

Analysis of Road Performance Used Indonesian Highway Capacity Manual 1997: A Case Jalan K.H Abdul Halim Majalengka-Indonesia

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Abstract

Jalan K.H Abdul Halim is one of the urban streets located in the center of Majalengka city, this road their several activity centers in Majalengka city. This area is growing so that traffic flow along this road is increasing, causing various traffic problems such as traffic jams. The development of highway construction is increasing rapidly In Indonesia, along with the rapid use of private vehicles. Road infrastructure development can be in the form of widening the shoulder of the road to minimize congestion. Data collection techniques in this study use Primary and Secondary methods. Peak currents on this road occur in the afternoon or at intervals of 17:15-17:30. Jalan K.H. Abdul Halim type is 4/2 UD or 4 Lanes 2 Directions are undivided. The capacity of Jalan K.H Abdul Halim is 1147 with DS 0,85 in the morning until noon, and 1,02 in the afternoon. The degree of saturation on this road is obtained, namely Sunday morning and Sunday afternoon 0.85, while on Sunday afternoon, it reaches 1.02. The results showed that LoS in the morning and afternoon was C and changed to F in the afternoon. LoS with an F value in the afternoon is quite surprising because a city with a large population is experiencing extraordinary traffic jams.

Keywords: Degree Saturation, Level of Services, Road Characteristics.

1. Introduction

Roads are an essential means of transportation to connect various places such as industrial centers, agricultural areas, and settlements as well as a means of distributing goods and services to support the economy. The increasing growth of vehicles, in terms of the number and capacity of the cargo carried, causes damage to the road surface and pavement structure. This damage can also cause various problems, one of which can increase the number of traffic accidents worldwide. In 2018, nearly 1.35 million people worldwide died in traffic accidents yearly, implying that one person dies in a traffic accident every 24 s, an increase of 100,000 people compared to 2015 (Aish & Robusté, 2022). However, traffic accidents are not only caused by damage to the road surface. Besides that, it can also be caused by various other factors, including driving at high speed, doing activities that can interfere with driving concentration, going against the flow, and so on.

Indonesia's rapid economic growth has also increased the number of private vehicles. This also clearly affects the balance between the number of oncoming vehicles and road capacity. As a result, the increasing use of private vehicles will reduce road capacity, causing traffic jams. Traffic congestion is a situation or condition where traffic stops or even stops due to the number of vehicles exceeding the capacity of the road (Kumita, Munandar, & Shabir, 2022). Traffic congestion has been an area of significant bother

across the globe (Samal, Kumar, Santhosh, & Santhakumar, 2020). In Indonesia, traffic jams often occur, especially in big cities such as Jakarta, Bandung, Surabaya, and others.

Over time, Majalengka City experienced relatively fast economic growth, with many developments in Majalengka. One of them is the total renovation of recreational areas in the city of Majalengka, such as the total renovation of Majalengka square, the total renovation of GGM, the construction of the skywalk, the total renovation of the aerospace park, and others. The existence of a new face in the recreation area affects the volume of vehicles that crowd the road. Vehicle volume is the number of vehicles crossing the road per unit of time. In contrast, road capacity is the road capacity to accommodate the volume of vehicles per unit of time (Sharfina & Saputra, 2022). Inadequate road capacity coupled with rapid economic growth in Majalengka has affected traffic in Majalengka. Traffic depends on road capacity, where many vehicles want to move, but if the road capacity cannot accommodate them, traffic existing will be obstructed.

The traffic congestion in Majalengka City, especially in Jalan K.H. Abdul Halim, occurred during rush hours, such as at 07.00 and 16.00 WIB. Traffic congestion cannot be avoided because at 07.00 and 16.00 WIB. The community is still carrying out various activities, whether going to/from work, going to/returning from school, or it occurs due to other activities. Especially on weekends, people flock to the recreation areas in Majalengka so which causes congestion, especially along Jalan K.H. Abdul Halim, due to the many on-street parking in recreational areas. Routines like this cause traffic jams. Traffic jams have been caused by the high volume of vehicles that are not suitable for the road capacity so, at peak hours, there will be traffic jams (Nisumanti, Mulyaningsih, & Puspita, 2021). Therefore, an increase in population can directly trigger an increase in the need for the use of means of transportation such as cars, motorbikes, etc., and can indirectly cause congestion, especially if the existing road capacity is unable to accommodate the increased number of the vehicle (Ali & Abidin, 2019). The Jalan K.H. Abdul Halim capacity is still unable to accommodate the volume of vehicles because the distance between the shoulders of the road still needs to be narrower. Urban traffic, as vital infrastructure construction, plays a crucial role in modern life (Yujun, Juhua, Jiahong, Yue, & Zhang, 2019). The amount of damage to the road and the distance between the narrow shoulders along that side road being able to cause traffic jams can also cause traffic accidents.

From some of the problems above, to achieve efficiency and smoothness along the K.H. Abdul Halim needs to improve the performance road. This study aims to calculate the average daily traffic figures along Jalan K.H. Abdul Halim. Then, provide solutions to problems that occur along the K.H. Abdul Halim section so that traffic activities are not hampered and prevent accidents along the Jalan K.H. Abdul Halim.

2. Literatur Review

2.1 Roads

According to the Law of the Republic of Indonesia, Roads were Number 38 in 2004. Land transportation infrastructure includes all parts of the road, including supporting buildings and equipment designated for traffic, which is on the ground surface, above ground level, below ground level, and ground level or water, as well as above water, except railroads, lorry roads, and cable roads (Masitoh, Rozy, & Anwar, 2020). Based on their function, roads are divided into 4: arterial roads, collector roads, local roads, and environmental roads. Arteries are roads that carry high levels of blood. Its function is to transmit traffic from collector roads to freeways and express roads and between city centers at the highest possible level of service. Collector roads are built to serve and connect cities between regional activity centers and local activity centers or small-scale areas, as well as regional feeder ports. Regional roads are efficiently connected between national activity centers, environmental activity centers, regional activity centers, or environmental activity centers, and between environmental activity centers. Environment roads are roads that are in residential areas or official roads for residential areas.

The development of highway construction is now increasing rapidly in Indonesia, along with the rapid use of private vehicles. In recent years, environmental aspects related to road infrastructure construction have increased (Trunzo, Moretti, & D'Andrea, Life cycle analysis of road construction and use,

2019). There are many impacts arising from the development of road infrastructure, both positive and negative impacts. Sustainable transportation infrastructure is one of the key sectors to improve economic development and society (Luo, Song, & Wu, 2021). The negative impact of road infrastructure development is the reduction of green areas in urban areas. However, in other countries, this impact can be appropriately minimized. At the international level, several efforts have been made to apply GPP to the road sector: in Sweden, environmental aspects are integrated into road maintenance contracts. In Finland, procurement methods are implemented to reduce the environmental impacts of roads. GPP has been implemented in the Netherlands to manage the leading road network (Trunzo, Moretti, & D'Andrea, Life cycle analysis of road construction and use, 2019). Road infrastructure development can be in the form of widening the shoulder of the road to minimize congestion. Congestion is already a common problem, and there are many ways to work out solutions (Rifai, Surgiarti, Isradi, & Mufhidin, 2021).

Road as a means of transportation is one thing that is very important for the success of a development. The success of the development is greatly influenced by its role in transportation as the center of economic, sociocultural, security, and political life (Isradi, Dwiatmoko, Setiawan, & Supriyatno, 2020). Of course, in developing road infrastructure, it is necessary to pay attention to the safety aspects of making these roads. The ideas and principles of quality management and sustainable safety have made progress in the last 20 years and it could be the reason that drove policymakers and project managers to understand the requirement for simple road security tools (Sahu, Mishra, Barik, & Sahu, 2022).

2.2 Road Characteristics

Characteristics of the main roads will affect the road's capacity and performance if the road is burdened with traffic flow. Road characteristics can be divided into three main parts (IHCM, 1997). The first is the geometry of the road, namely the shape that describes the road, which includes the type of road, the width of the traffic lane, and the road elevation. Then the second is Traffic Flow, traffic flow can be obtained by calculating LHR. LHR is a standard term used in calculating the traffic load on a road section and becomes the basis for the transportation planning process or in measuring pollution caused by traffic flow on a road section. Daily traffic is the average daily traffic volume (Wibisono, Ramadan, & Fajar, 2019). Based on the type of data acquisition, there are 2 types, namely Annual Average Daily Traffic (LHRT) and Average Daily Traffic (LHR). LHR is the quotient of the number of vehicles obtained during the observation with the length of the observation on road planning at the Tumpaan-Lopana location $LHR = \text{Total Traffic During Observation} / \text{Observation Time}$. This LHR data is entirely accurate if the observations are made at sufficient time intervals to reflect traffic fluctuations during the observations. Finally, the third is side friction, and side friction dramatically affects the performance of urban roads. Side barriers are activities on the road that often cause conflicts and affect traffic flow (Kumita K. I., 2022).

2.3 Level of Service

Level of service is a measure of a road segment filled with the value of road capacity, degree of saturation, and speed for each road segment (Sriana & Hayati, 2021). It aims to optimize road network users to improve safety, order, and smooth traffic on the road. However, traffic jams still occur in the area, so the level of service is classified as impaired. Table 1 is the level of services according to USHCM 1985.

Table 1. Level of Services (USHCM 1995)

VCR	Level of Services Classification
0,1-0,7	The service conditions are excellent, and the vehicle can run smoothly.
0,7-0,8	Good service conditions, where the vehicle runs smoothly with few obstacles.
0,8-0,9	The service conditions are pretty good, where vehicles can run smoothly, but traffic obstacles are more disturbing.
0,9-1,0	Poor service conditions, where the vehicle runs with many

VCR	Level of Services Classification
	obstacles.
>1	In bad service conditions, where vehicles run very slowly and tend to get stuck, many vehicles will pass on the shoulder of the road.

3. Methodology

Research is an intellectual activity (Pandey & Pandey, 2021). Data collection techniques in this study use Primary and Secondary methods. Primary data was obtained by involving the active participation of researchers. Usually, primary data is collected through survey activities, observations, experiments, questionnaires, personal interviews, and other media used to obtain field data (Isradi, Muftidin, Dermawan, Rifai, & Prasetijo, 2022). This research was conducted in 2022 by researching Jalan K.H Abdul Halim, calculating average daily traffic figures, road capacity, degree of saturation, and level of road service to obtain data on K.H Abdul Halim's service level. When secondary data was obtained from IHCM 1997, this research was conducted while attending the Traffic Engineering Course at Universitas Majalengka. This research was conducted in Majalengka Regency on Jalan K.H Abdul Halim KM 1. For the calculation, use a traffic counter application.

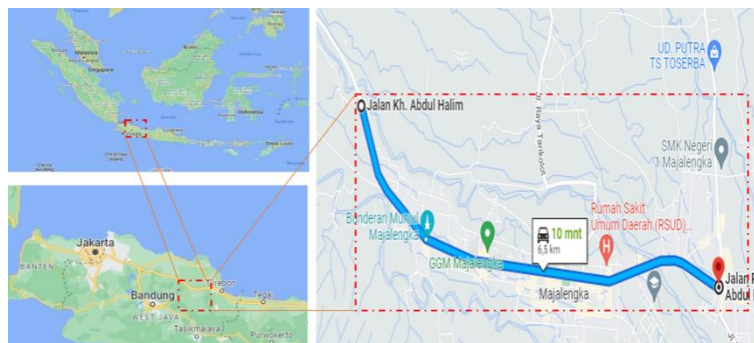


Figure 1. Research location

The first data collection method, namely field observations, involves the study of humans who move and make choices in realistic, natural environments, including regular and emergency conditions (Feng, Duives, Daamen, & Hoogendoorn, 2021). The primary data collection technique used the results of a K.H Abdul Halim road survey which were observed and recorded. The nature of systematic reviews and their focus on examining studies that emphasize testing theories is inappropriate when different types of evidence are being synthesized, and there is a need to interpret studies (Ruggiano & Perry, 2019). This primary data is divided into several types, such as traffic volume, calculating three types of vehicles that pass Jalan K.H Abdul Halim, then recording them on the traffic volume form.

To get the volume of road vehicles K.H Abdul Halim conducted a survey. Monitoring this traffic volume takes one day, namely Sunday. Recording of traffic flows is carried out within 1 hour, divided into four intervals. Each interval is 15 minutes, and each period is morning, afternoon, and evening. This research required road geometry data at the survey point. The point of this research survey is at KM 1 Jalan K.H Abdul Halim because of its strategic location and is a point that is quite dense with vehicles. Therefore, the survey on Jalan K.H Abdul Halim was carried out at one point, namely at KM 1, where surveyors were stationed to record vehicles passing at each predetermined cross-section.

To achieve the objectives of this study, not only primary data is needed but also secondary data. Where this data is data from the results of previous research or data from certain agencies or institutions, this second data can also be obtained by searching the internet. For example, population data obtained from the Central Statistics Agency for Majalengka Regency is one of the secondary data. Not only that, but the data also needed next is a map of Jalan K.H Abdul Halim itself. This map is obtained on Google Maps.

4. Result and Discussion

The primary data that will be discussed in this article is data from actual research or surveys. The method used is the IHCM 1997 method. The type of road on Jalan K.H Abdul Halim is type 4/2 UD or four lanes two directions not divided, while the width of the two lanes is the same, namely 7 meters, and the road shoulder is 0.2 meters, as well as the roadside for Jalan K.H Abdul Halim. The sidewalk is 1 meter. The road has a median of 1 meter. The total area of the two lines is 14 meters. The road is classified as an arterial road that flows traffic from collector roads to freeways and freeways, as well as between urban centers with the highest possible level of service.

The results showed that the average daily traffic flow on Sunday on Jalan K.H Abdul Halim KM 1 showed that the peak flow occurred at the time interval 17:15-17:30 WIB.

Table 2. Traffic Flow

No	Period	HV	LV	MC	Vehicle	PCU	(PCU/15 minute)*4	4 x 15 minute (PCU/hour)
1.	07:30 -07:45	54	102	259	415	236,95	947,8	980,7
2.	07:45 - 08:00	43	101	284	428	227,9	911,6	
3.	08:00 -08:15	51	116	310	477	259,8	1039,2	
4.	08:15 - 08:30	61	116	243	420	256,06	1024,2	
5.	13:30 - 13:45	21	90	170	281	159,8	639,2	984,25
6.	13:45 - 14:00	36	133	294	463	253,3	1013,2	
7.	14:00 - 14:15	37	147	366	550	286,6	1146,4	
8.	14:15 - 14:30	36	172	263	471	284,55	1138,2	
9.	16:45 - 17:00	14	171	351	536	276,95	1107,8	1169,8
10.	17:00 - 17:15	25	168	374	567	294	1176	
11.	17:15 - 17:30	31	163	409	603	305,55	1222,2	
12.	17:30 -17:45	31	153	400	584	293,3	1173,2	
Total		440	1632	3723	5795	3134,8	12539	3134,75

From the results of calculating the capacity of the Jalan K.H Abdul Halim, the data is obtained in Table 3.

Table 3. Road capacity

Roads name	Base Capacity (C0)	Wide (FCw)	Direction Separator (FCsp)	Side Resistance (FCsf)	City Size (FCcs)	Capacity (pcu/hour)
Jalan K.H Abdul Halim	1500	0,91	1	0,84	1	1146,6

When analyzing the degree of saturation and the level of service on Jalan K.H. Abdul Halim, the reference used is IHCM, 1997, using the maximum traffic volume data, namely on Sunday at 16.00 -17.00 WIB, and using the maximum side obstacle data at 16.00 -17.00 WIB, then it can be seen that the degree of saturation on Sunday morning was 0.85, during the day it was the same, namely 0.85, while in the afternoon it increased to 1.02., the free flow speed was 60 km/hour and the road capacity was 1146.6 PCU/hour, based on this calculation Jalan K.H Abdul Halim. Currently, the service level category is C with the characteristics of traffic conditions reaching 1169.8 PCU/hour, 2-way traffic speed ranging from 60 km/hour.

The increasing volume of road traffic influences this traffic flow condition in Majalengka, which is

caused by the pull on the main road segment. The attraction on the main road in Majalengka is the Jogja Store and various restaurants along the road. Many things cause people's desire to come to this main road, starting from shopping for daily needs or as a place of entertainment such as drinking coffee, family playgrounds, lodging places, and so on. This condition causes traffic problems such as vehicles in and out of shopping centers, pedestrians, and disorderly road user behavior which is one of the factors for the level of road service in Majalengka. Changes in the Degree of Saturation in the morning, afternoon, and evening can be seen in figure 2.

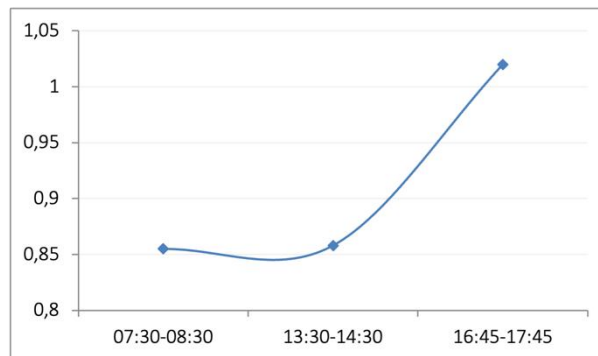


Figure 2. Degree of saturation

Based on the research results, the service level on Sunday morning and Sunday afternoon are still quite good, while in the afternoon the service level is in a wrong category. This is what causes congestion.

Table 4. Level of Services

Period	Degree of saturation	Level of Services
07:30-08:30	0,85	C
13:30-14:30	0,85	C
16:45-17:45	1,02	F

The level of road service discussed in this study in Majalengka is a measure used to determine the quality of a particular road segment in serving the traffic flow that passes through it. The Level of Service describes the operational conditions of traffic flow and drivers' perception in terms of speed, travel time, comfort, freedom of movement, security, and safety. The relationship between road speed and volume needs to be known because speed and volume are essential in determining road service levels. The results showed that LoS in the morning and afternoon was C and changed to F in the afternoon. LoS with an F value in the afternoon is quite surprising because a city with a large population is experiencing great traffic jams.

5. Conclusions

The capacity of Jalan K.H Abdul Halim is 1147 with DS 0,85 in the morning until noon and 1,02 in the afternoon. So that the degree of saturation on this road is obtained, namely Sunday morning and Sunday afternoon 0.85 while on Sunday afternoon it reaches 1.02. The results showed that LoS in the morning and afternoon was C and changed to F in the afternoon. LoS with an F value in the afternoon is quite surprising because a city with a large population is experiencing great traffic jams.

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