
ANALYSIS OF THE APPLICATION OF UNDERPASS AT CIBIRU ROUNDABOUT USING PTV VISSIM

Bangga Fitriyanda Umar¹, Khalda², Silvina Sintianti³, Shinta Novriani⁴

Universitas Swadaya Gunung Jati, Cirebon, Indonesia

[banggaumar2345@gmail.com¹](mailto:banggaumar2345@gmail.com), [khaldaattamimi10@gmail.com²](mailto:khaldaattamimi10@gmail.com),
[silvinasintianti97@gmail.com³](mailto:silvinasintianti97@gmail.com), [shinta.novrianii@gmail.com⁴](mailto:shinta.novrianii@gmail.com)

ABSTRACT

Traffic congestion is a persistent global issue, particularly in densely populated cities like Bandung, Indonesia. The construction of an underpass offers a potential solution to reduce congestion at high-density intersections, such as the Cibiru Roundabout, which connects JL. Soekarno-Hatta, JL. Cibiru, and JL. A.H Nasution. This research analyzes traffic performance and assesses the feasibility of implementing an underpass at this location. A quantitative descriptive research method was used, with data collected through field measurements of vehicle volume and speed. The analysis followed the Indonesian Road Capacity Guidelines (PKJI) 2023 to evaluate capacity, degree of saturation, and service level. Using PTV VISSIM software, simulations were conducted to project traffic conditions over the next ten years, considering a 5% annual growth rate. Results indicate significant congestion, with service levels reaching "F" across various segments. Simulation outcomes suggest that an underpass would improve traffic flow by increasing capacity, reducing delays, and shortening queues. This study provides a valuable reference for urban planners seeking effective interventions in other cities facing similar traffic challenges.

Keywords: roundabout, PKJI 2023, ptv vissim, underpass.

Corresponding Author: Shinta Novriani

E-mail: shinta.novrianii@gmail.com



INTRODUCTION

Traffic congestion is still unresolved worldwide, especially in every country with big cities (Haryati, 2020; Prasetyo et al., 2022). Indonesia has several big cities closely related to this issue, one of which is the city of Bandung, which has a high population (Ekiciputara et al., 2022; Marza et al., 2023). Unsurprisingly, Bandung has many congestion points, including the Cibiru roundabout, which brings together three road junctions, one of which is JL. Soekarno-Hatta, JL. Cibiru and JL. A.H Nasution. Bandung is a famous city and the largest metropolitan city in West Java. Bandung has experienced rapid growth in various sectors, such as a center of trade, tourism, education, culture, and industrial center.

Interestingly, after Jakarta and Surabaya, Bandung has the second-highest population in Indonesia. Data from the Central Agency Statistics (BPS) in 2023 shows that the city of Bandung has a population of 2,469,589 (Prasetyanto et al., 2021; Tjahjono et al., 2021). With the increasing number of people in Bandung and the continued growth of traffic, several problems arise, including congestion (Rivaldi & Novriani, 2024). This study aims to identify the traffic density and performance at the Cibiru Roundabout, Bandung City, and provide recommendations for reducing vehicle density in the next ten years. Traffic jams occur when traffic is hampered or stopped due to the volume of vehicles exceeding the available capacity. Congestion has detrimental consequences for the economy and the environment (Gertler et al., 2024; Prasetyanto et al., 2021; Sari & Yudhistira, 2021; Siregar et al., 2021).

The Cibiru Roundabout is a circular intersection used as a substitute for traffic lights or stop signs to regulate the traffic flow that connects the city of Bandung with Bandung Regency (Datu et al., 2018). The problem occurred because the traffic flow from Jalan Soekarno Hatta to Jalan Cibiru met the flow from Jalan A.H Nasution. The Cibiru Roundabout is also one of the strategic transportation nodes in Bandung, where traffic activity is very high and is often the focus of attention related to congestion problems and traffic violations. Traffic jams usually occur at this roundabout during busy traffic hours, coupled with the environment around the roundabout (Suryaningsih et al., 2020).

PTV VISSIM is a program for reviewing simulation results by entering geometric and vehicle data, as well as other elements to be visualized in the form of animations or outputs to review traffic performance (Al-Msari et al., 2024; Haq et al., 2022; Karakikes et al., 2017; Kučera & Chocholáč, 2021; Luo et al., 2024). VISSIM's PTV software can simulate existing traffic conditions. The outputs on VISSIM PTV are queue length, delay, speed, stops, and travel time, which function in engineering traffic (Al-Msari et al., 2024; Mitkas & Politis, 2020; Prasetyo et al., 2022).

Traffic congestion remains a critical issue in urban centers worldwide, particularly in densely populated cities like Bandung, Indonesia. Research, such as Harwidyo (2022), explored the effectiveness of underpasses in reducing traffic delays in other Indonesian cities, indicating that such infrastructure can significantly improve traffic flow and reduce congestion. Additionally, Apriyono et al. (2021) evaluated various traffic management solutions, showing that underpasses have notable benefits for minimizing intersectional delays. Despite these, studies have examined the specific conditions at the Cibiru Roundabout in Bandung, a crucial intersection linking key roadways such as JL. Soekarno-Hatta, JL. Cibiru, and JL. A.H Nasution.

This study uniquely focuses on the Cibiru Roundabout to assess the feasibility of an underpass and provides simulations projecting traffic conditions over the next decade. By addressing the congestion challenges specific to this location, this research adds to the existing body of knowledge. It offers a model that could apply to other high-density intersections. The findings will guide urban planners and policymakers in making data-driven decisions for Bandung and similar urban areas.

In recent years, urban areas worldwide, especially in densely populated cities, have grappled with significant traffic congestion issues. Previous studies have highlighted various strategies to alleviate congestion. For example, a study by Harwidyo (2022) analyzed the impact of underpass implementation on reducing traffic delays in Jakarta, demonstrating that underpasses can improve traffic flow and decrease congestion. Similarly, research by Andika (2021) focused on roundabouts in other major Indonesian cities, showing how traffic infrastructure improvements, such as underpasses and bypasses, effectively reduce saturation levels and improve road service quality.

However, limited research has citly on the unique traffic conditions at the Cibiru Roundabout in Bandung, a crucial intersection connecting several major roads. Given Bandung's rapidly growing population and economic activities, understanding the impact of an underpass at this location is essential for improving local traffic management. This study addresses this gap by analyzing the potential benefits of implementing an underpass at the Cibiru Roundabout, providing insights that could support similar projects in other urban settings.

Based on this problem, the focus of the problem is to analyze the traffic performance of the Cibiru Roundabout with the title "Analysis of the Implementation of the Cibiru Roundabout Underpass Using PTV VISSIM" Case Study of the Cibiru Roundabout, Bandung City aiming to determine the traffic performance at the Cibiru roundabout and simulate the existing and alternative conditions so that the traffic flow at the Cibiru roundabout will be smooth. The method used in this

study is quantitative descriptive based on the Indonesian Road Capacity Guidelines (PKJI 2023) and recommends making an alternative in the form of an Underpass from Jl. Soekarno-Hatta towards Jl. Cibiru.

METHOD

Research Flow

This study employs a quantitative descriptive research design to evaluate traffic performance at the Cibiru Roundabout in Bandung, Indonesia. The research aims to assess the current traffic conditions and simulate the potential impact of implementing an underpass to reduce congestion. Data was collected through field observations and measurements, focusing on vehicle volume, speed, and traffic patterns. Data was gathered over a specific time frame to ensure accuracy and reliability, capturing peak traffic hours to understand congestion levels thoroughly (Wallwey & Kajfez, 2023).

The Indonesian Road Capacity Guidelines (PKJI) 2023 served as the primary framework for analyzing traffic performance, including metrics such as capacity, degree of saturation, and level of service at the roundabout. PTV VISSIM software was used for traffic simulation, allowing researchers to project traffic conditions with and without an underpass over a ten-year period, assuming a 5% annual growth rate in vehicle numbers. This simulation provided insights into how the underpass might improve traffic flow, reduce delays, and minimize queue lengths in the future.

Primary and secondary data management uses the 2023 PKJI reference, resulting in traffic performance outputs that are used as study material for recommendations to be applied to the Cibiru Bandung roundabout. The location of this research was the Cibiru Roundabout, Bandung City. Primary data is obtained through a traffic survey. The observation is carried out for 11 hours in the morning from 06.00 – 10.00 WIB, afternoon from 11.00 – 14.00 WIB, and afternoon from 16.00 – 19.00 WIB, with the provision that it is taken at one peak hour.

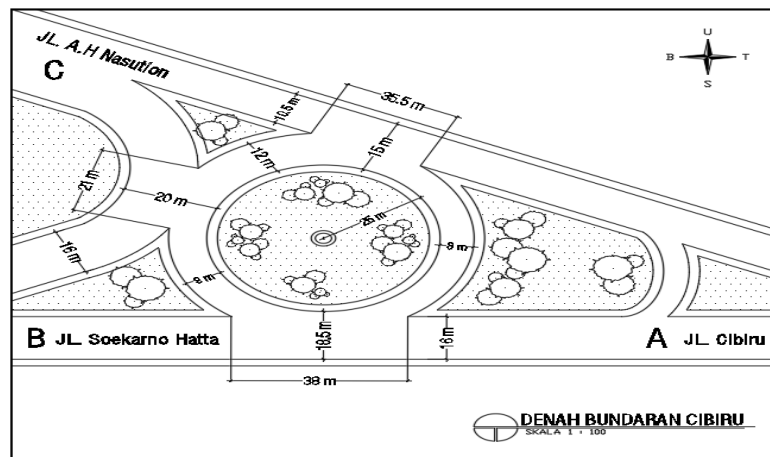


Figure 1.
Research Location
Source: Analysis, 2024

In this study, the 2023 Indonesian Road Capacity Guidelines are guidelines used to analyze the performance of the Cibiru roundabout (Ahmad et al., 2023).

1. Vehicle Volume Calculation

The data used refers to one busy hour throughout the 11-hour study. The data entered in the modeling are road geometry, traffic volume data, driving behavior data, and existing conditions. The secondary data used are aerial photos from Google Earth and Bing maps in the VISSIM system.

2. Capacity Calculation (C)

$$C = C_0 \times F_{UK} \times F_{RSU}$$

3. Degree of Saturation

$$DJ = q / C$$

4. Delay

a. Traffic Delay of Roundabout Interwoven Section

$$D_j > 0,60: T_R = \frac{1}{(0,59186 - 0,52525 \times D_j) - (1 - D_j) \times 2}$$

$$D_j \leq 0,60: T_R = 2 + 2,68982 \times D_j - (1 - D_j) \times 2$$

b. Roundabout Traffic Delay

$$T_{LL} = \sum_{i=1}^n \frac{q_{total} \times T_{Ri}}{q_{masuk}}$$

c. Roundabout Delay

$$T = T_{LL} + T_G$$

5. Queue Opportunities

$$\text{Upper Limit : } Pa = 26,55 \times D_j - 55,55 \times D_j^2 + 108,57 \times D_j^3$$

$$\text{Lower Limit : } Pa = 9,415 \times D_j + 29,967 \times D_j^{4,619}$$

RESULTS AND DISCUSSION

Roundabout Geometric Analysis

The geometry of the Cibiru Roundabout is the size of the width of the road at the Roundabout, including the road to enter and exit the Roundabout. The geometric data obtained from the results of direct surveys in the field can be seen in Table 1.

Table 1. Geometric Roundabout

Direction	Entry Width (m)		Braid Width (m)	Length of braid (m)
	W1	W2		
JL. Cibiru - JL. Soekarno-Hatta	16	9	38	38
JL. Soekarno-Hatta - JL. A.H Nasution	16	12	21	15
JL. A.H Nasution - JL. Cibiru	10.5	8	35,5	15

Source: Analysis, 2024

Traffic Flow Volume Analysis

Traffic flow is the volume of motor vehicles passing through a section of a road with vehicle units in an hour (Vehicle/hour) or passenger car units in an hour (Skr/hour) (Arrang & Rangan, 2020). In the traffic flow for each flow of movement in each type of a vehicle in the form of:

- Motorbike (SM)
- A Passenger Car (MP),
Transportation included in MP is ordinary cars, public transportation, and pick-ups.
- Medium Vehicle (KS),
Transportation included in KS is a regular Bus and Regular Truck
- Big Bus (BB),

- e. Large Trucks (TB) and
 Transportation included in TB is Tronton and Container

Table 2. Vehicle Volume

Approach	Times	Volume	
		Vehicle/hour	Skr/hour
JL.Cibiru - JL.Soekarno Hatta	Morning	7656	4376,4
	Afternoon	10703	5646
	Evening	11182	5930,4
JL.Soekarno Hatta - JL.A.H Nasution	Morning	8463	4798,6
	Afternoon	10121	5543
	Evening	11378	6077,3
JL.A.H Nasution - JL.Cibiru	Morning	7553	4139,3
	Afternoon	8402	4548,2
	Evening	9291	5000,7

Source: Analysis, 2024

Traffic Characteristics Analysis

Traffic characteristics analysis is research conducted to understand and identify vehicle movement characteristics on the road. By being guided by the PKJI 2023, the value of capacity, degree of saturation, and level of road service are obtained (Kumalawati et al., 2023).

- a. Capacity

Table 3. Capacity

Approach	Times	C ₀ (Skr/hour)	F _{UK}	F _{RSU}	C (Skr/hour)
JL. Cibiru - JL.Soekarno Hatta	Morning	5831,56	1	0,92	5339,7
	Afternoon	5827,15	1	0,91	5315,49
	Evening	5827,06	1	0,92	5334,32
JL.Soekarno Hatta - JL. A.H Nasution	Morning	4037,37	1	0,92	3696,84
	Afternoon	4032,32	1	0,91	3678,26
	Evening	4038,71	1	0,92	3697,19
JL. A .H Nasution - JL. Cibiru	Morning	4534,64	1	0,92	4152,17
	Afternoon	4531,57	1	0,91	4133,68
	Evening	4533,39	1	0,92	4150,04

Source: Analysis, 2024

The highest capacity occurs in the morning on the approach of JL. Cibiru – JL. Soekarno Hatta is C = 5339,7 Skr/hour. During the day, it is found in the approach part of JL. Cibiru – JL. Soekarno Hatta is C = 5315,49 Skr/hour, and in the afternoon, it is found in the approach section of JL. Cibiru – JL. Soekarno Hatta is C =5334,32 Skr/hour.

- b. Degree of saturation

Table 4. Degree of Saturation

Approach	Times	q (Skr/hour)	C (Skr/hour)	DJ (Skr/hour)	LOSS
	Morning	4376,4	5339,7	0,82	D

JL. Cibiru - JL. Soekarno Hatta	Afternoon	5646	5315,49	1,06	F
	Evening	5930,4	5334,32	1,11	F
JL. Soekarno Hatta - JL. A.H Nasution	Morning	4798,6	3696,84	1,30	F
	Afternoon	5543	3678,26	1,51	F
	Evening	6077,3	3697,19	1,64	F
JL. A .H Nasution - JL. Cibiru	Morning	4139,3	4152,17	1,00	E
	Afternoon	4548,2	4133,68	1,10	F
	Evening	5000,7	4150,04	1,20	F

Source: Analysis, 2024

From the table above, it can be concluded that the JL approach is saturated to a degree. Cibiru - JL. Soekarno Hatta scored 0,82 – 1,11 with a service level (LOSS) of D-F, which means that the flow is almost unstable – there is often congestion and long queues. As well as the approach part of JL. Soekarno Hatta - JL. A.H Nasution and JL. A.H Nasution - JL. Cibiru received a DJ score of > 1 with a service level (LOSS) of F, meaning there are often traffic jams and long queues.

c. Delay

Table 5. Delay

Approach	Times	T _R (Sec/skr)	T _{LL} (Sec/skr)	T (Sec/skr)
JL. Cibiru - JL. Soekarno Hatta	Morning	16,1	5,29	9,29
	Afternoon	16,5	5,91	9,91
	Evening	16,5	5,77	9,77
JL. Soekarno Hatta - JL. A.H Nasution	Morning	16,8	6,06	10,059
	Afternoon	17,1	6,03	10,03
	Evening	17,3	6,19	10,19
JL. A .H Nasution - JL. Cibiru	Morning	16,4	5,09	9,09
	Afternoon	16,5	4,77	8,77
	Evening	16,7	4,90	8,90

Source: Analysis, 2024

From the table above, it can be concluded that there is a delay in the JL approach. JL. Cibiru - JL. Soekarno Hatta got a value of T = 9,29 – 9,77 Sec/skr. As well as the approach part of JL. Soekarno Hatta - JL. A.H Nasution got a value of T = 10,03 – 10,19 Sec/skr, and JL. A.H Nasution - JL. Cibiru in got a value of T = 8,77 – 9,09 Sec/skr.

Table 6. Queue Opportunities

Approach	Times	Upper Limit (Qp%)	Lower Limit (Qp%)
JL. Cibiru - JL. Soekarno Hatta	Morning	44.22	19.67
	Afternoon	95.64	49.60
	Evening	110.04	59.35
JL. Soekarno Hatta - JL. A.H Nasution	Morning	178.31	112.20
	Afternoon	285.41	213.39
	Evening	375.75	313.06
JL. A.H Nasution - JL. Cibiru	Morning	78.83	38.93
	Afternoon	106.58	56.95
	Evening	141.29	82.25

Source: Analysis, 2024

d. Queues Opportunities

From the table above, it can be concluded that the queue opportunity in the approach. JL. Cibiru - JL. Soekarno Hatta got an upper limit value of 44,22% - 110,04%, a lower limit value of 19,67% - 59,35%, as well as the approach part of JL. Soekarno Hatta - JL. A.H Nasution got an upper limit value of 178,31% - 375,75%, a lower limit value of 112,20% - 313,06%, and JL. A.H Nasution - JL. Cibiru got an upper limit value of 78,83% - 141,29% and a lower limit value of 38,93% - 82,25%.

Analysis Existing

The existing analysis aims to observe the behavior and output of the VISSIM program and compare it with alternatives. The results of the existing analysis presented include the values of volume, speed, delay, and queue length. The use of the VISSIM program in the existing analysis needs to be calibrated and validated. The calibration results in the VISSIM program are shown in the following table(Andika, 2021).

Table 7. Calibration Values Used in VISSIM

Type Driving Behaviour	Parameter Driving Behaviour	Value	
		Default VISSIM	Adjustment Calibration
Car following	Average standsill distance	2 m	0,45 m
	Additive part of safety distance	2 m	0,45 m
	Multiplicative part of safety distance	3 m	1 m
Lateral	Desired position at free flow	Middle of lane	Any
	Distance standing	1 m	0,2 m
	Distance driving	1 m	0,5 m

Source: Analysis, 2024

After adjustment, the table shows that there are differences in rider characteristics, which are presented by VISSIM by default and after calibration. Driving behavior is an adjustment to the characteristics of drivers in Indonesia. With these characteristic data, the results obtained are in accordance with the actual situation in the field. A regression test is required to present the validation value after the calibration (Wibowo et al., 2023). After adjustment, the table shows that there are differences in rider characteristics, which are presented by VISSIM by default and after calibration. Driving behavior is an adjustment to the characteristics of drivers in Indonesia. With these characteristic data, the results obtained are in accordance with the actual situation in the field. A regression test is required to present the validation value after calibration.

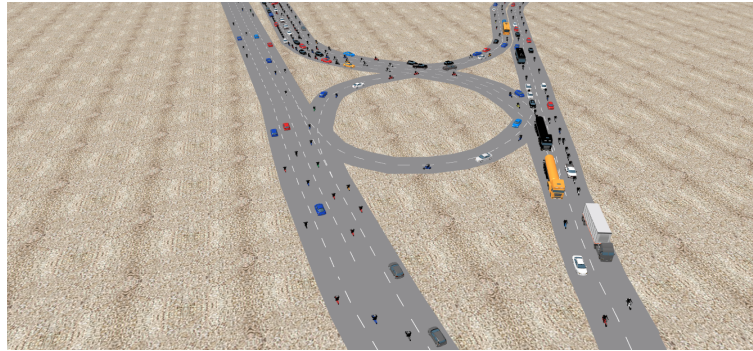


Figure 2.

VISSIM Conditions Before Calibration

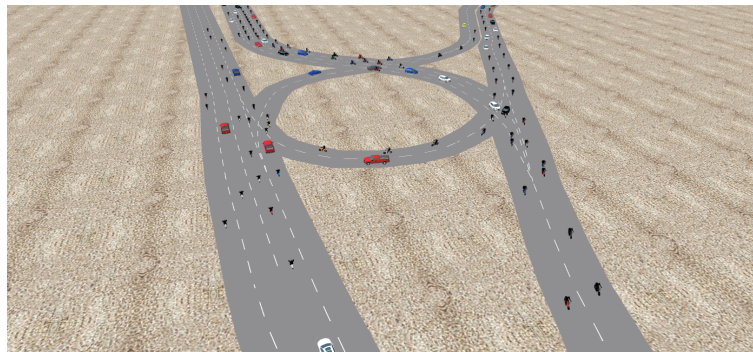


Figure 3.

VISSIM Condition After Calibration

The VISSIM software outputs the values of the vehicle queue's volume, speed, delay, and length, displayed in the following table.

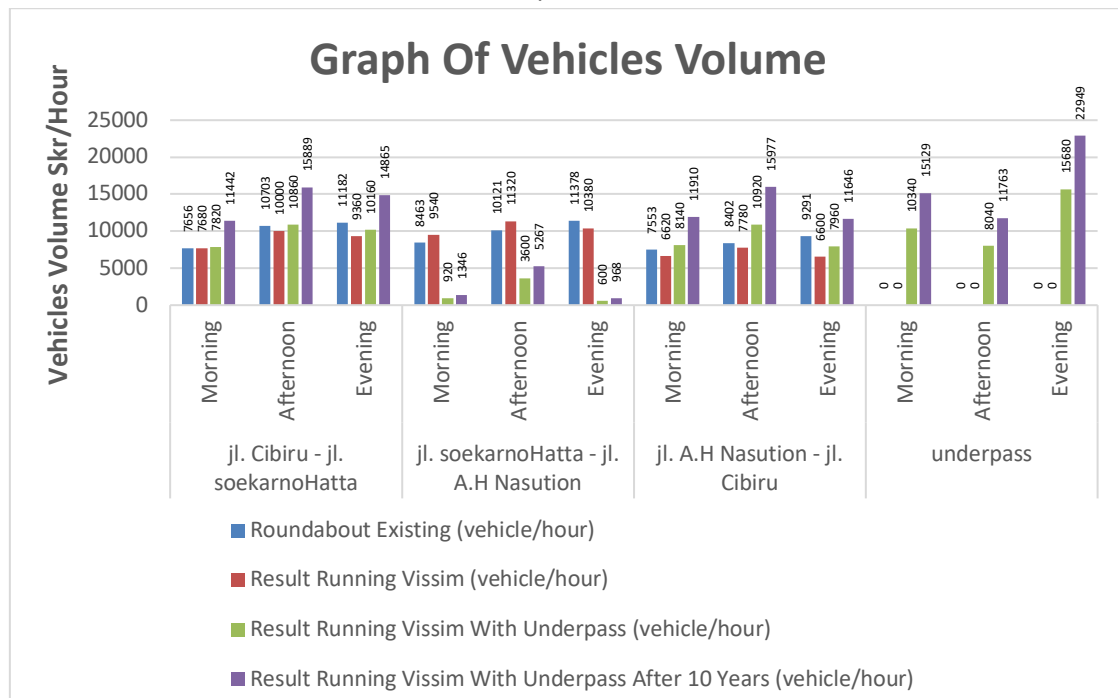
Table 8. Volume Comparison Between Existing, Vissim, and Projection Underpass Alternatives After 10 Years

Approach	Times	Existing Roundabout (Vehicle/hour)	Result Running Vissim (Vehicle/hour)	Result Running Vissim With Underpass (Vehicle/hour)	Result Running Vissim With Underpass After 10 Years (Vehicle/hour)
JL. Cibiru - JL. Soekarno	Morning	7656	7680	7820	11442
Hatta	Afternoon	10703	10000	10860	15889
	Evening	11182	9360	10160	14865
JL. Soekarno - JL. Hatta	Morning	8463	9540	920	1346
A.H	Afternoon	10121	11320	3600	5267
Nasution	Evening	11378	10380	600	968
JL. A .H - Nasution	Morning	7553	6620	8140	11910
Cibiru	Afternoon	8402	7780	10920	15977
	Evening	9291	6600	7960	11646
Underpass	Morning	-	-	10340	15129

Afternoon	-	-	8040	11763
Evening	-	-	15680	22949

Source: Analysis, 2024

Judging from the table above, the highest volume of vehicles in the existing data of the Cibiru roundabout is 11,378 Vehicles/hour from the direction of JL. Soekarno Hatta - JL. A.H Nasution in the afternoon. The highest volume of vissim running output is 11,320 Vehicles/hour from the direction of JL. Soekarno Hatta - JL. A.H Nasution during the day. The highest volume of running vissim output with Underpass was 15,680 Vehicles/hour from the direction of Underpass in the afternoon. The highest 10-year projected output volume of the Underpass running output is 22,949 Vehicles/hour from the direction of the Underpass in the afternoon.



Graph 1.

Volume Comparison Between Existing, Vissim, and Projection Underpass Alternatives After 10 Years

Source: Analysis, 2024

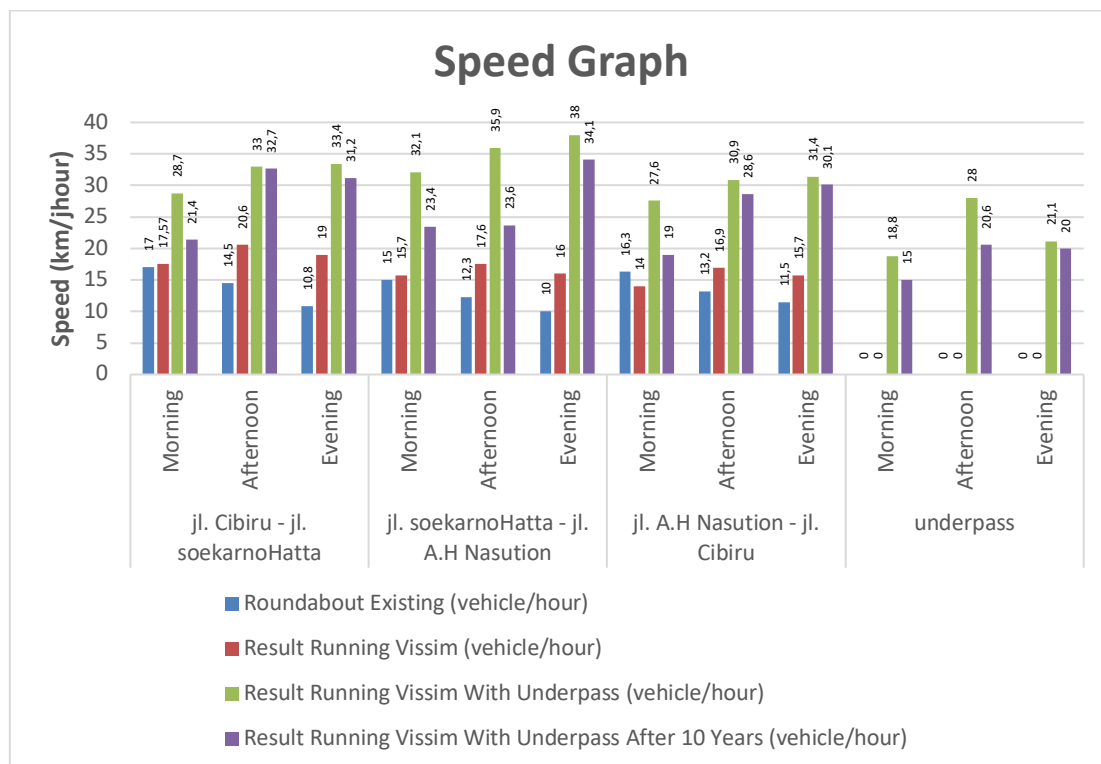
Table 9. Speed Comparison Between Existing, Vissim, Existing Underpass, and Projection Underpass Alternatives After 10 Years

Approach	Times	Speed Existing (Km/hour)	Result Running Vissim (Km/hour)	Result Running Vissim with Underpass (Vehicle/hour)	Result Running Vissim With Underpass After 10 Years (Vehicle/hour)
JL. Cibiru - JL. Soekarno Hatta	Morning	17	17,57	28,7	21,4
	Afternoon	14,5	20,6	33	32,7
	Evening	10,8	19	33,4	31,2
	Morning	15	15,7	32,1	23,4

JL. Soekarno	Afternoon	12,3	17,6	35,9	23,6
Hatta - JL.	Evening	10		38	34,1
A.H			16		
Nasution					
JL. A .H	Morning	16,3	14	27,6	19
Nasution -	Afternoon	13,2	16,9	30,9	28,6
JL. Cibiru	Evening	11,5	15,7	31,4	30,1
	Morning	-	-	18,8	15
Underpass	Afternoon	-	-	28	20,6
	Evening	-	-	21,1	20

Source: Analysis, 2024

Judging from the table above, the highest vehicle speed in existing conditions is 17 km/h from the direction of JL. Cibiru - JL. Soekarno Hatta, in the morning, the highest vehicle speed due to running vissim was 20,6 km/hour from the direction of JL. Cibiru - JL. Soekarno Hatta, the highest vehicle speed after the addition of the Underpass, is 38 Km/hour from the direction of JL. Soekarno Hatta - JL. A.H Nasution and the highest vehicle speed from the output of the 10-year projected Underpass is 34,1 Km/hour. The decline in top speed is caused by traffic density increasing over time from year to year.



Graph 2.

Speed Comparison Between Existing, Vissim, Existing Underpass, and Projection Underpass. Alternatives After 10 Years

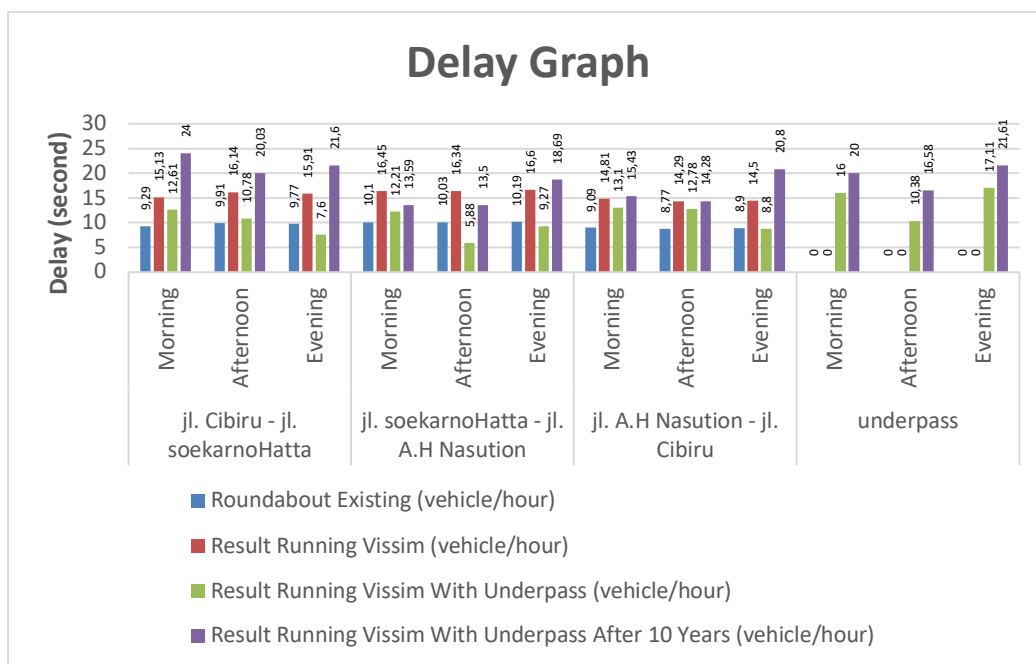
Source: Analysis, 2024

Table 10. Delay Comparison Between Vissim, Underpass, and Projection Underpass Alternatives After 10 Years

Approach	Times	Delay Existing (Second)	Result Delay Running Vissim (Second)	Result Delay Running Vissim With Underpass (Second)	Result Delay Running Vissim With Underpass After 10 Years (Second)
JL. Cibiru - JL. Soekarno Hatta	Morning	9,29	15,13	12,61	24
	Afternoon	9,91	16,14	10,78	20,03
	Evening	9,77	15,91	7,6	21,6
JL. Soekarno Hatta - JL. A.H Nasution	Morning	10,1	16,45	12,21	13,59
	Afternoon	10,03	16,34	5,88	13,5
	Evening	10,19	16,6	9,27	18,69
JL. A .H Nasution - JL. Cibiru	Morning	9,09	14,81	13,1	15,43
	Afternoon	8,77	14,29	12,78	14,28
	Evening	8,9	14,5	8,8	20,8
Underpass	Morning	-	-	16	20
	Afternoon	-	-	10,38	16,58
	Evening	-	-	17,11	21,61

Source: Analysis, 2024

Judging from the table above, the highest delay result of the output of the vissim is 16,45 Seconds from the direction of JL. Soekarno Hatta - JL. A.H Nasution. The speed of the vissim delay with the highest Underpass was 17,11 Seconds from the direction of the Underpass. The highest speed on the vissim projection after ten years is 21,61 Seconds from the direction of the Underpass.



Graph 4.

Delay Comparison Between Vissim, Underpass, and 10-Year Projection Underpass Alternative

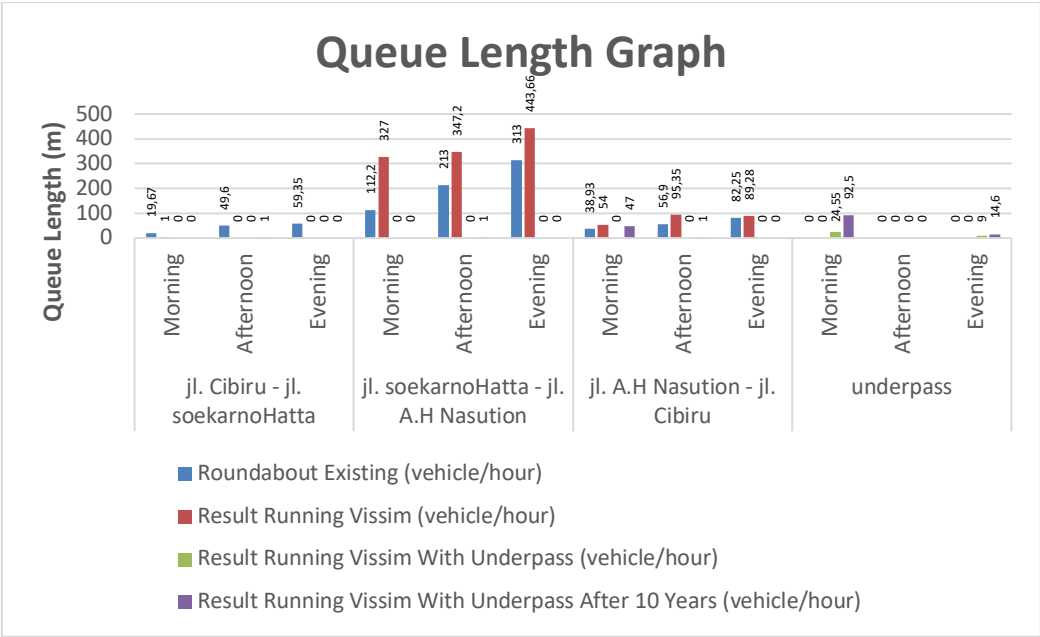
Source: Analysis, 2024

Table 3.8 Comparison of Queue Length Between Vissim, Underpass, and Projection Underpass Alternatives After 10 Years

Approach	Times	Queue Opportunities Roundabouts (%)	Vissim Queue Running Results (meter)	Results of Running Vissim Queue with Underpass (meter)	Results of Running the Vissim Queue with Underpass after 10 years (meter)
JL. Cibiru - JL. Soekarno	Morning	19,67%	1	0	0
Hatta	Afternoon	49,6%	0	0	1
	Evening	59,35%	0	0	0
JL. Soekarno	Morning	112,2%	327	0	0
Hatta - JL. A.H	Afternoon	213%	347,2	0	1
Nasution	Evening	313%	443,66	0	0
JL. A .H	Morning	38,93%	54	0	47
Nasution - JL. Cibiru	Afternoon	56,9%	95,35	0	1
	Evening	82,25%	89,28	0	0
Underpass	Morning	-	-	24,55	92,5
	Afternoon	-	-	0	0
	Evening	-	-	9	14,6

Source: Analysis, 2024

Judging from the table above, the highest queue result from the result running vissim was 443,66 meters in the afternoon from the direction of JL. Soekarno Hatta – JL. A.H Nasution. The condition of the highest queue result from the result of running vissim after adding the Underpass is 24,55 meters in the morning from the direction of the Underpass, the highest queue result from the result of running vissim after adding the 10-year projection Underpass is 92,5 meters in the morning from the direction of the Underpass. Queue from the direction of JL. Soekarno Hatta – JL. A.H Nasution can be overcome because part of the vehicle volume is allocated through the Underpass; the increase in queues from the direction of the Underpass in the 10-year projection is in line with the increase in traffic growth at the Cibiru roundabout in Bandung city.



Graph 5.
Queue Length Comparison Between Vissim, Underpass, and 10-Year Projection Underpass Alternative

Source: Analysis, 2024

The following is a view of the traffic flow state after the VISSIM program for the Underpass alternative was simulated.

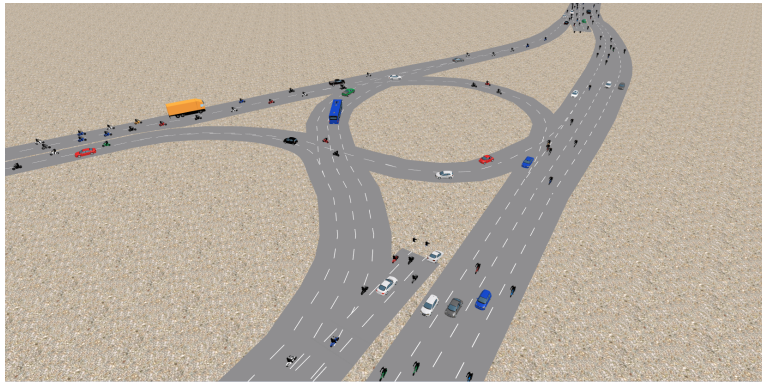


Figure 4.
VISSIM Condition Visible Above Underpass



Figure 5.
VISSIM Visible Underpass Condition

CONCLUSIONS

The performance of the Cibiru Bandung roundabout is currently poor due to excessive vehicle volume, which is passing its capacity and causing significant congestion. Data shows that the roundabout handles 84,749 vehicles daily with an average speed of 13.4 km/h, an average delay of 9.6 seconds, and a congestion probability reaching 105%. The degree of saturation is 1.64, with a service level of F, indicating frequent congestion and long queues. To address this, an Underpass was proposed as a solution, and the simulation results showed improved traffic flow. With the Underpass, the vehicle volume increased to 95,040 vehicles per day, the average speed rose to 30 km/h, and the delay was reduced to 11 seconds, resulting in an average queue of 3 meters and a service level of B, meaning stable traffic flow with some speed restrictions. For a 10-year projection, traffic volume is expected to rise to 139,151 vehicles per day, with an average speed of 25 km/h, an average delay of 18 seconds, and an average queue of 13.1 meters, resulting in a service level of C, indicating a stable but limited flow due to high traffic volume. Overall, the Underpass from JL was implemented—Soekarno to JL. Cibiru can significantly increase traffic volume and reduce congestion. However, further research is needed due to time constraints, and future studies should explore alternative solutions such as toll roads or an Electronic Road Pricing (ERP) system to address congestion. The researcher also suggests developing this study with a new method to obtain more accurate and comprehensive data for better traffic management solutions.

REFERENCES

- Ahmad, M. I. C., Lefrandt, L. I. R., & Rompis, S. Y. R. (2023). Analisis Kinerja Simpang Bersinyal Menggunakan Metode PKJI Dan Metode PTV VISSIM (Studi Kasus: Jl. Sam Ratulangi–Jl. Babe Palar, Kota Manado). *TEKNO*, 21(83), 67–77.
- Al-Msari, H., Koting, S., Ahmed, A. N., & El-shafie, A. (2024). Review of driving-behaviour simulation: VISSIM and artificial intelligence approach. *Heliyon*, 10(4). <https://doi.org/10.1016/j.heliyon.2024.e25936>
- Andika, A. S. (2021). Proyeksi Kinerja Tundaan Pada Bundaran Monumen Selamat Datang, Jakarta. *Jurnal Konstruksia*, 13(1), 128–136.
- Apriyono, T., & Rumlus, D. P. (2021). Analisis faktor-faktor yang mengakibatkan kemacetan lalu lintas pada ruas jalan budi utomo dan jalan hasannudin di kota timika. *Jurnal Kritis (Kebijakan, Riset, Dan Inovasi)*, 5(2), 96–114.
- Arrang, A. T., & Rangan, P. R. (2020). Arus Lalu Lintas, Kapasitas Dan Tingkat Pelayanan Ruas Jalan Dalam Kota Rantepao. *Journal Dynamic Saint*, 5(1), 874–883.

- Datu, V. V., Rumayar, A. L. E., & Lefrandt, L. I. R. (2018). Analisis Simpang Tak Bersinyal Dengan Bundaran (Studi Kasus: Bundaran Tugu Tololiu Tomohon). *Jurnal Sipil Statik*, 6(6).
- Ekiciputara, M. S., Kadir, Y., & Desei, F. L. (2022). Analisis Kinerja Bundaran (Roundabout) Menggunakan Metode Pedoman Kapasitas Jalan Indonesia 2014 (Studi Kasus: Bundaran Saronde Kota Gorontalo). *Composite Journal*, 2(2), 32–39.
- Gertler, P. J., Gonzalez-Navarro, M., Gračner, T., & Rothenberg, A. D. (2024). Road maintenance and local economic development: Evidence from Indonesia's highways. *Journal of Urban Economics*, 143. <https://doi.org/10.1016/j.jue.2024.103687>
- Haq, M. T., Farid, A., & Ksaibati, K. (2022). Estimating passing sight distances for overtaking truck platoons – Calibration and validation using VISSIM. *International Journal of Transportation Science and Technology*, 11(2), 255–267. <https://doi.org/10.1016/j.ijtst.2021.03.009>
- Haryati, N. (2020). Analisa Biaya Operasional Kendaraan Akibat Pemakaian Badan Jalan Yang Bersifat Pribadi (Studi Kasus: Penutupan Jl. Wakaaka Dengan Pemilihan Rute Melalui Jl. Hayam Wuruk, Kota Baubau). *Jurnal Media Inovasi Teknik Sipil Unidayan*, 9(2), 113–123.
- Karakikes, I., Spangler, M., & Margreiter, M. (2017). Designing a Vissim-Model for a motorway network with systematic calibration on the basis of travel time measurements. *Transportation Research Procedia*, 24, 171–179. <https://doi.org/10.1016/j.trpro.2017.05.086>
- Kučera, T., & Chocholáč, J. (2021). Design of the city logistics simulation model using PTV VISSIM software. *Transportation Research Procedia*, 53, 258–265. <https://doi.org/10.1016/j.trpro.2021.02.033>
- Kumalawati, A., Seran, L. M., & Karels, D. W. (2023). Analisis Karakteristik Lalu Lintas Terhadap Tingkat Pelayanan Pada Ruas Jalan Ij Kasimo Kabupaten Belu. *Jurnal Teknik Sipil*, 12(2), 185–192.
- Luo, Z., Molan, A. M., Hummer, J. E., & Pande, A. (2024). Introducing the concept of alternative intersections with three-phase traffic signals. *Transportation Letters*. <https://doi.org/10.1080/19427867.2024.2334101>
- Marza, P., Burhanuddin, B., & Usrina, N. (2023). Analisis Efektivitas Bundaran Pada Persimpangan Jalan Pase Kota Lhokseumawe. *Prosiding Seminar Nasional Teknik UISU (SEMNASTEK)*, 6(1), 223–228.
- Mitkas, D. Z., & Politis, I. (2020). Evaluation of alternative Ramp Metering scenarios on freeway on-ramp with the use of microscopic simulation software Vissim. *Transportation Research Procedia*, 45, 483–490. <https://doi.org/10.1016/j.trpro.2020.03.042>
- Prasetyanto, D., Rizki, M., & Maulana, A. (2021). The Role of Attitude, Behavior, and Road Conditions in Traffic Violation among Workers and Students in Bandung City, Indonesia. *The Open Transportation Journal*, 15(1), 147–159. <https://doi.org/10.2174/1874447802115010147>
- Prasetyo, H. E., Setiawan, A., Soeratmodjo, I. S., & Pamungkas, P. T. (2022). Proyeksi Panjang Antrian Pada Bundaran Kelapa Gading Dengan Menggunakan PTV VISSIM. *Konstruksia*, 14(1), 122–130.
- Rivaldi, R., & Novriani, S. (2024). Evaluasi Kinerja Lalu Lintas Terhadap Kapasitas Ruas Jalan Di Kota Bandung (Studi Kasus: Jalan Raya Ujung Berung Kota Bandung). *Journal of Research and Innovation in Civil Engineering as Applied Science (RIGID)*, 3(1), 22–33.
- Sari, Y., & Yudhistira, M. H. (2021). Bad light, bad road, or bad luck? The associations of road lighting and road surface quality on road crash severities in Indonesia. *Case Studies on Transport Policy*, 9(3), 1407–1417. <https://doi.org/10.1016/j.cstp.2021.07.014>
-

- Siregar, M. L., Tjahjono, T., & Nahry. (2021). Speed characteristics of heterogeneous traffic on inter-urban roads in Indonesia. *Transportation Research Procedia*, 52, 404–411. <https://doi.org/10.1016/j.trpro.2021.01.047>
- Suryaningsih, O. F., Hermansyah, H., & Kurniati, E. (2020). Analisis Kinerja Simpang Bersinyal (Studi Kasus Jalan Hasanuddin-Jalan Kamboja, Sumbawa Besar). *INERSIA Informasi Dan Ekspose Hasil Riset Teknik Sipil Dan Arsitektur*, 16(1), 74–84.
- Tjahjono, T., Swantika, B., Kusuma, A., Purnomo, R., & Tambun, G. H. (2021). Determinant contributing variables to severity levels of pedestrian crossed the road crashes in three cities in Indonesia. *Traffic Injury Prevention*, 22(4), 318–323. <https://doi.org/10.1080/15389588.2021.1872065>
- Wallwey, C., & Kajfez, R. L. (2023). Quantitative research artifacts as qualitative data collection techniques in a mixed methods research study. *Methods in Psychology*, 8. <https://doi.org/10.1016/j.metip.2023.100115>
- Wibowo, T. A., Setiawan, A., Rais, S., & Idzihart, N. A. (2023). Strategi Pengembangan Pariwisata Desa Leuweunggajah Kecamatan Ciledug Kabupaten Cirebon. *Jurnal mata pariwisata*, 2(1), 23–28.



© 2024 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).