hu et al., 2025; lo Storto & Evangelista, 2023; Pinheiro et al., 2025). As population and vehicle numbers increase each year, the demand for reliable road infrastructure also rises (Illahi et al., 2024; Otero-Romero et al., 2025; Xylia et al., 2025). This necessitates a comprehensive planning approach that considers road function, traffic volume, and the characteristics of passing vehicles (Fruelda et al., 2025; Inman et al., 2024; Shang et al., 2025).

In terms of pavement construction, rigid pavement has become the primary choice for high-traffic routes due to its superior structural durability and relatively lower maintenance costs compared to flexible pavements, despite requiring higher initial construction investment (Fini & Hajikarimi, 2025; Rout et al., 2023; Zarei et al., 2025a). Concrete pavement acts as a rigid slab capable of efficiently distributing loads to underlying layers, thus maintaining road structural stability over a long period (Abellán-García et al., 2024; Li et al., 2025; Liu et al., 2024).

However, rigid pavement design must be based on applicable technical standards to ensure that construction quality meets safety, comfort, and durability requirements (Mohd Tahir et al., 2022; Styer et al., 2024; Zhang et al., 2024). In Indonesia, common guidelines for rigid pavement design include the Pd T-14-2003 method and SNI 8457:2017, which provide guidance on material specifications, concrete slab thickness, and reinforcement details based on traffic load analysis. Although these two methods differ in their approaches, both aim to ensure the performance of the road structure under operational conditions.

This study aims to analyze the quality components of rigid pavement on the Cimanying–Jiput segment based on vehicle volume using calculation approaches from both methods. The results are expected to provide technical recommendations regarding the more optimal and cost-effective planning method, based on traffic conditions and site characteristics. Additionally, this research contributes to efforts aimed at improving the sustainability of national road infrastructure quality.

2. LITERATURE REVIEW

Rigid pavement is a type of pavement that utilizes concrete slabs as the main layer to withstand traffic loads (Heneash et al., 2025a; Lei et al., 2025; Verma et al., 2025). Unlike flexible pavement, which is more flexible and absorbs deformation, rigid pavement has high stiffness, enabling it to effectively distribute loads to underlying layers (Lan et al., 2025; Styer et al., 2024; Zhao et al., 2025). This pavement structure generally consists of three main layers: the surface layer (concrete slab), sub-base, and subgrade (Heneash et al., 2025b). The quality of rigid pavement construction is influenced by several factors, including concrete quality, slab thickness, type and specification of reinforcement, and traffic characteristics (Ghara et al., 2025). Vehicle volume, especially heavy vehicles, is an important parameter in design analysis because it affects stress distribution across pavement layers and the potential for structural damage throughout the road's service life (Zarei et al., 2025b).

In Indonesia, technical guidelines for rigid pavement design are outlined in two primary documents: Pd T-14-2003 and SNI 8457:2017. These two documents have different approaches and methodologies in the planning process. Pd T-14-

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2003 is a document issued by the Directorate General of Highways of the Ministry of Public Works and Public Housing in 2003. This method uses an empirical approach based on traffic volume data and traffic growth projections over the road's service life. Although it has been widely used in the planning of national roads in Indonesia, this method tends to be less flexible in accommodating variations in material characteristics and actual loads in the field.

In contrast, SNI 8457:2017 is a more modern national standard that adopts a mechanistic-empirical approach. This approach enables more accurate calculations of the behavior of pavement structures under traffic loads, including the effects of variations in material modulus and subgrade soil properties. Additionally, SNI 8457 provides flexibility in material selection and the determination of structural dimensions in a more rational and economical manner.

Table 1. Systematic Comparison of Pd T-14-2003 and SNI 8457:2017

Aspect	PD T-14-2023
Planning Approach	Empirical
Basis of Analysis	Based on Traffic Volume Data and Traffic Growth During the Plan Period
Calculation Accuracy	Relatively Simple and Less Detailed
Input Parameters	Limited to traffic data and flat ground conditions
Construction Specifications	Provides standard tables for slab thickness
Suitability for heavy vehicle loads	Less sensitive to variations in heavy vehicle loads

In Indonesia, technical guidelines for rigid pavement design are outlined in two primary documents: Pd T-14-2003 and SNI 8457:2017. Pd T-14-2003 was issued by the Ministry of Public Works and uses an empirical approach based on traffic volume data and projected traffic growth over the design life. This method has been widely used in the planning of national roads in Indonesia before the introduction of newer standards. In contrast, SNI 8457:2017 is a more modern national standard that incorporates a mechanistic approach into road structure calculations. This method provides more detailed calculations regarding layer interaction and material usage. Both methods differ in terms of input parameters, calculation formulas, and construction detail specifications such as slab thickness and reinforcement dimensions. This study compares the analysis results of both methods in the context of traffic volume on the Cimanying–Jiput road segment.

Several studies have been conducted comparing the Pd T-14-2003 and SNI 8457:2017 methods in rigid pavement design. One such study was conducted by Prasetyo & Wibowo (2020) on the Sukabumi–Cianjur road section, which found that SNI 8457:2017 provided more economical design results while still meeting load-bearing requirements. Their research showed that the SNI method tends to be more precise in accounting for variations in heavy vehicle loads. Additionally, Kumar et al. (2024) concluded that the SNI method is more sensitive to variations in heavy vehicle volume, resulting in more realistic designs. These previous studies serve as references for developing the analytical method and interpreting the results in this research.

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3. RESEARCH METHODOLOGY

This research was conducted on the Cimanying–Jiput road segment in Pandeglang Regency, Banten Province. This area was chosen because it is a strategic route connecting several residential areas, agricultural zones, and access to tourist attractions around Jiput Subdistrict. The road is planned to be constructed using concrete pavement (rigid pavement) to enhance its structural capacity and durability against increasing traffic loads. Field data collection was carried out from March to April 2025, while the analysis phase was conducted gradually from May to June 2025. The research process flow is illustrated in the

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following diagram.

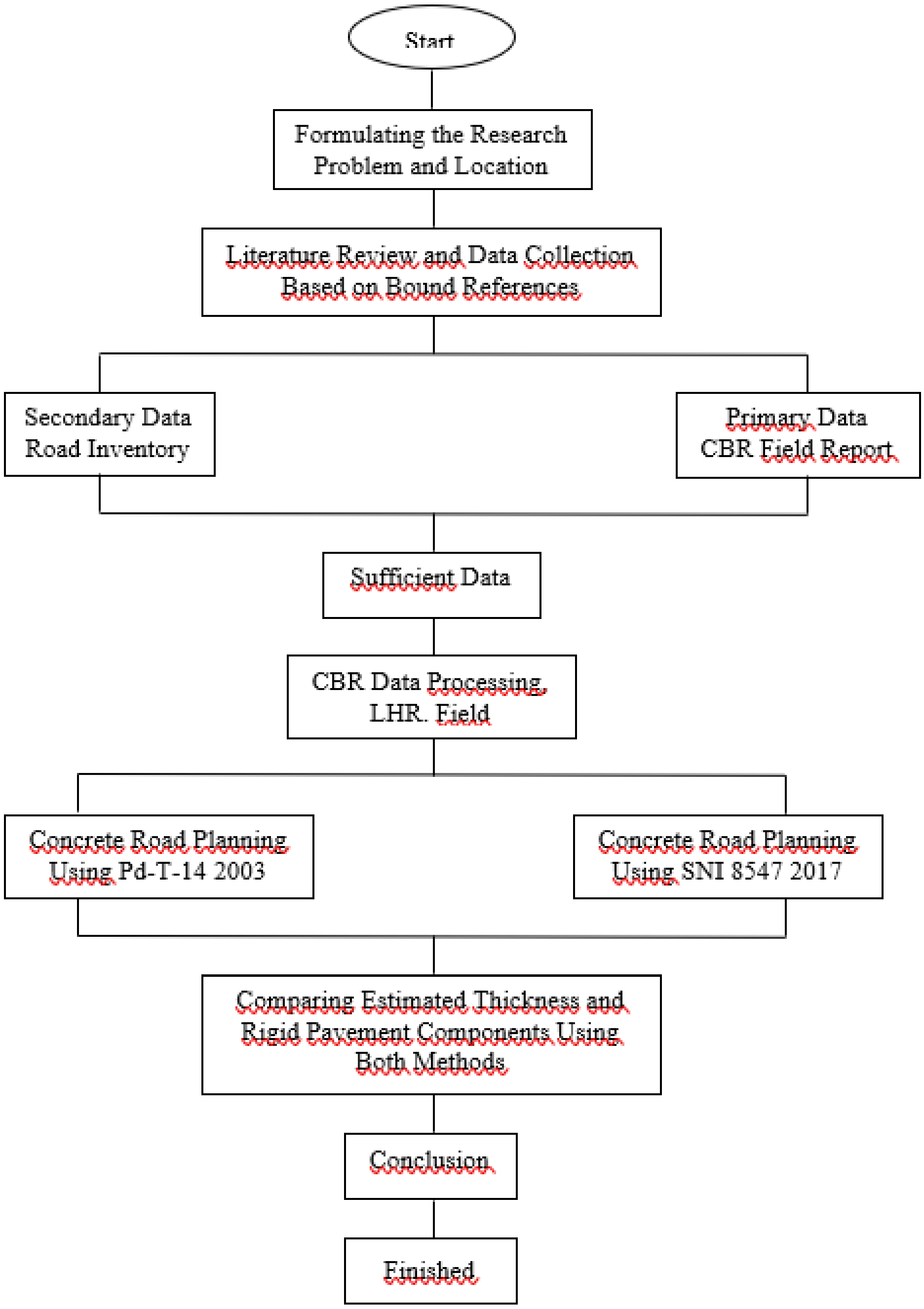

Figure 1. Research Flowchart

The research flowchart illustrates the sequence of steps carried out in the research process, starting from data collection to result evaluation. These stages include: problem identification, preliminary study, collection of primary and secondary data, analysis using the Pd T-14-2003 method, analysis using the SNI 8457:2017 method, comparison of results from both methods, and the formulation of conclusions and recommendations.

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This research was conducted in four main stages. The first stage involved the collection of primary and secondary data as a basis for analysis. Primary data were obtained through direct observation at the project site to gather information on the existing road conditions, soil type, and traffic characteristics. Secondary data were collected from relevant government agencies such as the Pandeglang Regency Public Works Department (Dinas PUPR) and the National Road Implementation Agency (BBPJN), including traffic volume, vehicle types, and projections of average daily traffic growth over the design life. In addition, geotechnical data—particularly the California Bearing Ratio (CBR) value of the subgrade—were also collected, as this serves as an important parameter in determining the required thickness of the pavement structure.

The second stage was the structural analysis of rigid pavement using the Pd T-14-2003 method. This is a national guideline that has been widely used in rigid pavement planning in Indonesia. The analysis was based on traffic volume data, traffic growth projections, and CBR values to determine the required concrete slab thickness, concrete quality class, and reinforcement specifications.

In the third stage, a reanalysis was conducted using the SNI 8457:2017 method. This method adopts a more modern semi-mechanistic approach, resulting in a more accurate design by considering the interaction between pavement layers and the mechanical properties of materials. The input parameters used still referred to the same data set, but the formulas and construction requirements differed, particularly regarding reinforcement specifications and load distribution.

The fourth stage involved comparing the results from both methods. The outcomes of the two approaches were evaluated to assess their effectiveness, cost efficiency, and suitability to field conditions. This evaluation aimed to provide technical recommendations for selecting the more optimal method for the rigid pavement project on the Cimanying–Jiput section.

The research methodology is descriptive-comparative with an analytical approach. This approach was chosen to provide a clear overview of the differences in calculation results between the two standard methods—Pd T-14-2003 and SNI 8457:2017. Using relevant field and secondary data, both methods were applied in parallel to evaluate the quality components of rigid pavement in relation to vehicle volume. The findings of this study are expected to contribute valuable technical insights for future road infrastructure planning processes.

4. ANALYSIS AND DISCUSSION

Average Daily Traffic (LHR)

In the stage of designing concrete pavement, vehicle axle configurations are classified into four main categories: single axle with a single wheel (STRT), single axle with dual wheels (STRG), tandem double axle with dual wheels (STdRG), and

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triple axle with dual wheels (STrRG). Each type of axle has a different structural impact on the pavement. A traffic survey conducted over two days as well as one weekend day (each lasting 24 hours) on the Cimanying–Jiput road segment in Pandeglang Regency yielded vehicle data for the year 2024. The details are presented in the following table.

Table 2. LHR Data for the Cimanying–Jiput Road Segment

No	Vehicle Type	Class	Number Of Vehicles
1	Sedan, Jeep, and Station wagon	3	505
2	Pick up	3	639
3	Micro Truck, Delivery Van, Pickup Box	4	276
4	Light-duty 2-axle Truck	6a	90
5	Truck 3 as	7a	40

Bina Marga 2003 Method

This method is used to calculate the thickness of rigid pavement in the road design under study. To perform the analysis, the following planning data are required:

a. Planning Data
   - CBR = 15%
   - Sub-base Thickness = 10cm
   - Pavement Design = Jointed Reinforced Concrete Pavement
   - Design Life = 20 years
   - Traffic Growth Rate (i) = 31,3
   - Unit Weight of Concrete = 2400 kg/m^3

The road width on the Cimanying–Jiput segment is 6 meters, consisting of 2 lanes that accommodate vehicle movements from opposite directions simultaneously. Based on this characteristic, the directional distribution coefficient (C) is obtained as 0.50. This coefficient value corresponds to the table below and is relevant to the regulations for directional distribution on a two-lane road.

Table 3. Koefisien Distribusi (C)

Pavement Width (L_p)	Number Of Lanes (n_1)	Distribution Coeficient	
		1 Way	2 Way

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$L_p < 5{,}50$ m	1	1	1
$5{,}50 \text{ m} \le L_p < 8{,}25$ m	2	0,70	0,50
$8{,}25 \text{ m} \le L_p < 11{,}25$ m	3	0,50	0,475
$11{,}23 \text{ m} \le L_p < 15{,}00$ m	4		0,45
$15{,}00 \text{ m} \le L_p < 18{,}75$ m	5		0,425
$18{,}75 \text{ m} \le L_p < 22{,}00$ m	6		0,40

Source: Pd T-14-2003 Guidelines

Table 4. Load Safety Factor (FKB)

No	Application	F_{KB} Value
2	Freeway and arterial roads with medium commercial vehicle volume	1.1

Source: Pd T-14-2003 Guidelines

b. Traffic Analysis

Based on the data presented, the process of estimating the thickness of rigid pavement (rigid pavement) can be carried out through the following steps. One of the key stages is the calculation of the cumulative number of commercial vehicle axles (Jumlah Sumbu Kendaraan Niaga / JSKN) over the 20-year design life for the Cimanying–Jiput road segment. The calculation is as follows:

$$R = \frac{(1 + annual\ traffic\ growth\ rate)^{UR} - 1}{annual\ traffic\ growth\ rate} \quad (1)$$

$$R = \frac{(1 + 4.50\%)^{20} - 1}{4.50\%} = 31{,}37$$

The daily number of axle loads (JSKNH) is obtained from the survey and found to be:

JSKNH = 852

$JSKN_{UR}$ = JSKNH x 365 x R x C (2)

JSKNUR = 852 x 365 x 31,37 x 0,50 = 4877942,527

This value represents the total number of axle load repetitions expected during the 20-year design period.

c. Axle Load Repetition Analysis

The frequency of axle load repetitions is calculated as the product of load distribution over the proportions of different axle types , using a mathematical approach formulated as follows:

Calculation of Load Proportion:

To calculate the Load Proportion for each vehicle, the following formula can be used:

$$\text{Load Proportion / Ton} = \frac{Total\ Axles\ of\ Each\ Axle\ Type}{Total\ Axles\ of\ All\ Axle\ Types} \quad (3)$$

Axle Proportion

To calculate the axle proportion for each vehicle, the following formula can be used:

Axle Proportion =

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$$\frac{Total\ Axles\ of\ STRT}{Total\ Axles\ of\ STRT \times Total\ Axles\ of\ STRG \times Total\ Axles\ of\ STdRG} \quad (4)$$

Repetition

The repetition that occurs is calculated using the formula: Load Proportion × Axle Proportion × Planned Traffic Volume (JSKNR) The results based on the above calculations are presented in the following table:

Table 5. Axle Repetition Calculation

Axle type	Axle load (tons)	Number of axles	Load proportion	Axle proportion	Planned traffic	Repetition that occurs
(1)	(2)	(3)	(4)	(5)	(6)	(7) =(4) x (5) x (6)
STRT	2	522	0,4047	0,6673	4877942,527	1317330,859
	2	522	0,4047	0,6673	4877942,527	1317330,859
	2	180	0,1320	0,6673	4877942,527	429564,4104
	2	80	0,0587	0,6673	4877942,527	190917,5157
Total		1364				
STRG	4	360	1	0,1761	4877942,527	859128,8208
Total		360				
STdRG	8	320	1	0,1761	4877942,527	763670,063
Total		320				
						4877942,527

From the calculation of load proportion and axle proportion, the repetition result obtained is in accordance with the result of the Commercial Vehicle Axle Number (JSKNRencana), with the axle repetition value obtained being 4,877,942.527.

a. Determining the thickness of the subgrade and effective CBR

To determine the thickness of the foundation to be used, refer to the information in the following figure:

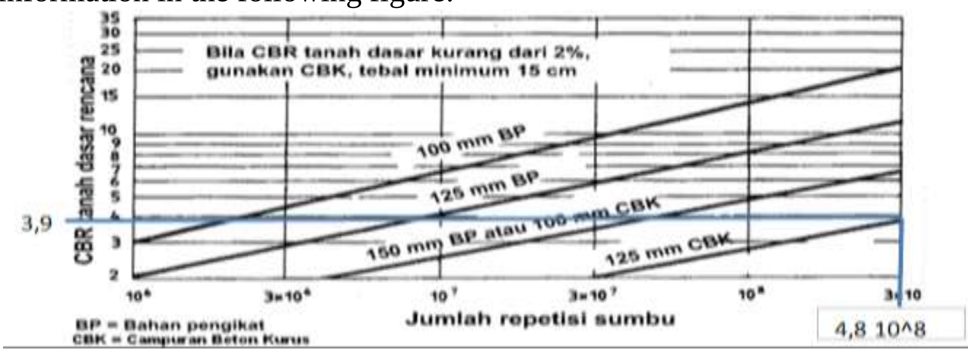

Figure 2. Estimated Calibrating Bearing Ratio (CBR) graph for the subgrade soil

In the table for determining the estimated CBR of the planned subgrade with a planned JSNKN value, the value obtained is 3.9%.

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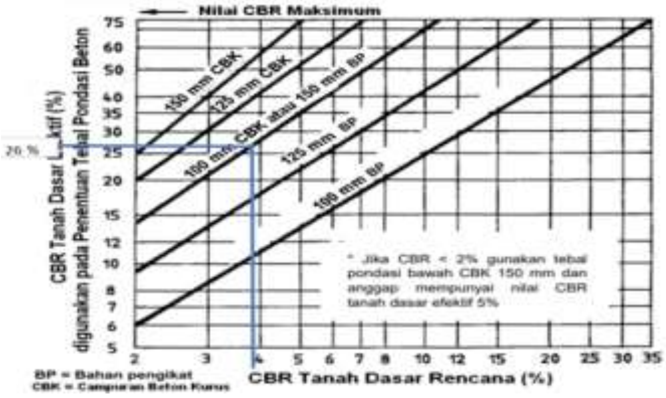

Figure 3. Graph of effective subgrade estimates and determination of concrete foundation thickness

Based on the table above, with a planned CBR value of 3.9% and a concrete foundation thickness of 100 mm using lean concrete mix, the effective subgrade CBR value is 26%. To determine the thickness of the concrete slab, the urban traffic planning graph table can be used. Using FKB 1.1 and a JSKNH value of $4.8x10^8$.

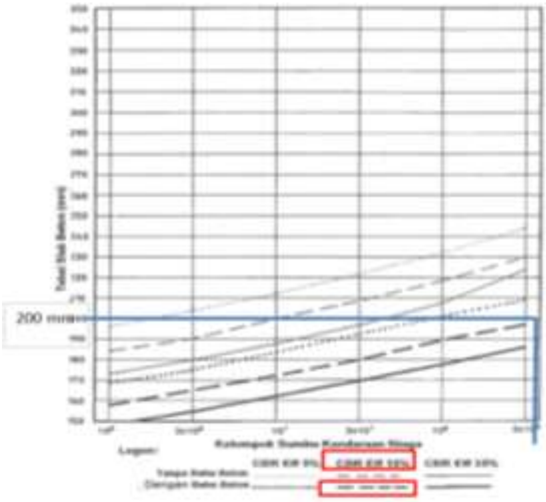

Figure 4. Graph showing concrete slab thickness planning

Concrete slab thickness:

- Flexural strength = 4,25 Mpa
- CBR of subgrade = 3,9 %
- Effective CBR = 26 %
- Concrete slab thickness = 200 mm mm Reinforced Concrete Slab (BBDT)

b. Determining the Equivalent Stress (ES) and Erosion Factor (EF)

With an effective CBR calculation of 26%, the next step is to find the equation using the interpolation method. This process is carried out between CBR values of 25% and 35%, considering that the effective CBR value is not listed in the following table.

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Table 6. Interpolation of Equivalent Stress (ES) and Erosion Factor (EF)

Slab Thickness	Calibrating Bearing Ratio Effective %	TE			FE With Ruji		
		Single Axle Single Wheel	Single Axle Dual Wheel	Tandem Axle Dual Wheel	Single Axle Single Wheel	Single Axle Dual Wheel	Tandem Axle Dual Wheel
200	25	0.85	1.3	1.1	1.75	2.35	2.4
200	26	0.848	1.295	1.095	1.748	2.348	2.40
200	35	0.83	1.25	1.05	1.73	2.33	2.36

The erosion analysis diagram and the overall load cycle, as well as the erosion factor with concrete walls, show that there is no damage due to fatigue because the percentage is 0.0%, which is less than 100%. Thus, the design thickness of 200 mm or 20 cm is considered safe.

c. Calculation of concrete pavement reinforcement

The results of the calculation of rigid pavement thickness using the 2003 road construction method show a plate thickness of 200 mm. To determine the diameter of the rods, refer to the following table:

Table 7. Rebar Diameter

No	Concrete slab thickness, h (mm)	Rebar diameter (mm)
4	190 < h < 220	33

Source : Pd T-14-2003

As shown in the table data provided, the diameter of the plain rebar with a thickness of 33 mm on a 200 mm concrete slab, a rebar length of 45 cm, and a spacing of 30 cm between rebars was obtained. Furthermore, to determine the tie bars, reference can be made to the 2003 Bina Marga guidelines, which specify the use of threaded steel with a diameter of 16 mm, a length of 70 cm, and a spacing of 75 cm between bars. The calculation of reinforced concrete slabs connected to reinforcement can be performed using the appropriate formula.

- Plate thickness (h) = 200 mm, 0.2 m
- Plate width = 6 meter
- Plate length (L) = 8 meter
- Allowable tensile strength of steel = 240 Mpa
- Friction coefficient between concrete slabs = 1.5 for lean concrete foundations
- Concrete density (M) = 2400 kg/m^3
- Gravity (g) = 9.81 m/dt^2

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a. Calculation of Longitudinal Reinforcement

$A_s = \frac{\mu . L.M.g.h}{2.fs}$ (5)

$A_s = \frac{1.5 \ x\ 8\ x\ 2400\ x\ 9.81\ x\ 0.2}{2\ x\ 240}$ = 117.72 mm^2/m’ (As Perlu)

As Minimum = 0,1 x 200 x 100 = 200 mm^2/m’ > A_s Perlu

So, 10 mm diameter reinforcement bars with a spacing of 20 cm were used.

Check the As Using = $\frac{1000}{distance}$ x π x r^2 (6)

= $\frac{1000}{200}$ x 3.14 x 5^2 = 392.5 mm^2/m’ > As Perlu (Safe)

b. Calculation of Transverse Reinforcement

$A_s = \frac{\mu . L.M.g.h}{2.fs}$ (7)

$A_s = \frac{1.5 \ x\ 6\ x\ 2400\ x\ 9.81\ x\ 0.2}{2\ x\ 240}$ = 88.29 mm^2/m’ (As Perlu)

As Minimum = 0,1 x 200 x 100 = 200 mm^2/m’ > A_s Perlu

So, 10 mm diameter reinforcement bars with a spacing of 45 cm were used.

Cek the As Using = $\frac{1000}{jarak}$ x π x r^2 (8)

= $\frac{1000}{450}$ x 3.14 x 5^2 = 174.44 mm^2/m’ > As Perlu (Safe)

SNI 8457 Method 2017

The following is the calculation for pavement thickness planning using SNI 2017:

a. Planning Data

CBR	= 15 %
Lower Foundation Thickness	= 10 cm
Planned Pavement (BBDT)	= Reinforced Concrete Pavement
Planned Lifespan	= 20 Years
Traffic Growth Rate (i)	= 3,5 %
Distribution Factor (C)	= 0,50 (1 Lane, 2 Directions)
Berat Isi Beton	= 2400 kg/m^3

b. Data California Bearing ratio (CBR)

The CBR values obtained from testing soil samples using a Dynamic Cone Penetrometer (DCP) were taken at 100-meter intervals along the Cimanying–Jiput Road section. The complete CBR test results are presented in the following table.

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Table 8. CBR Values with Field DCP

No	Station	Calibrating Bearing Ratio
1	00+000	7.60
2	00+100	18.55
3	00+200	10.08
4	00+300	14.25
5	00+400	12.30
6	00+500	13.10

To determine the CBR design value of the subgrade, an inter-seasonal factor of 0.80 is applied and the average Calibrating Bearing Ratio (CBR) is taken. CBR Design Value = CBR Value x Inter-seasonal Factor (9) This can be seen in the summary table of CBR design analysis results below:

Table 9. Summary of CBR Design Analysis Results

Segmen	CBR_{Segmen}	CBR_{Desain}	FK (%)
1	10.12	7.07	29.54

c. Average Daily Traffic Data (LHR)

The research location is on a collector road with relatively low traffic levels, as the total number of vehicles passing through the road is relatively small. Therefore, the following formula is used to calculate traffic growth:

$$R_{20} = \frac{(1 + 0.01\ x\ growth\ factor\ Annual\ traffic)^{Planned\ Age\ -1}}{0.01\ x\ Annual\ traffic\ growth\ rate} \quad (10)$$

$$R_{20} = \frac{(1 + 0.01\ x\ 3.50\%)^{20\ -1}}{0.01\ x\ 3.50\%}$$ = 28.280 % (for R 20 years, 2024-2043)

Calculating the number of axle groups from the initial LHR data to the planned age, i.e., over a 20-year period, can be done using the formula below:
Axle Groups = LHR 2024 x Number of Axle Groups (JKS)
Number of axle groups 2024-2043 = Axle groups in 2024 x 364 x 0.5 x 1 x R20 (11)

From the calculations using the above formula, the results of the data processing can be displayed in the following table:

Table 10. Cumulative Calculations for Vehicle Axle Groups

Group	Vehicle Type	Number of Vehicles	Number of Axle Groups	Axle Group 2024	Number of Axle Groups 2024-2043
Gol.4	Pick up box	276			
Gol. 6a.2	Truck 2 sumbu	90	2	180	9.3.E+00
Gol. 7a2	Truck 3 Sumbu	40	2	80	4.1.E+00
Cumulative heavy vehicle axle group					1.34.E+06

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d. Concrete Slab Thickness Planning

Determination of foundation structure

From the cumulative value of the heavy vehicle axle group with CBR data, the following formula is obtained:

HVAG = 1.34.E+06 (12)

CBR = 7.07 %

The relationship between CESA and CBR values can be represented through a line graph based on the data in the table. Based on this data, it is determined that the foundation thickness used is 150 mm, with a stabilization layer above the subgrade material that also has a thickness of 150 mm. The subgrade for rigid pavement construction is classified as fine-grained soil (classification A4 to A6), with an influence depth of 150 mm. Additionally, based on the analysis of cumulative axle loads from heavy vehicles, the relationship between cumulative loads and pavement design is presented in the form of a line graph using Material Design Table 4A. For pavements with soil classification A4, an adjusted reference table is used as shown below:

Table 11. Design Chart-4A Rigid Pavement

	Subgrade			
	Soft soil with supporting layer		Normally compacted	
	A1	A2	A3	A4
Concrete slab shoulder (tied shoulder)	Yes	No	Yes	No
	Concrete slab thickness (mm)			
Access limited to passenger cars and motorcycles only	160	175	135	150
Trucks can access	180	200	160	175
Crack distribution reinforcement	Yes		Yes if the foundation bearing capacity is not uniform	
Dowel	Not required			
LMC	Not required			
Class A foundation layer (nominal grain size 30 mm)	125 mm			
Transverse joint spacing	4 mm			

Source : Metode SNI 8457 2017

Based on the provisions in SNI 8457:2017, concrete road planning is intended to serve average daily commercial vehicle traffic (LHRN) of < 500 vehicles/day, with a total cumulative traffic load of < 1 million ESAL over a 20-year design life. Determining the thickness of the concrete pavement is a critical aspect of the design process, so the average LHRN value from two types of vehicles is used, namely 130 vehicles per day for Commercial Daily Traffic Control.

Table 12. LHRN Control

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No	Description	Explanation
1	Average truck volume = 130 trucks / day	Trucks 50–500 trucks per day
2	MST Max 8 Ton with Maximum Volume 10% LHRN	10% × 500 trucks = 50 (permitted)
3	< 1 million ESAL over the design life	Average trucks carry 40 tons, so less than 50 trucks, meeting the collector road requirement for < 1 million ESAL over the design life

Source : SNI 8457 2017

"Based on the survey results, the number of commercial vehicles with a road volume of 500 vehicles per day was recorded for collector roads. As per the planning catalog obtained, the technical data for the concrete road includes :

Table 13. Design catalogue

Description			Road type
			Collector road
1.	Daily commercial traffic		50 – 500
2.	Heaviest axle load (MST)		Maks, 8 Ton
3.	Concrete thickness		200 mm
4.	Minimum Flexural Strength, Sc		3,8 (Mpa)
5.	Thin Concrete Thickness		100
6.	Lower Foundation Layer Thickness	CBR of Subgrade Soil CBR ≥ 6%	150
7.	Transverse Joint Spacing		4,0 m
8.	Tie Bars	Minimum Steel Quality	BjTS 30
		Diameter,ø	16 mm
		Panjang, L	700 mm
		Spasi, S	750
9.	Dowel	Minimum Steel Grade	BjTp 30
		Diameter,ø	25 mm
		Length, L	450 mm
		Spacing, S	300 mm

Source : Metode SNI 8457

e. Calculation of concrete pavement reinforcement

The data used in calculating reinforcement for continuous concrete pavement can be calculated using the formula below:

- Plate thickness (h) = 20 cm, 0.2 m
- Plate width = 6 m
- Plate length (L) = 10 m

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- Coefficient of friction between concrete plate and foundation = 1.5
- Allowed tensile strength of steel = 350 Mpa
- Concrete density (M) = 2400 kg/m^3
- Gravity (g) = 9.81 m/dt^2

a. Longitudinal Reinforcement

$A_s = \frac{\mu .L.M.g.h}{2.fs}$ (13)

$A_s = \frac{1.5 \ x\ 10\ x\ 2400\ x\ 9.81\ x\ 0.2}{2\ x\ 350}$ = 100 mm^2/m' (As Required)

As Minimum = 0,1 x 200 x 100 = 200 mm^2/m' > A_s Perlu

Therefore, 10 mm diameter and 20 cm spacing are used

Check As Reinforcement using = $\frac{1000}{jarak}$ x π x r^2 (14)

= $\frac{1000}{200}$ x 3.14 x 5^2 = 392.5 mm^2/m' > As Required (Safe)

b. Transverse Reinforcement

$A_s = \frac{\mu .L.M.g.h}{2.fs}$ (15)

$A_s = \frac{1.5\ x\ 6\ x\ 2400\ x\ 9.81\ x\ 0.2}{2\ x\ 359}$ = 61 mm^2/m' (As Required)

As Min. = 0,1 x 200 x 100 = 200 mm^2/m' > A_s Required

Therefore, a diameter of 10 mm and a spacing of 45 cm are used

Check the reinforcement bar spacing using = $\frac{1000}{jarak}$ x π x r^2 (16)

= $\frac{1000}{200}$ x 392.5 x 5^2 = 174.44 mm^2/m ' > As Required (Safe)

Pd T-14-2003 SNI 8457 2017

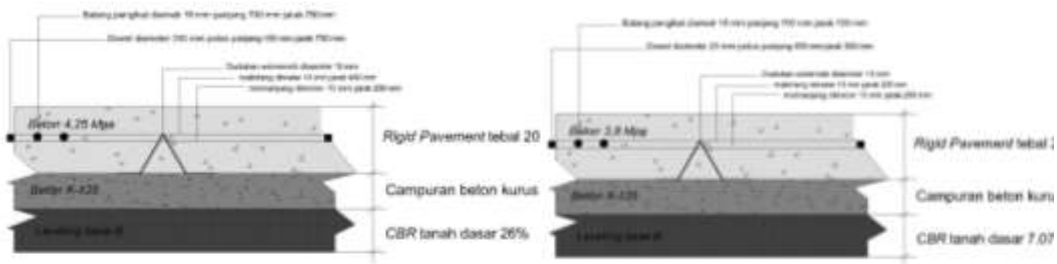

Figure 5. Results of Calculations Using Both Methods

This study aims to analyse the quality components of rigid pavement based on the volume of vehicles passing through the Cimanying–Jiput road section in Pandeglang Regency. Two national standard methods were used in the analysis, namely the Technical Guidelines Pd T-14-2003 and SNI 8457:2017, with a focus on evaluating concrete slab thickness, reinforcement specifications, and the relationship between traffic volume and structural requirements. The analytical approach employed was descriptive-comparative, using field and secondary data as the basis for analysis. The road section studied has characteristics as a collector road

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with medium-low traffic volume, making it an ideal object for comparing the design responses of the two methods.

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In the Pd T-14-2003 method, after interpolating the effective CBR value of 26%, the recommended concrete slab thickness is 200 mm with the type of pavement being Reinforced Concrete Pavement (RCP). A load safety factor (LSF) of 1.1 is used in the calculations, in accordance with guidelines for arterial or collector roads with medium vehicle volumes. Meanwhile, in SNI 8457:2017, based on the cumulative vehicle axle group (HVAG = 1.34 million ESAL) and the subgrade CBR value of 7.07%, the concrete slab thickness is also recommended to be 200 mm for collector road conditions. This indicates similar results despite differing theoretical approaches. However, SNI 8457:2017 sets a limit that for commercial vehicle volumes less than 500 vehicles/day, the slab thickness can be adjusted for low traffic scenarios. The results of this study are still within that range, so the use of a 200 mm thickness is considered sufficiently safe.

The reinforcement calculations show differences in material parameters and analysis procedures. The Pd T-14-2003 method uses a steel tensile strength of 240 MPa, with 10 mm diameter reinforcement bars installed at a distance of 20 cm (longitudinal) and 45 cm (transverse). A bar diameter of 33 mm, length of 45 cm, and spacing of 30 cm are used. On the other hand, SNI 8457:2017 uses a higher allowable tensile strength for steel (350 MPa), but still employs 10 mm diameter reinforcement bars with a similar installation pattern. Tie bars with a diameter of 16 mm, length of 700 mm, and spacing of 75 cm are used according to the standard. Although there are differences in the assumptions regarding steel tensile strength, both methods result in relatively similar reinforcement configurations. This indicates that the quality of the reinforcement does not significantly alter the geometric dimensions but rather affects the efficiency of material use and construction costs.

In the equivalent stress (ES) and erosion factor (EF) analysis using the Pd T-14-2003 method, no fatigue damage was found, with a damage percentage of < 100%. This proves that a plate thickness of 200 mm is sufficient to withstand

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repeated vehicle axle loads. Meanwhile, SNI 8457:2017 does not explicitly mention flexural stress analysis, but provides guidance on the minimum flexural strength of concrete at 3.8 MPa, which in this case is exceeded by the value of 4.25 MPa. This indicates that the planned concrete quality is more than sufficient to support the structural design.

In terms of cost efficiency, the Pd T-14-2003 method tends to be more conservative in terms of reinforcement specifications and plate thickness, which may result in higher construction costs. Conversely, SNI 8457:2017 is more flexible and allows for cost optimisation through a traffic volume-based approach. Since the Cimanying–Jiput road section is a collector road with relatively low commercial vehicle traffic volume (< 500 vehicles/day), SNI 8457:2017 is more appropriate as its approach is more realistic in terms of local traffic conditions and long-term maintenance capabilities.

The findings of this study have several practical and theoretical implications. Although using different approaches, both methods provide relatively consistent results in terms of concrete slab thickness and reinforcement specifications. This indicates that both methods are valid for use in the context of collector roads with medium-low traffic volumes. Concrete with a flexural strength of 4.25 MPa is more than sufficient to support existing traffic loads. This suggests that improving concrete quality could be an alternative to increasing slab thickness, especially for projects with budget constraints. SNI 8457:2017 provides greater flexibility in designing pavement structures based on subgrade classification, traffic volume, and traffic growth. Therefore, SNI 8457:2017 is more suitable for infrastructure projects in areas with variable traffic conditions.

After performing calculations for plate thickness and reinforcement using both methods, namely Technical Guide Pd T-14-2003 and SNI 8457:2017, the results can be summarized and compared systematically. This comparison aims to provide a comprehensive overview of the similarities and main differences in the design outputs generated by each method based on traffic data and field conditions on the Cimanying–Jiput road section. The summary of calculation results from both methods is presented in the following table.

Table 14. Results of Comparison of Plate Thickness and Reinforcement Planning

Component	Pd T-14-2003	SNI 8457:2017
Slab Thickness (mm)	200	200
Concrete Strength (Flexural)	4.25 MPa	Minimum 3.8 MPa (Designed: 4.25 MPa)
Longitudinal Reinforcement	Ø10 mm, Spacing 20 cm (As = 392.5 mm²/m')	Ø10 mm, Spacing 20 cm (As = 392.5 mm²/m')
Transverse Reinforcement	Ø10 mm, Spacing 45 cm (As = 174.44 mm²/m')	Ø10 mm, Spacing 45 cm (As = 174.44 mm²/m')
Shrinkage/Tie	Ø33 mm, Length 45 cm,	Not explicitly specified

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Reinforcement	Spacing 30 cm	(Calculated using formula, not table)
Tie Bars	Ø16 mm, Length 70 cm, Spacing 75 cm	Ø16 mm, Length 700 mm, Spacing 750 mm (?) *
Design Basis	Empirical Approach, Effective CBR 26%	Mechanistic-Empirical Approach, Design CBR 7.07%
Fatigue/Erosion Analysis	Calculated, Result is Safe (<100%)	Not explicitly calculated as in Pd T-14

For further study, it is recommended that more soil samples be taken and laboratory tests be conducted to validate the CBR values and basic soil characteristics more accurately. The implementation of software such as MEPDG (Mechanistic-Empirical Pavement Design Guide) or Kenpave can provide a more detailed picture of the distribution of stress and deformation in pavement structures. A comparative study of the two methods can also be expanded by evaluating the life cycle costs of the road, including long-term maintenance and repair costs. To enhance the generalisation of the findings, similar research can be conducted at other locations with different geological and traffic characteristics.

Overall, this study successfully demonstrated that both methods — Pd T-14-2003 and SNI 8457:2017 — can be used to design rigid pavement on the Cimanying–Jiput section. Although the final results are relatively similar in terms of slab thickness and reinforcement specifications, SNI 8457:2017 offers a more modern, flexible, and field-relevant approach. Therefore, the best technical recommendation is to use SNI 8457:2017 for rigid pavement projects in areas with similar characteristics.

5. CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the analysis of rigid pavement quality components on the Cimanying–Jiput Road Section, it was concluded that both the Pd T-14-2003 and SNI 8457:2017 methods yielded a concrete slab thickness of 200 mm for the given traffic and subgrade conditions (effective CBR of 26% for Pd T-14-2003 and CBR design of 7.07% for SNI 8457:2017). The flexural strength used was 4.25 MPa for Pd T-14-2003 and a minimum of 3.8 MPa (also planned at 4.25 MPa) for SNI 8457:2017. While the final thickness and primary reinforcement specifications (10 mm diameter bars) were similar, differences emerged in other design elements such as dowel bar size (33 mm vs. 25 mm) and the specific calculation approaches for parameters like steel tensile strength (240 MPa vs. 350 MPa). Both methods confirmed the structural adequacy of the 200 mm slab, with the Pd T-14-2003 fatigue analysis showing a damage percentage well below 100%, and the SNI method meeting its minimum strength requirements.

Recommendations

Future work should focus on validating the underlying assumptions and technical parameters of both design methods. It is recommended to conduct more comprehensive soil testing to accurately determine CBR and other subgrade

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characteristics. Additionally, exploring more advanced design approaches, such as mechanistic-empirical methods or life cycle cost analyses, is suggested to further optimize pavement design and construction efficiency. Given its more modern approach and adaptability to specific traffic and subgrade conditions, SNI 8457:2017 is generally recommended for similar road projects.

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