Journal of Integrated and Advanced Engineering (JIAE)
Vol. 4, No. 1, March 2024: 65-76
http://asasijournal.id/index.php/jiae
http://doi.org/10.51662/jiae.v4i1.131

A study on the operational performance of the Trans Padang bus Corridor VI (City center - Andalas University)

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Abstract
Trans Padang is an integrated highway bus system in Padang City that has operated since January 2014. Buses run every day from 06.00 WIB to 19.00 WIB. No literature has been cited. Trans Padang Corridor VI Bus serves the corridor from Andalas University to the city center, and the route distance is ±13. 14 km. In this research, a study was carried out to determine whether the operations of the Trans Padang Corridor VI Bus were following the Decree of the Director General of Land Transportation No. SK.687/AJ.206/DRJD/2002. Six parameters were studied: load factor, headway, waiting time, travel time, stopping time at bus stops, bus speed, and bus fleets. Two methods were used to collect data: a dynamic and static survey. A dynamic survey was carried out to record the departure and arrival times of buses at each bus stop, the number of passengers getting on and off, the distance travelled by bus, the bus route, the bus stop, the bus travel time, and the bus stopping time. A static survey is carried out to record the arrival and departure times of buses at certain stops. The study results show that only the waiting time parameters follow the technical instructions; the existing waiting time is 6.03, and in the technical instructions, the waiting time is set at 5-10 minutes.

Keywords:
Headway;
Integrated bus system;
Load factor;
Operational Performance;
Trans Padang Bus Guidance;
Travel time;

Article History:
Received: November 29, 2023
Revised: March 2, 2024
Accepted: March 12, 2024
Published: March 14, 2024

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INTRODUCTION

One public transportation that operates in Padang City is the Trans Padang Bus. The Trans Padang Bus itself is a Bus Rapid Transit (BRT), which is targeted to have six corridors. Of the six corridors, four corridors are already operational, namely: Corridor I, which serves the City Center – Border City route; Corridor serves the Teluk Bayur – Anak Aie Terminal route; Corridor V, which serves the City Center – Indarung route; and corridor VI serving the City Center – Andalas University.

The Trans Padang Bus for Corridor VI was inaugurated on 19 December 2022 and will operate on 26 December 2022. This Trans Padang Bus is operated to provide comfortable public transportation and reduce congestion. To achieve these aims, optimal operational performance of Trans Padang buses is needed. For this reason, it is necessary to research the Trans Padang Corridor VI Bus to determine whether the performance of the Trans Padang Corridor VI Bus is optimal based on the decision of the Director General of Land Transportation No.SK.687/AJ.206/DRJD/2002.

MATERIAL AND METHOD

The primary and secondary data used in this research are primary and secondary data. Primary data is directly taken in the fields [1]. In this case, the primary data used is data on the operational characteristics of the Trans Padang Corridor VI Bus, which was taken directly in the field. Secondary data is obtained from other parties [1][2]. Secondary data in this research is data on bus stops and positions obtained from related parties. Quantitative methods are used in data analysis. Quantitative research is carried out by collecting data in numerical form; it can be done by comparing several variables or assessing the effectiveness of several interventions [3][4]. In this method, the data and analysis results are presented in the form of diagrams and tables. The results obtained from the analysis are used to determine and compare the operational performance of the Trans Padang Corridor VI Bus with the applicable technical guidelines.

Bus Trans Padang Corridor VI

Trans Padang is an integrated highway bus system in Padang City that has operated since January 2014. Buses run every day from 06.00 WIB to 19.00 WIB. Currently, Trans Padang serves four corridors: Pasar Raya Padang to Lubuk Buaya (Corridor I) and Teluk Bayur to Anak Air Terminal (Corridor IV). Pasar Raya Padang goes to Indarung (Corridor V), and Pasar Raya Padang goes to Andalas University (Corridor VI).

Trans Padang has 55 fleet units. In detail, there are 25 units for Corridor I, 10 for Corridor IV, 10 for Corridor V, and 10 for Corridor VI. The Trans Padang Corridor VI Bus was inaugurated on 19 December 2022 and has been operating since 26 December 2022. This bus has a route length from the city center to Andalas University, namely ±16.36 km, and from Andalas University to the city center, namely ±13. 14 km.

Corridor VI serves the Andalas University Campus – Padang City Center route. The ten buses were divided into two groups with different departure times. Five buses started operating from the Padang State Polytechnic bus stop, while five other buses started working from the CGV stop. Each bus runs six trips in one day.

The Trans Padang Bus, as presented in Figure 1, has a passenger capacity of 40 people, with details of 20 people sitting and 20 people standing with handrails, and is equipped with priority seating facilities for elderly passengers, pregnant women, and passengers with children and passengers with special needs. Special. Tickets can be purchased at bus stops at IDR 1,500 for students and IDR 3,500 for the general public for one trip (flat) far or near. In 2015, Trans Padang ticket purchase transactions could be served using BRI Bank Electronic Money (Brizzi).

Along this route, as depicted in Figure 2, the Trans Padang Bus Corridor VI in the direction of the city center towards Andalas University has 37 stops. In addition, in the order of Andalas University towards the city center, it has 24 stops, as depicted in Figure 3, which can be seen in Table 1 and Table 2.

Currently, Trans Padang Bus on Corridor VI has ten buses in operation. The ten buses were divided into two groups with different starting stops. Five buses start operating from the Padang State Polytechnic bus stop, while five other buses start operating from the CGV stop, and each bus operates six routes in one day. Every ten buses in corridor vi have a different number. The bus numbers are 46, 47, 48, 49, 50, 51, 52, 53, 54, 55. Apart from the different bus numbers, it turns out that the positions of the passenger exit doors on the Trans Padang Corridor VI buses are not all the same. There are five buses whose entrance is at the front, and the exit is in the middle of the bus, while for five more buses, the entrance is at the front, and the exit is at the back of the bus.

Figure 1. The Trans Padang Bus

Figure 2. the Trans Padang bus Corridor VI Route

Table 1. Trans Padang Bus Corridor VI

No.	Bus Stop Name	Distance Between Bus Stop (meter)
1	CGV	770
2	Bumi Putera	200
3	Bank Panin	210
4	Gramedia	280
5	MCD	200
6	Elizabeth / KFC	760
7	SMK 3	230
8	SMP 1	310
9	BCA Sawahan	430
10	RS Puti Bungsu	710
11	Stasiun KA Simpang Haru	320
12	BRI Simpang Haru	530
13	Dallas Swalayan	730
14	SMP 31	350
15	Simpang Anduring	290
16	Masjid Raya Kebenaran	670
17	Musholla Singapura	340
18	SMP Muhammadiyah 7	770
19	Masjid Jamik	640
20	SMP 10	390
21	Simpang Koto Tiga	350
22	Kampel	630
23	Polsek Pauh	1290
24	Simpang Kapala Koto	1390
25	Simpang Batu Busuk	210
26	Kos Arafah	800
27	PKM UNAND	350
28	Rektorat UNAND	170
29	Fakultas Ekonomi UNAND	120
30	Fakultas Peternakan UNAND	270
31	Fakultas Pertanian UNAND	370
32	Lapangan Futsal	390
33	Fakultas FMIPA UNAND	120
34	Gedung I UNAND	140
35	Gedung G UNAND	120
36	Fakultas Farmasi	510
37	PNP	

In one Trans Padang Corridor VI bus unit, one driver and one steward have shifts during their working hours. Drivers and stewards on the morning shift work 2.5 bus miles, while drivers and stewards on the afternoon shift work 3.5 bus miles. Buses operate from 06.15 WIB and end at 18.00 WIB.

Data Collecting

In this research, two methods were used to collect data: a dynamic survey and a static survey. Dynamic surveys are carried out in operating vehicles (on the bus) [5, 6, 7, 8]. This survey was conducted on weekdays and weekends. Each time of the survey was carried out during peak hours (morning and afternoon) and during non-peak hours (afternoon).

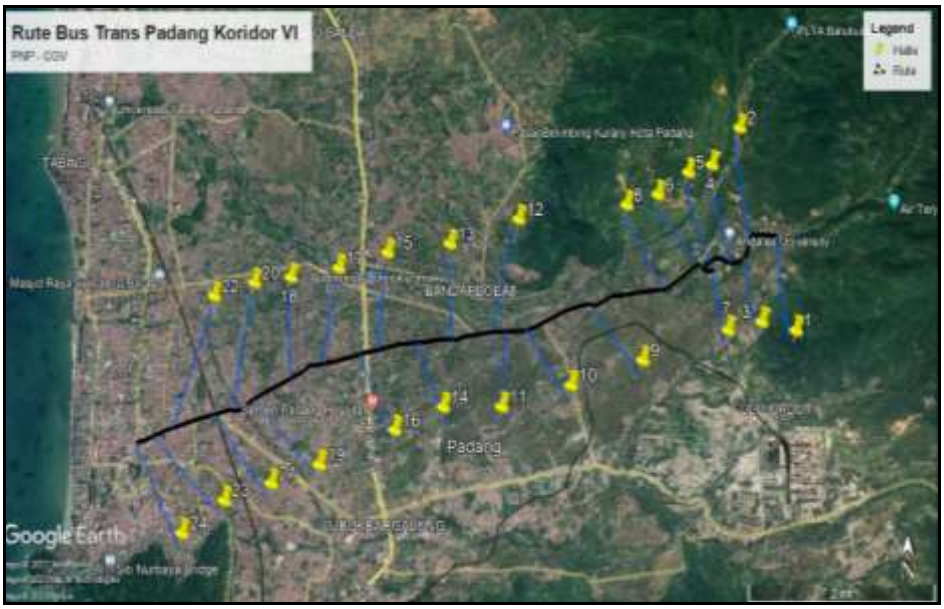

Figure 3. Number and Figure Caption

Table 2. Trans Padang Bus Corridor VI

No.	Bus Stop Name	Distance Between Bus Stop (meter)
1	PNP	
2	Café Queen	650
3	Fakultas Hukum	250
4	Fakultas Keperawatan	400
5	Fakultas Kedokteran	130
6	Simpang RS UNAND	240
7	RS UNAND	1150
8	Simpang Batu Busuk	1290
9	Simpang Kapalo Koto	1350
10	Polsek Pauh	370
11	Simpang Jembatan Kuranji	280
12	Kampel	720
13	SMP 10	610
14	Masjid Jamik	750
15	SMP Muhammadiyah 7	390
16	Musholla Singapura	640
17	Masjid Raya Kebenaran	690
18	SMP 31	790
19	Dallas Swalayan	430
20	BRI Simpang Haru	400
21	Stasiun KA Simpang Haru	700
22	RS Puti Bungsu	360
23	BCA Sawahan	300
24	CGV	

This survey was conducted over two days, namely Thursday, 22 June 2023, to represent a working day and Saturday, 24 June 2023, to represent a holiday. This dynamic survey was carried out to record the departure and arrival times of buses at each bus stop, the number of passengers getting on and off, the distance travelled by bus, the bus route, the bus stop, the bus travel time and the bus stopping time. On the bus, there are two surveyors. One surveyor

is tasked with recording passengers getting on and off at the entrance and exit, while the other will mark stops using a geo-tracker application. Static surveys are carried out outside the vehicle [9, 10, 11]. This survey aims to observe, count or record information from every vehicle that passes at a certain bus stop during operational hours [5]. Static Surveys are carried out simultaneously with dynamic Surveys. This survey was conducted over four days. Sunday, 11 June 2023, represents a holiday and Tuesday, 13 June 2023, represents a working day at the SMP 10 bus stop. Tuesday, 20 June 2023, represents a working day, and Sunday, 2 July 2023, represents a weekend at the Bumi bus stop. This static survey is carried out to record the arrival and departure times of buses at certain stops [12].

Data Analysis

The data analysis compared the operational characteristics of the Trans Padang Bus Corridor VI with the Decree of the Directorate General of Land Transportation No. SK.687/AJ.206/DRJD/2002 concerning Technical Guidelines for Organizing Public Passenger Transport in Urban Areas on Fixed and Regular Routes. These regulations were stipulated on 15 August 20021. The function of this regulation is used as technical guidelines for the implementation of public passenger transportation in urban areas on fixed and regular routes. This decision is used as a basis for public transport operations on the route.

RESULTS AND DISCUSSION

Load Factor

Passenger load factor, or load factor, measures the capacity utilization of public transport services like airlines, passenger railways, and intercity bus services. It is generally used to assess how efficiently a transport provider fills seats and generates fare revenue [13, 14, 15]. According to the Directorate General of Land Transportation (2002), the load factor is the ratio of sold capacity to the available capacity for a single trip, usually expressed in percent (%). The load factor for public transportation on each route ranges from 30% to 100% [8]. The load factor significantly affects passenger comfort. According to the Decree of the Director General of Land Transportation No. SK.687/AJ.206/DRJD/2002, the value of the load factor at dynamic times is 70%. From the obtained load factor data, a comparison is produced of the average load factor value for weekdays and weekends, which can be seen in Figure 4.

Based on Figure 1, the average load factor value of the Trans Padang corridor VI Bus is 21%. The value is below the load factor stated in the Decree of the Director General of Land Transportation No. SK.687/AJ.206/DRJD/2002, the value of the load factor at dynamic time is 70%. Buses that operate with low load factors are operationally inefficient. A higher passenger load factor means more seats are occupied by paying passengers.

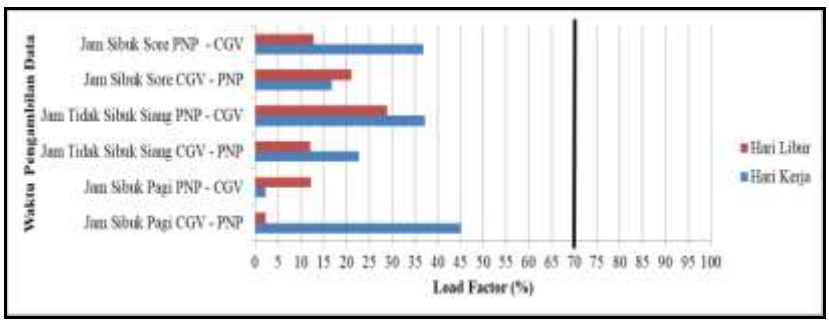

Figure 4. Load factor of Trans Padang Bus Corridor VI

This directly translates to increased revenue for the bus company. By maximizing the utilization of available seats, the bus operator generates more ticket sales and increases its overall revenue. Also worth noting is that a study found that both in-vehicle time and passenger load factors substantially affect passenger comfort perception. In general, the effect of the passenger load factor on comfort perception is larger than that of in-vehicle time, especially for seated passengers. Passengers feel uncomfortable if the load factor is less than 40% probability of getting a seat [16][17].

Headway and Waiting Time

Headway in the context of public transportation, specifically city buses, refers to the amount of time between consecutive buses on a particular route [18][19]. It's essentially the interval or frequency at which buses arrive at a specific stop. Waiting time for public transportation refers to the time passengers spend waiting at a stop or station for the bus (or other mode of public transport) to arrive. This begins from the moment a passenger arrives at the stop and ends when the bus arrives. Waiting time is a significant component of a passenger's total travel time and is often perceived as wasted time, making it a critical factor in passenger satisfaction. Reducing waiting times can improve the passenger experience and encourage more people to use public transportation.

Time headway between public transport for ideal hours is 5-10 minutes, and for peak hours is 2-5 minutes, while the average waiting time value is 5-10 minutes, and the maximum is 10-20 minutes. Based on Figure 5 shows the time headway on weekdays is higher than on weekends. Headway in the afternoon peak hour is higher than in the morning rush hour. The lowest headway is 11.2 minutes, the highest headway is 51.1 minutes, and the average headway time for Trans Padang Corridor VI Buses at three stops is 12 minutes. All Trans Padang bus headway times exceed the required limit in the Decree of the Directorate General of Land Transportation No. SK.687/AJ.206/DRJD/2002, 5-10 minutes. Waiting time can be defined as half of the average intermediate time value. Therefore, the value of the waiting time for the Trans Padang Bus Corridor VI is 6.03 minutes.

Travel Time

Travel time is the time it takes a vehicle to traverse a route in one trip, including stopping times for picking up and dropping off passengers and slowdowns due to roadblocks. This study concerns travel time variability over the course of the day (also known as inter-period or period-to-period variability). It describes variability between vehicles making similar trips at different times on the same day [20, 21, 22]. Bus travel times are usually longer for a given trip during peak periods compared with off-peak periods. The variability over the course of the day can be caused by short-term changes in congestion, incidents, or weather conditions [23].

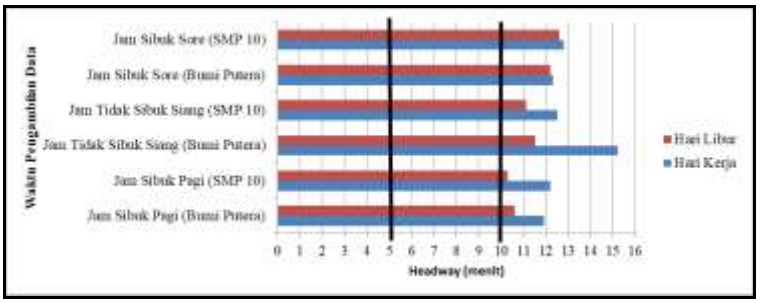

Figure 5. Time Headway of Trans Padang Bus Corridor VI

Based on the Decree of the Director General of Land Transportation No. SK.687/AJ.206/DRJD/2002, travel time for normal hours is 60-90 minutes, and for peak hours is 120-180 minutes. Weekday data is represented in the survey on Thursday, 22 June 2023, and weekends are represented in the survey on Saturday, 24 June 2023. The results of the travel time data can be seen in Figure 6.

From Figure 6, the average value for Trans Padang Bus Corridor VI travel time is 45.02 minutes on weekdays and 46.23 minutes on weekends. The average value for the overall Trans Padang Bus Corridor VI travel time was 45.42 minutes.

Stopping Time in the Bus Stop

Based on the decision of the Director General of Land Transportation No.SK.687/AJ.206/DRJD/2002, the value of bus stopping time is 4-6 minutes. This stop time data was obtained during a dynamic survey by knowing when the bus arrived at the initial/destination stop. The downtime data results can be seen in Figure 7.

From Figure 7, the average value for stopping time for Trans Padang Corridor VI buses at the start and end of the route is 11.45 minutes on weekdays and 14.52 minutes on holidays. From these two data, the average value for the overall stopping time of the Trans Padang Corridor VI bus was 13.19 minutes.

Number of Bus Fleets

Based on the Decree of the Director General of Land Transportation No. SK.687/AJ.206/DRJD/2002, the fleet size for medium buses is 20 units. Data was obtained from direct surveys by interviewing bus stewards. Based on the results of interviews with Trans Padang Corridor VI bus stewards, it was found that the number of fleets operating for Corridor VI is ten units.

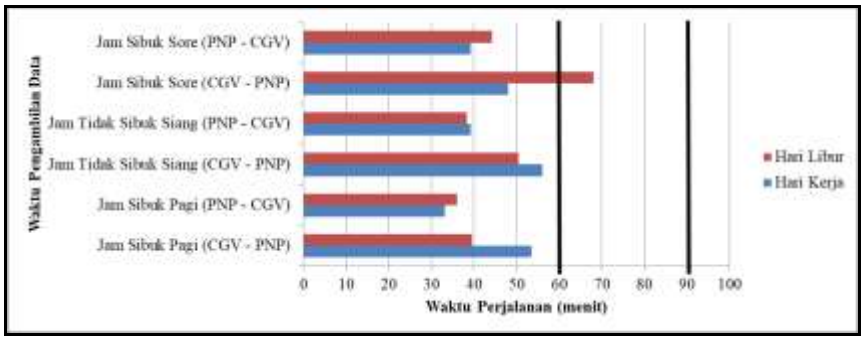

Figure 6. Trans Padang Bus Travel Time Corridor VI

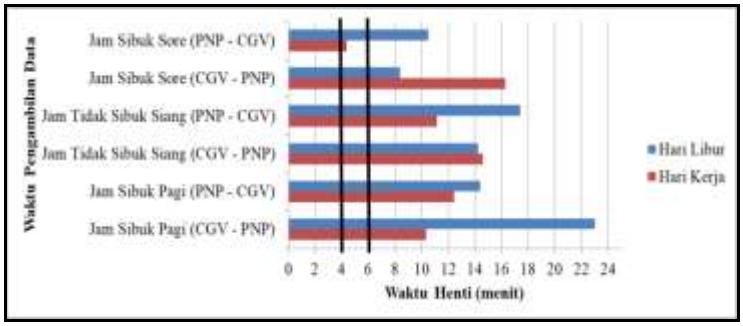

Figure 7. Trans Padang Corridor VI bus stopping times at the start and end of the route

Bus speed

The speed of public transport vehicles is affected by many external factors, including traffic volume, organization and infrastructure [24, 25, 26, 27, 28]. Based on the Decree of the Director General of Land Transportation No. SK.687/AJ.206/DRJD/2002 vehicle speed for buses is 30 km/hour. Data bus speed was obtained from dynamic surveys on weekdays and weekends. Bus Trans Padang speed can be seen in Figure 8.

From Figure 8, the average value for the Trans Padang Bus Corridor VI speed on weekdays is 22,315 km/hour; on holidays, it is 24,826 km/hour. From these two data, the average value for the overall speed of the Trans Padang Bus Corridor VI was also obtained, namely 23,570 km/hour.

Bus Capacity

Vehicles Based on the Decree of the Director General of Land Transportation No.SK.687/AJ.206/DRJD/2002, the vehicle capacity for medium buses is 500-600 people/day. From the data that has been obtained, an analysis is carried out to obtain the bus capacity in a day. The bus has a capacity of 40 passengers, and there are sic circulations every day. Therefore, the number of passengers that can be carried by buses is 480 people/day for one bus.

Circulation Time

Based on the Decree of the Director General of Land Transportation No. SK.687/AJ.206/DRJD/2002, the circulation time value is 105 minutes. Data for circulation time is obtained from data on bus travel times and bus stopping times at the start/end of the route, which are then added up. Table 3 and Table 4 show the average circulation time value for Trans Padang Bus Corridor VI is 113.34 minutes for weekdays and 122.30 minutes for weekends. From these two data, the overall value of the average circulation time was 117.82 minutes.

Trans Padang Corridor VI Bus Performance Analysis

After all the data obtained has been analyzed, the results of the analysis are compared with the bus operational performance standards contained in the Technical Guidelines for the Implementation of Public Passenger Transport in Urban Areas on Fixed and Regular Routes, Ministry of Transportation of the Republic of Indonesia, Directorate General of Land Transportation, 2002. Results of Bus Performance Analysis Trans Padang Corridor VI can be seen in Table 5. It can be seen that the only thing that meets the standards is the waiting time.

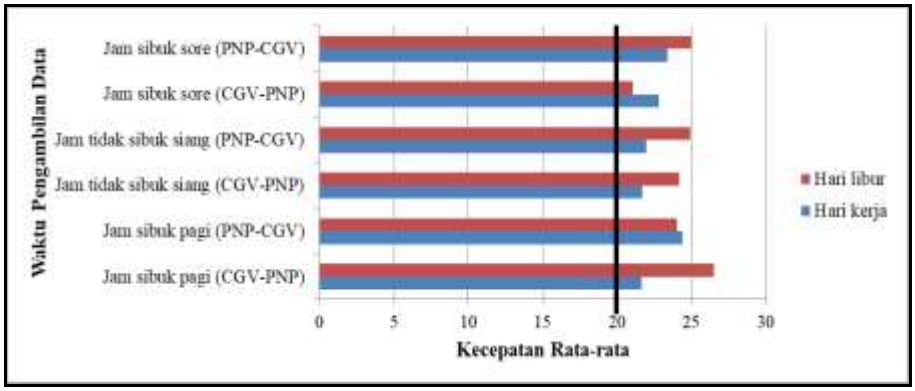

Figure 8. Bus speed data

Table 3. Circulation time on weekdays

Data collection time	Travel time (minutes)	Stopping time (minutes)	Cycle Time (minutes)
Morning Peak Hour (CGV - PNP)	53.47	10.35	110.20
Morning Peak Hour (PNP - CGV)	33.16	12.42	
Afternoon off Peak Hour (CGV - PNP)	56.04	14.58	121.39
Afternoon off Peak Hour (PNP - CGV)	39.24	11.13	
Afternoon Peak Hour (CGV - PNP)	48.10	16.29	108.44
Afternoon Peak Hour (PNP - CGV)	39.30	4.35	
Average	45.02	11.45	113.34

Table 4. Circulation times on weekends

Data collection time	Travel time (minutes)	Stopping time (minutes)	Cycle Time (minutes)
Morning Peak Hour (CGV - PNP)	39.52	23.02	113.45
Morning Peak Hour (PNP - CGV)	36.14	14.37	
Afternoon off Peak Hour (CGV - PNP)	50.52	14.23	121.37
Afternoon off Peak Hour (PNP - CGV)	38.42	17.40	
Afternoon Peak Hour (CGV - PNP)	68.08	8.38	132.07
Afternoon Peak Hour (PNP - CGV)	44.30	10.51	
Average	46.23	14.52	122.30

Table 5. Results of analysis of Trans Padang Bus Corridor VI

No.	Indicator	Technical Instructions	Analysis	Results	
1	Load factor	70%	21%	not according to technical instructions	
2	Headway	Normal time Peak hours	5 - 10 minutes 2 - 5 minutes	12 minutes	not according to technical instructions
3	Waiting time	Average Maximum	5 - 10 minutes 10 - 20 minutes	6,03 minutes	according to technical instructions
4	Travel time	Normal Peak hour	60 - 90 minutes 120 - 180 minutes	45,42 minutes	not according to technical instructions
5	Stopping time	4 - 6 minutes	13,19 minutes	not according to technical instructions	
6	Number of Bus Fleets	20 units	10 units	not according to technical instructions	
7	Bus Speed	30 km/hour	23,570 km/hour	not according to technical instructions	
8	Bus Capacity	500 - 600 passengers/day	480 orang/day	not according to technical instructions	
9	Cycle time	105 minutes	117,82 minutes	not according to technical instructions	

CONCLUSION

This investigation was conducted to establish if the Trans Padang Corridor VI Bus operations were in accordance with the Director General of Land Transportation's Decree No. SK.687/AJ.206/DRJD/ 2002. Six criteria were investigated: load factor, headway, waiting time, travel duration, stop time at bus stops, bus speed, and bus fleets. Data were collected using two methods: a dynamic and a static survey. A dynamic survey was conducted to record the departure and arrival times of buses at each bus stop, the number of people boarding and disembarking, the distance traveled by bus, the bus route, the bus stop, the bus travel time, and the bus pausing time. A static survey is conducted to capture the arrival and departure timings of buses at certain stops. The study results suggest that only the waiting time

parameters adhere to the technical requirements; the current waiting time is 6.03, whereas the technical instructions call for a waiting period of 5-10 minutes. The study results show that only the waiting time parameters follow the technical instructions; the existing waiting time is 6.03, and in the technical instructions, the waiting time is set at 5-10 minutes.

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