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Nomor: 167-D/861/FT-UNTAR/II/2021

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Untuk melaksanakan **Mempresentasikan Hasil Penelitian** dengan data sebagai berikut:

Judul Makalah	:	Safety Audit of Becakayu Toll Road
Nama Seminar	:	The 3 rd Tarumanagara International Conference on the Applications of Technology and Engineering (TICATE) 2020
Penyelenggara	:	Universitas Tarumanagara
Peran	:	Pemakalah (Presenter)
Waktu Pelaksanaan	:	03 - 04 Agustus 2020

Demikian Surat Tugas ini dibuat, untuk dilaksanakan dengan sebaik-baiknya dan melaporkan hasil penugasan tersebut kepada Dekan Fakultas Teknik Universitas Tarumanagara.

11 Februari 2021

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for the contribution as

PRESENTER

Paper Title :

Safety Audit of Becakayu Toll Road

August 3rd - 4th, 2020 | Universitas Tarumanagara, Jakarta

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Safety audit of becakayu toll road

Safety audit of becakayu toll road

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Abstract. Road Safety Audits are an effort to recognize the possible accident Hazards from road infrastructure in traffic and the surrounding environment. Data from this audit was obtained by direct observation on the BECAKAYU toll road. Matters reviewed in this road audit are included: geometric, pavement, markings, signs, and complementary structures. This toll road connected the cities of Bekasi - Cawang - Kampung Melayu. The purpose of this study is to analyze the road's geometric, pavement, the street furniture and complementary structures of the toll road with a field survey to find out what need to recomend or added. The data obtained in this study will be compared with government regulations, whether they have accorded the regulations or not.

1. Introduction

Toll roads are public roads that are part of the road network system and national road users are required to pay [14,17]. Toll roads are normally interpreted as a freeway to shorten the travel time of the road, but with the high demand for toll roads use, sometimes the toll road is equal congested than ordinary roads.

The Becakayu Toll Road (Bekasi - Cawang - Kampung Melayu) with 21.04 Km in length was inaugurated on the 3rd of November 2017. The Becakayu toll road only operates on the Cipinang Melayu - Jakasampurna road section (section I B-C). This toll road will expand as far as 3.5 Km from Casablanca - Cipinang Melayu (section I A) and tambun, Jakasampurna - Duren Raya (section II). This toll road was built by 2 x 3 lanes with a 3.5 m road width for the design speed of 80km / hour. This toll road is expected to reduce congestion for riders who needed to travel from or headed to Bekasi via Kalimalang. Concerns have arisen when road construction continues, but the road safety system still not optimal in its implementation [1].

Road safety audits are series of formal test for potential traffic accidents from new or existing roads, road safety audits include geometric designs, road pavement, road facilities, complementary buildings, and conditions around the road to be audited [2,3,4,5,6,7,8]. Road safety audits is an assessment of existing or new roads by a group of observers in terms of planning, development, operation, and maintenance to actualize an expressway with minimum accident rate. [9]

As shown in Figure 1 is a trace of the becakayu toll road [20]

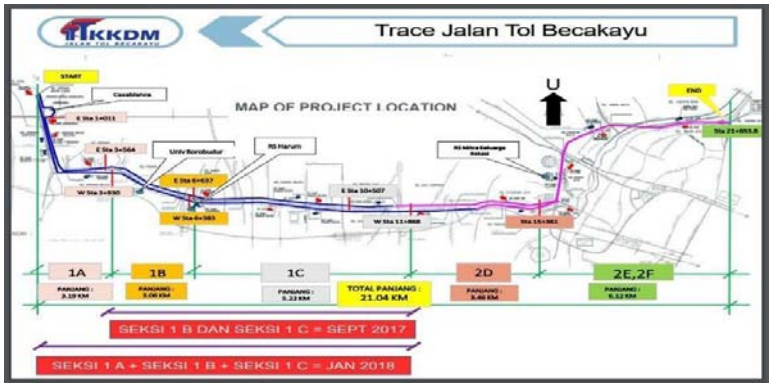

Figure 1. Trace of Becakayu toll road (Source: https://www.skyscrapercity.com)

2. Research Methodology

2.1. Method of data collection

The data collection method is done by field observations. Observations began from the toll entrance until the toll exit. Data collection phase was obtained by researchers using of a recording from the GoPro camera for more accurate results. Data has been obtained are going to be analysed from the aspects of geometry, pavement, signs, markers, and complementary buildings on the Becakayu toll road

2.2. Data compilation

Data was taken by direct observation and recording the existing condition of the becakayu toll road by Go Pro cameras, such as road pavement, signs, markers, roads geometric, and complementary buildings every 80 meters. The results of the recording will be used to analyse further the condition of the Becakayu toll road.

3. Analysis and Discussion

3.1. Design speed

Becakayu Toll Road has a design speed of 80 km/h, this speed accordance the rules of urban geometric planning, which is the design speed according to the road function. [10, 11]. Based on the results obtained by the speed gun, the car speed on the Becakayu Toll Road did more faster than the design speed that has been determined, the results obtained from the speed gun is average 106 km/h.

3.2. Size specifications for signs

The size of the signs contained in the Regulations has characterized specifications: very small, small, medium, and large. For design speed between 60-80 km /h used large-size warning signposts.

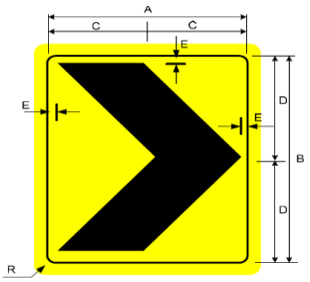

Figure 2. Size Segmentation for Signs
(Source: Guide for placement of road equipment facilities)

3.3. Stopping Sign Distance

Stopping Sign Distance where the driver can see an object that causes the driver to stop when the brakes are stepped on / the distance needed to stop the vehicle since braking motion. [12,19]. According to the Department of Public Works (2009) on the Geometry for Toll Roads, stopping sign distance can be calculated based on the formula:can be calculated based on the formula:

$$Ss = 0{,}278 \times VR \times T + (0{,}039 \times \frac{VR^2}{a})$$

Where:
VR = Design Speed (km/hr)
T = Reaction Time, set at 2.5 s
a = Deceleration (m/s^2), set at 3.4 m/s^2

The following is a table of distance point of view obtained by using the existing speed from Table 4.1 and calculation examples:

$$Ss = 0.278 \times 106 \times 2.5 + 0.039 \times \frac{106^2}{3.4} = 202.55 \text{ m} = 205 \text{ m}$$

$$Ss = 0.278 \times 116 \times 2.5 + 0.039 \times \frac{116^2}{3.4} = 234.96 \text{ m} = 235 \text{ m}$$

3.4. Direct observation analysis

The results of data collection were made in the form of a table 1, so it is easier to see signs, markers, road pavement, geometric and complementary buildings. Based on the observation result, there are many spots on the Becakayu toll road that are very short of signs. From table 1 it can be seen that there is no such road sign at all at km 5 + 40, km 8 + 60 direction Bekasi, and at km 9 + 48, 5 + 8 direction Jakarta does not correspond to Ministerial Regulation No. 13 of 2004 which is the absence of speed limit warning signs to warn a driver about the speed limits.

Ministerial Regulation No. 13 of 2004 Article 39 paragraph 2 states the placement of warning signs on the side of the road before a dangerous place or section of road at least 80 (eighty) meters with a design speed between 61 (sixty-one) to 80 (eighty) kilometers per hour. There are no signs on several road segment is a violation of Minister Regulation No. 13 of 2004.

From tables 1, it can be seen that some sections do not have warning signs for right or left turn at km 7 + 48 towards Bekasi and km 11 + 48 towards Jakarta is not following Minister Regulation No. 13 in 2004 which is no warning sign to warn the driver to turn right. For the placement of warning signs to turn right / left must be placed based on design speed because the design speed on the Becakayu toll road is 80 km / h based on the Ministerial Regulation No. 13 of 2004, so the placement of right / left turn warning signs must be 80 meters before the turning location.[18]

From the observation for markers on Becakayu Toll Road, the result was satisfying. There are no markers that faded / not visible, these markers include oblique markers, arrow markers, longitudinal markers.

The road pavement on the Becakayu Toll Road is passable even though it is a bit bumpy due to its road pavement joint [13]. Complementary buildings in Becakayu Toll Road also satisfying, with CCTV located every 1 km that can add security for the drivers and reflectors that exist on each road section with a distance of each reflector of 20 (twenty) meters. However, because the Becakayu Toll Road is fairly quiet, the driver who passes the Toll Road exceeds the predetermined speed limit of 80 km/h so it can increase the risk of accidents.

Table 1. Problems and Recommendations on Becakayu Toll Road Safety Audit

No.	Safety Issues	Risk	Recommendation
1.	There are no signs on the km 5 + 40, km 8 + 60 towards bekasi, and at km 9 + 48, 5 + 8 towards Jakarta	Medium	Given the command signs for maximum and minimum speed to warn the drivers about the speed limit.
2.	Lack of safety fences on a rather sharp bend	High	Safety fences are provided on each turn, from the beginning till the end of the turn
3.	Placement of warning signs which is not in accordance with the Ministrial Regulations	Medium	The placing of the signs 80 meters before location that is dangerous
4.	There are no warning signs for right / left turn	High	Placing turn right/left warning signs before the turning location

4. Discussion

From the analysis results, it was found that the average speed of a moment for 10 sample vehicle taken on

the becakayu toll road was 106 km/hour, because of becakayu toll road still relatively quiet, the classification of the Toll road is 80 km/hou

The measurement result of the existing signs in the Becakayu Toll Road has according the standards of Ministerial Regulation No. 13 of 2004 with a large size category, that standard size signs categorized based on predetermined design speed, design speed > 80 km/hr. Must be installed with large-size sign

There are also signs that not following the regulations which are warning signs that is placed in hazard locations. It should be placed 80-meter before the hazard location based on the predetermined plan speed. The absence of signs on the segment km 5 + 40 - 6 + 36, km 8 + 60 - 9 + 16 in the direction of Bekasi, and at km 9 + 48 - 8 + 20, km 5 + 8 - 5 + 24 in Jakarta. And some roads do not have warning signs for turning right/left at km 7 + 48 towards Bekasi and km 11 + 48 in the direction of Jakarta.

Other complementary buildings such as CCTVs, reflectors, drainage, and road dividers already following minimum service standards on toll roads [15] in the safety section with a reflector distance of 25 meters on all toll road sections. Reflector on Becakayu toll road is being placed every 20 meters, it proves that the Becakayu toll road has met the minimum standard has been determined, and CCTV every 1 km. It proves that the Becakayu toll road has met the minimum standard has been determined.

5. Conclusion

The conclusions of the results of this study are:

1. From the results of field observations, it was found that the speed on the Becakayu Toll road is not appropriate with predetermined design speed, the existing momentary speed obtained through 10 the sample is 106 km / h greater than the planned speed of 80 km/hr. This condition is caused by the Becakayu Toll Road condition which is relatively quiet, therefore the maximum and minimum speed warning signs must be placed every 80 meters, so it can remind the driver of the speed limit.
2. From the results of field observations, it is found that there are many aspects on the toll road sections becakayu that is not following Minister Regulation No. 13 of 2014 namely the absence of signs along the road at km 5 + 40, km 8 + 60 towards Bekasi, and at km 9 + 48, 5 + 8 towards Jakarta. Then also the lack of sign for right/left turn on the road section 7 + 48 towards Bekasi, and 11 + 48 towards Jakarta.
3. From the sign measurements in becakayu toll road, it was found that the signs are on the becakayu toll road classified as large, due to design speed >80 km/hour.
4. From the measurement results, the obtained width of the road lane is 3.5 meters, and the width of the shoulder of the road is 2 meters. The width of the lane and shoulder of the becakayu toll road is following the regulations established by the freeway Geometry Regulation for toll roads (2009)
5. From the observation, we know that the road pavement, complementary buildings, and road markings are satisfying because there is no flaw along the becakayu toll road.

6. References

[1] Fadli, Isya M., and Sugiarto. (2017). Analysis of Road Safety Handling and Audit Priorities in Segments Accident Prone in the City of Banda Aceh and Aceh Besar. Journal of Civil Engineering, Syiah Kuala University. Aceh.

[2] Satyan P., Mogre SK, (2017). A Spatial Approach for Performing Road Safety Audit of Highways. International Journal of Science Technology & Engineering. India

[3] Austroads, 2009, in the Ministry of Public Works, 2010
[4] Ram, SA.An Industry View on Road Safety Auditing" inProceedings of the 2013 Australasian Road Safety Research Policing & Education Conference 28th–30th August (Brisbane Queensland).
[5] Mulyono AT Berlian K Gunawan HE 2009cAudit Keselamatan Infrastruktur Jalan (Studi Kasus Jalan Nasional KM78-KM79 JalurPanturaJawa, KabupatenBatang) Civil Engineering Journal Vol.6 No.3 Page 163- 174 ISSN 0853-2982 Accredited Decree No.83 / DIKTI / Kep / 2009
[6] Indonesian National Police. Integrated Road Safety Management System (2016)
[7] Indriastuti K A Yessi F and Edy P. 2011.Karakteristik Kecelakaan Dan Audit Keselamatan Jalan Pada Ruas Ahmad Yani Surabaya. Malang: Brawijaya University.
[8] Sugiyanto, G., Mulyono, B. dan Santi, M.Y. 2014. Karakteristik Kecelakaan Lalu Lintas dan Lokasi Black Spot di KabupatenCilacap, JurnalTeknikSipilUniversitasAtma Jaya Yogyakarta, Volume 12, No. 4, April 2014, hal. 259- 266.
[9] Satyan P., Mogre SK, (2017). A Spatial Approach for Performing Road Safety Audit of Highways. International Journal of Science Technology & Engineering. India
[10] Setyarini NLPE and Putranto, LS Key Factors to Become Successful Road Safety Auditor Proceeding of Symposia of Infrastructure and Transportation, Quality in Research 2019, Padang
[11] Ministry of Transportation of the Republic of Indonesia, 2014. Regulation of the Minister of Transportation of the Republic of Indonesia No PM 12 of 2006 concerning Traffic Engeneering Management. Jakarta: Minister of Transportation of the Republic of Indonesia.
[12] Ministry of Public Works. (2016). Road Safety Training for Road Safety Audit.
[13] Suwarto F. and Nugroho A., (2019). Road Safety Audit as a Basis for Planning Implementation Road Characteristics Journal of Civil Engineering Projects. Semarang.
[14] Government Regulation of the Republic of Indonesia. (2015). "Number 15 About Toll Roads". Jakarta: State Gazette Republic of Indonesia Year 2005 Number 32
[15] Minister of Public Works of the Republic of Indonesia. 2014. "Regulation of the Minister of Public Works of the Republic of Indonesia No. 16 / PRT / M / 2014 concerning Toll Road Minimum Service Standards. Jakarta.
[16] Laws of the republic Indonesia. 2009. "Law of the Republic of Indonesia No. 22 of 2009 concerning Traffic and Public Transportation. Indonesia.
[17] Laws of the republic Indonesia. 2004. "Law of the Republic of Indonesia No. 38 of 2004 concerning Street. Indonesia.
[18] Ministry of Transportation Directorate General of Land Transportation. "Equipment Facility Placement Guide Street". Indonesia
[19] Ministry of Public Works Directorate General of Highways. 2009. Geometry of Freeway for the Road Toll No.007 / BM / 2009. Indonesia
[20] www.skyscrapercity.com accessed 27 August 2019