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ANALYSIS OF UNDERPASS DEVELOPMENT ON THE TRAIN CROSS

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ABSTRACT - Traffic jams on Jalan Sultan Hasanudin Pasar Tambun often occur, especially during peak hours. Services on Jalan D According to Number 96 Year 2015 About Guidelines for the Implementation of Traffic Management and Engineering Activities, the level of service on arterial roads is at least C. There is a potential safety risk for pedestrians, because there are no pedestrian crossing facilities. Then analyze the benefits of underpass construction on level crossings for road users. This study aims to improve safety and security for vehicle users passing through the tunnel, identify the construction of underpasses at railroad crossings, minimize queue lengths and delays while crossing Jalan Sultan Hasanudin and improve road smoothness, and provide recommendations for the need for pedestrian facilities on the Jalan Sultan Hasanudin section. Sultan Hasanuddin. The method used is descriptive quantitative analysis, namely in the form of calculating traffic performance, technical requirements of the railway line, the benefits of the underpass for train operations and the need for pedestrian crossing facilities. The results of the analysis identify the need for underpass maintenance costs for safety and security for passing vehicle users, it is necessary to add a zebra cross and pelican on Jalan Sultan Hasanudin on pedestrian facilities to cross, close the u-turn of the Ataqwa mosque which is moved to the u-turn access of the police station. south tambun, then the construction of the tunnel is very useful for rail operations and road users..

Keywords: Traffic Engineering, Underpass, Pedestrian, U-Turn, The Train.

I. INTRODUCTION

Level crossings or intersections and/or intersections between railway lines and other buildings are accident-prone points that are difficult to resolve given the low discipline of road users to comply with warning signs at level crossings (Aswad, 2013). Accident data from 2015 to 7 June 2019 accidents at level crossings were 1,470 incidents with details of 179 incidents at guarded level crossings and 1,291 at unguarded crossings, this shows the lack of awareness of road users to prioritize

³ train travel. Pada perlintasan sebidang antara jalur kereta api dengan jalan pengemudi kendaraan wajib berhenti ketika sinyal sudah berbunyi, palang pintu kereta api sudah mulai ditutup dan/atau ada isyarat lain untuk mendahulukan perjalanan kereta api (UU RI, 2009).

Underpass is a road that is below ground level (Santosa et al., 2016), the main part of which is a road, rail, or pedestrian path. The underpass is an alternative to be able to overcome the long queue of vehicles at the intersection, the function of using the underpass is to improve the road geometry, to be able to provide comfort and safety for pedestrians and road users. In RTRW (Rencana Tata Ruang Wilayah) of Bekasi Regency, Tambun Selatan District as the urban center is part of the Jabodetabek PKN urban system which carries out the function of national-scale industrial development. ⁶ Based on data from the Central Statistics Agency in 2018, the population of South Tambun District in Bekasi Regency is 134,067 people with an area of 4,310 Ha. Long queues and delays on roads are common problems in Bekasi Regency, especially at the Pasar Tambun intersection.

At the Pasar Tambun Intersection there is a Mekarsari Street section in the north which is a residential area and there is a Tambun Station, the west is Jalan Sultan Hasanudin I which is the Tambun market area and access to Bekasi City, then the east is Jalan Sultan Hasanudin II access to Cikarang which there is an industrial area. In the area there are long queues and delays due to the disproportionate volume of vehicles and road volume. Based on the results of the survey the performance of the existing intersection produces a delay at busy time of 14 seconds with service level B, but the service level of Jalan Sultan Hasanudin D is unstable vehicle volume with high-passing vehicles with the lowest speed of 50 km/hour. The level of service on arterial roads is at least C (PM RI, 2015).

There are no road crossing facilities, in this case there is a potential risk to pedestrian safety, pedestrians are part of the traffic movement because their activities are moving. To ensure the safety of pedestrians, their rights and obligations in traffic are regulated, and they are ⁴entitled to the availability of supporting facilities.

The underground crossing with a length of 162 meters was inaugurated on 10 May 2017, in this case there is no underpass maintenance. Tunnel maintenance started 5 years after the tunnel operation. Then it is necessary to calculate the maintenance cost for the underpass (Firmansyah & Istiar, 2016; Muzdar et al., 2018). Based on data, the number of daily train trips in the Tambun area is 49 commuterline (source: KRL Access, 2021) and 18 long-distance trains (source: KAI Access, 2021) with an average number of accidents of 1 accident per day. There is no benefit of underpass construction on Jalan Mekarsari for road users. Analyzing the construction of underpasses at railroad crossings. To overcome the problems that occur at the Pasar Tambun intersection, this study will examine the feasibility of constructing an underpass at the railroad crossing at Pasar Tambun intersection. Congestion at level crossings is due to the closing of the crossing gates to prioritize train travel, resulting in a queue of motorized vehicles (Hartono, 2016).

II. METHOD

The research method used is quantitative descriptive analysis in the form of calculating traffic performance, technical requirements of the railway line, the benefits of the underpass to road users, the cost of maintaining the underpass and the need for pedestrian crossing facilities. The research stages start from identification of existing problems, secondary data collection, primary data

collection, traffic analysis of existing conditions, traffic analysis of plan conditions, model validation, followed by conclusions and suggestions.

This research used primary and secondary data. Primary data were obtained from survey at the intersection of the Pasar Tambun. The survey carried out was an inventory of roads and intersections with the target data in the form of images of the geometric conditions of the intersection as well as facilities and equipment along with a cross section, the classified turning movement counting survey conducted direct observations and enumerations at each leg of the intersection within a certain period of time, and a survey of past travel speed. traffic on a road segment by noting the length of time the obstacle, the location and the causes of the obstacle. Secondary data were obtained from government in Bekasi Regency. It was also obtained from various texts such as books, journals, and related articles as a literature review to analyze more deeply. Testing the inter-relationship between variables using chi-square test, and then compiled a recapitulation of the results of the bivariate analysis and will be known whether the five variables of the research are interconnected.

III. RESULTS AND DICCUSSION

1. Underpass maintenance

⁴ Regulation of the Minister of Public Works and Public Housing Number 13 PRT of 2011 concerning Procedures for Road Maintenance and Surveillance (PM RI, 2011). Development costs have increased every year due to inflation. The amount of inflation that occurred based on the inflation rate of Bank Indonesia was 4.82%. So, the tunnel maintenance cost in 2022 is Rp. 9,590,327,674.00.

2. Benefits of the Underpass on the Road

Underpass needs to be done because it is very useful for the smooth running of road users (Sudarmanto, 2018). In addition, every train that crosses the level crossing, requires a waiting time of 3 minutes for road users. Starting from the safety time before the train passes (the clapper signal for the train that will pass) + the release time (opening) of the JPL doorstep. In a day the benefits of underpass construction for road users are at least 360 minutes or the equivalent of 6 hours per day. In one day the benefit of underpass construction for road users are at least 360 minutes or equivalent to 6 hours for each day.

3. Railroad Free Space

The railroad free space in the tunnel takes into account the type of rail facilities operated and the ballasted or unballasted system. The dimensions of the tunnel are determined by the free space plus at least 100 mm for maintenance.

The railroad free space of track complies with the standard provisions of PM Number 60 Year 2012 About Railroad Technical Requirements (PM RI, 2012), the following is an image free space on the rail road:

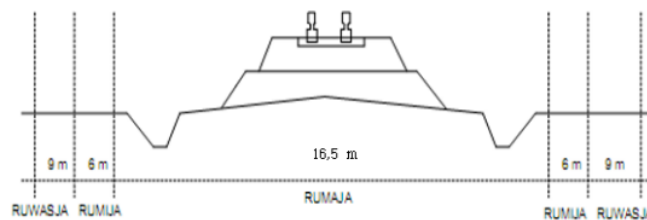


Figure 1 Free Space on Railroads

The free space on the rail road complies with the standard provisions, namely:

- a) Railroad Benefit Space at least 2.75 meters from the axle

For the benefit space of the railway line, it has met the standard provisions of 2.75 meters.

- b) Space Owned by Railroad 6 meters

The space belonging to the railroad has met the 6 meter standard. The space belonging to the railway line is intended to secure the construction of the rail road.

- c) Ruang Pengawasan Jalur Kereta Api (tidak ada batas minimum)

A piece of land outside the road belonging to the road that must be monitored, so that all activities and development within the boundaries of the ruwasja do not interfere with train operations. The field on the rumija has a function to secure and expedite the train.

4. Pedestrian Facilities

From the results of the pedestrian survey, it was found that the volume of pedestrians crossing, then obtained reference data in determining crossing facilities (Junaedi, 2014). Then the recommendations for crossing facilities will be obtained by looking at the number of people crossing and the volume of vehicles. The following is the result of determining the crossing facilities (Table 1).

Table 1 Calculation of Recommendation for Selection of Types of Crossings for Pedestrian Facilities

Time 60 Minutes	Pedestrian Crossing (P)	Vehicle (V)	V ²	PV ²
07:00-08:00	83	1375	1890625	156921875
08:00-09:00	69	1324	1752976	120955344
12:00-13:00	66	1497	2241009	147906594
13:00-14:00	46	1285	1651225	75956350
15:00-16:00	55	1451	2105401	115797055
16:00-17:00	48	1526	2328676	111776448
Average				121.552.277,67

From the results of the calculations above, it is obtained recommendations for different crossing facilities, namely the zebra cross and pelican recommendations. This is influenced by the number of pedestrians and the average number of vehicles which are in the range of 50 – 1100 (PU RI, 1997). Then for the recommended image of crossing facilities (Figure 2).

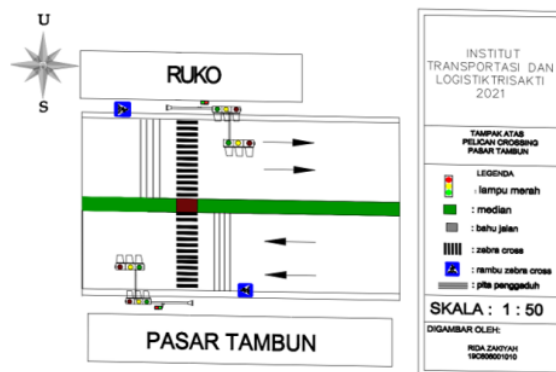


Figure 2 Top View of Pelican Crossing Pasar Tambun

In planning the duration of the pelican crossing lights, it is calculated only in period 4 as shown in the table below, while for period 1 the standard time from the book The Design of Pedestrian Crossings (Department for Transport of United Kingdom, 1995) is 7 seconds.

$$PT = \frac{12}{1,2} + 1,7 \left(\frac{83/60}{2,5-1} \right) = 11,57 = 12 \text{ seconds}$$

Table 2 The Period of the Pasar Tambun
Pelican Crossing Lights

Period	Traffic Lights		Duration (Seconds)
	Vehicle	Pedestrian	
1	Green	Red	7
2	Yellow	Red	3
3	Red	Red	3
4	Red	Green	12
5	Red	Flashing Green	3
6	Red	Red	3

5. Closing of U-Turn Access

One of the effects when making a reverse motion is the speed of the vehicle where the vehicle will slow down or stop. This slowdown will affect the flow of traffic in the same direction (Maer et al., 2019). In certain vehicles, to make a U-turn motion, it is not possible to directly make a rotation due to the condition of the vehicle that does not have a sufficient turning radius, so that it will cause other vehicles to be disturbed and even stop either from the same direction or from the opposite direction to be traversed (Balaka & Djalante, 2017). Jalan Sultan Hasanudin in Bekaasi Regency, West Java Province, is an arterial road with a relatively high traffic volume and there is a median opening (U-turn).

Based on observations at the study site, it is seen that there are vehicles that cannot perform U-turn movements smoothly, wherein the vehicle must perform additional maneuvers in order to fully adjust the turning movement.

Rp. 9,590,327,674.00. In this case, development has increased every year due to the inflation that occurs, the magnitude of the inflation rate that occurs is based on the inflation rate of Bank Indonesia of 4.82%.

2. The recommendation for pedestrian crossing facilities with zebra cross and pelican crossing with a cycle time of 31 seconds and a pedestrian duration of 12 seconds, this is influenced by the number of pedestrians on Jalan Sultan Hasanudin and the number of vehicles in $< 10^8$ for provision crossing facility.
3. Closing the U-turn access on Jalan Sultan Hasanudin, can eliminate the 25 second delay caused by the vehicle making a U-turn. Then the vehicle can make a U-turn at the Tambun Selatan Police Station, 290 meters from the foot of the intersection.
4. In the free space the rail road has complied with the standard provisions, are; The Railroad Benefit Space of 16.5 m has complied with the minimum standard of 2.75 m from the axle, the Railway Owned Space is 6 m and the Railway Track Control Room is 9 m. The number of daily train trips in the Tambun area is 49 commuterline and 18 long-distance trains with an average number of accidents of 1 accident per day. Based on the facts, that is because the crossing gate is in a damaged or malfunctioning condition and there is no free space for drivers to see the arrival of the train that will pass.
5. There are benefits to the construction of the underpass, namely the waiting time of 3 minutes for each train or 6 hours a day for trains crossing level crossings for road users.

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