LEADER
Civil Engineering and Architecture

Civil Engineering and Architecture Journal Vol 1 No.2 (2023) E-ISSN
DOI 10.37253/leader.v1i2.8101

Analysis of Traffic Congestion Cause U-turn Location (Case study: U-Turn in Panbil Industrial Estate U-Turn, Batam)

Havila Elysia[1], Usmanul Hayadi Umar[2]
[1,2]Faculty of Civil Engineering & Planning, Universitas International Batam, Indonesia
Correspondences email: 2211017.havila@uib.edu

ARTICLE INFO

Keywords:
Congestion,
U-turn
traffic

ABSTRACT

One of the nicknames of the Batam City is an industrial city, a city that experiences very fast population growth every year, this also affects the volume of vehicles on the main roads of the Batam City, one of which is the traffic on Jalan Ahmad Yani to be precise in front of the Panbil Industrial estate gate. Access to the Panbil Industrial Estate is located right in front of the u-turn location, drivers heading to Panbil Industrial Estate from the south and drivers wanting to leave Panbil Industrial Estate heading south, two directions with the same route which will cause congestion and queues for vehicles moving in the same direction as the vehicle before maneuvering to turn around or for vehicles on other lanes as a result of the vehicle's maneuvers. This study aims to determine how much influence the vehicle's turning maneuver has on road performance, as well as evaluate the traffic characteristics due to U-Turn.

1. Introduction

Traffic congestion is indeed a global phenomenon that occurs in many big cities around the world. High population density, growth of motorized vehicles, and lack of adequate transportation infrastructure are some of the main factors causing traffic jams [1]. Traffic jams now dominate life in major cities of the world. In Los Angeles, drivers inched along a 12-lane freeway. In Mexico City children started late for school to escape the morning smog. Office workers in Bangkok suffocate in overcrowded buses for an average of 2 hours daily. All of this is because more and more people are crowding into big cities, but more importantly, because people are moving more and more. Most of the extra movement is done in the car. Places like New York and London have almost a quarter of their land area devoted to roads, extensive metro systems under them, and are approaching their capacity to do more for drivers [2].

Traffic congestion in Indonesia is indeed a difficult problem to overcome because it involves many complex factors and is closely related. Congestion is a situation or condition of stagnation or even cessation of traffic caused by the large number of vehicles exceeding the capacity of the road. Traffic jams are often experienced in big cities in Indonesia such as Jakarta, Surabaya, Malang, Bandung, Sidoarjo, and others. Factors causing congestion occur because the road area does not accommodate the number of vehicles, parking in random places, disorderly traffic, lack of public transportation, flooding, road suitability or damage, and traffic accidents [3]. As for the U-Turn facility factor, the U-Turn facility is made to minimize congestion that often occurs, but the U-Turn facility causes conflict. The effect of the U-Turn causes congestion because vehicles that make a U-Turn cause higher vehicle volumes and lower vehicle speeds during rush hours [4].

The problem of congestion in the city of Batam occurs due to the increasing volume of vehicles which is also caused by the community's economic growth and technological developments. Settlements, hospitals, industrial areas, campuses, schools and shopping centers which are located along the road or on the right and left side of the road are also factors in the occurrence of traffic jams. According to data

Receieved 20 Mei 2023
Available online 30 Juni 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.2 (2023) E-ISSN
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from the Central Statistics Agency for Batam City, the export value of Batam City in January 2017 increased by around 25.43% compared to the export value in December 2016, besides that based on data from the Batam City Population and Civil Registry Service, the current population of Batam City is 1.2 million people, with a population growth rate of 7.4% per year. The increase in population and export value has an impact on increasing transportation mobility, where every activity carried out by individuals or groups will be more effective if supported by transportation facilities. Increased demand for transportation means that the role of roads and traffic is seen as an important aspect of determining the smooth running of human activities [5]. The volume of vehicles increases, the speed of vehicles decreases and congestion occurs at that point.

U-Turn facilities are made to minimize congestion that often occurs, but U-Turn facilities cause conflicts in certain cases. One example of a case that is familiar to the people of Batam is the line of vehicles that intrude every morning along Jl. Ahmad Yani, to be precise, in front of the entrance and exit of the Panbil Industrial Estate. Jalan Ahmad Yani is one of the roads that has a fairly high volume of vehicles, especially during peak hours from Panbil to Simpang Kabil. The reduction in the movement of traffic flow on this road section is one of the problems that needs to be addressed in an integrated and comprehensive manner [5].

In this study, the problem is the traffic jam at the door of Panbil Industrial Estate Jl. Ahmad Yani due to the existence of the U-turn which is too close to the Panbil red light and the U-Turn is right in front of the Panbil Industrial Estate door, Jl. Ahmad Yani. At that point the volume of vehicles increases and vehicle speeds decrease and again security officers or industrial area security always stop the flow of vehicles coming from the direction of Batuaji, when a vehicle coming from the opposite direction wants to enter the area.

Based on the road function Jl. Ahmad Yani is included in the primary collector road. The primary collector road itself is a collector road that functions to connect the National Activity Center (PKN) with Local Activity Centers (PKL), between Regional Activity Centers (PKW), or between Regional Activity Centers (PKW) and Local Activity Centers (PKL). The lowest vehicle speed on this road is 40 kilometers per hour. The width of the road body is at least 9 meters. In addition, primary collector roads may not be cut off in urban areas or urban development areas. Road planning should pay close attention to rainwater runoff. The pavement layer is easily damaged due to standing water due to the basic nature of the asphalt mixture itself. This condition is caused because asphalt has properties that are not too strong against water immersion [6].

2. Literatur Review

According to the KBBI (Big Indonesian Dictionary), traffic congestion is a condition when the traffic flow is stagnant, stopped, or not smooth. This can occur due to various factors such as the high number of vehicles, lack of adequate infrastructure, traffic accidents, and ineffective traffic policies. Traffic congestion is problems that occur as a result of population growth and density, such that the flow of vehicles moves very slow [7].

Congestion is a condition or situation in which the flow of vehicles on one or several roads moves very slowly or even stops, causing disruption to the activities and movements of road users and users. Congestion usually occurs due to an imbalance between the population and the increase in the number of motorized vehicles with the availability of available roads [8].

Traffic according to Article 1 Law Number 22 of 2009 concerning Road Traffic and Transportation, the notion of traffic is the movement of vehicles and people in the road traffic space, which is an infrastructure designated for the movement of vehicles, people and/or goods moving in the form of

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roads with supporting facilities [9]. Traffic can be interpreted as a relationship between humans with or without being accompanied by a means of locomotion from one place to another by using the road as a space for movement [10] [11] [12]. However, it should be noted that the use of the road as a space for movement is carried out with due observance of traffic rules and the safety of all parties involved [9].

U-turn is a facility to turn the direction of a vehicle directed by driving in a U-shape, usually used to switch to the opposite lane or reverse direction on a road that has a median or road divider. However, it should be noted that not all roads have U-turn facilities, and their use is also regulated by applicable traffic rules [13]. The 2005 u-turn planning guidelines guide how to plan for road u-turn facilities. These guidelines cover various matters, such as the median opening required to make a U-turn, the planned vehicle that will traverse the U-turn, the required turning radius, the required median width based on the design vehicle's turning radius, U-turns in a narrow median, U-turns at signalized intersections, landscaping, traffic sign placement, turnaround planning flowchart, and the impact of turnarounds on medians that do not meet the requirements [14].

3. Method

This study used a qualitative research method by narratively describing data analysis. Data collection in this study uses two methods, the first is data collection which is carried out under conditions that occur at the site [15] [16] [17]. This data is obtained by observing and recording events that occur to research subjects in the actual environment. To obtain road geometry data, vehicle speed, and vehicle volume. The second is carried out by researchers from previous research, research journals, and theories from books that strengthen research. This research was conducted during rush hour at the U-Turn Front Gate of Panbil Industrial Estate Jl. Ahmad Yani, Batam.

4. Result and Discussion

Based on direct survey results and data from previous research sources at the u-turn in front of the Panbil Industrial Estate gate, Jl. Ahmad Yani, Batam City, this road is known to be the main access for the people of Batuaji and its surroundings when going to or from work, however, along with the development of community growth, the road is always busy every morning and evening. In fact, the road will be even more congested during worksing hours and school children's hours.

Panbil Industrial Estate is one of the industrial areas in the Batam City, most of the people of Batam City work in the industrial section, and also the companies there apply working hours with shifts. This is also a factor in the occurrence of congestion because workers take the same route to enter and leave the industrial area.

Access to the Panbil Industrial Estate is located right in front of the u-turn location, drivers heading to Panbil Industrial Estate from the south and drivers wanting to leave Panbil Industrial Estate heading south, two directions with the same route which will cause congestion and queues for vehicles moving in the same direction as the vehicle before maneuvering to turn around or for vehicles on other lanes as a result of the vehicle's maneuvers.

4.1 Traffic Volume Survey Results

Data on total U-Turn vehicles is differentiated according to 2 types of vehicles, namely motorcycles and light vehicles. The total observations of U-Turn vehicles can be seen in the table 1&2

4.1.1. From the South Toward the PIE Gate

Table 1. Volume survey from south toward the PIE gate

Periode Of Time	Transportation Type

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		Motorcycle	Light Vehicle	Total U-Turns
Morning	07.00-07.15	55	11	66
	07.15-07.30	59	15	74
	07.30-07.45	58	18	76
	07.45-08.00	52	11	63
	08.00-08.15	52	9	61
	08.15-08.30	49	12	61
	08.30-08.45	56	15	71
	08.45-09.00	60	16	76
Evening	15.00-15.15	38	8	46
	15.15-15.30	41	14	55
	15.30-15.45	35	7	42
	15.45-16.00	33	16	49
	16.00-16.15	32	12	44
	16.15-16.30	50	15	65
	16.30-16.45	48	19	67
	16.45-17.00	35	20	55
	TOTAL	**753**	**218**	**971**

Table 1 shows the number of vehicles that made u-turns from the south toward the PIE gate on Monday May-25-2023 was 753 motorcycle, 218 light vehicles and a total 971 of vehicles.

4.1.2. The Exit Direction Towards the South

Table 2. Volume survey from the exit direction towards the south

Periode Of Time		Transportation Type		Total U-Turns
		Motorcycle	Light Vehicle	
Morning	07.00-07.15	45	5	50
	07.15-07.30	53	8	61
	07.30-07.45	55	11	66
	07.45-08.00	38	15	53
	08.00-08.15	40	8	48
	08.15-08.30	35	6	41
	08.30-08.45	54	12	66
	08.45-09.00	50	15	65
Evening	15.00-15.15	41	8	49
	15.15-15.30	31	10	41
	15.30-15.45	29	17	46
	15.45-16.00	35	15	50
	16.00-16.15	33	22	55
	16.15-16.30	37	16	53
	16.30-16.45	46	18	64
	16.45-17.00	52	20	72
	TOTAL	**674**	**206**	**880**

Table 1 shows the number of vehicles that made u-turns from the exit direction toward the south on Monday May-25-2023 was 674 motorcycle, 206 light vehicles and a total 880 of vehicles.

4.2 Operational Delay

Operational delay caused by a vehicle doing a u – turn is the difference in the travel time to get through observation area in disturbed and undisturbed current conditions in each 15-minute observation period [18].

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4.2.1 Operational Delay from the South Toward the PIE Gate

Table 3. calculation of operational delays

No.	Transportation Type	Time
1	Motorcycle 1	10.11
2	Motorcycle 2	11.15
3	Motorcycle 3	9.5
4	Motorcycle 4	10.00

From the table above, the average playing time is 10.19 seconds.

4.2.2 Operational Delay the Exit Direction Towards the South

Table 4. calculation of operational delays

No.	Transportation Type	Time
1	Motorcycle 1	9.1
2	Motorcycle 2	10.15
3	Motorcycle 3	12.15
4	Motorcycle 4	11.30

From the table above, the average playing time is 10.67 seconds.

5. Conclusion

The process of observing, calculating and analyzing the traffic flow that occurs due to the influence of vehicle reversal maneuvers on Jalan Ahmad Yani can be concluded is known that there are several factors that affect traffic flow resulting in congestion on the U-Turn in front of the Panbil Industrial Estate, due to side obstacles such as vehicles going against the flow, stopped vehicles, vehicles that are about to cross, and activities in and out of vehicles from the Panbil Industrial Estate. Furthermore, from the results of calculating the time delay in the direction from the south to the Panbil Industrial estate gate, the average value is 10.19 seconds, and from the exit direction towards the south is 10.67 seconds.

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Receieved 20 Mei 2023
Available online 30 Juni 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB