Proceedings of International Conference : Problem, Solution and Development of Coastal and Delta Areas
Semarang, Indonesia – September 26th, 2017
Paper No.C-27

THE TRAFFIC ANALYSIS ON THE SIGNALED T-JUNCTION (A Case Study Of Purwokerto Indah (Purin) T-Junction, Kendal)

Dwi Wahyu Hidayat
[1]Master Program of Civil Engineering, Sultan Agung Islamic University
UNISSULA Campus, Jl. Kaligawe Km. 4 Semarang 50112
ikwahyusite@gmail.com

Abstract- Purwokerto Indah T-Junction (Purin) is one of the T-Junctions located in the district of Kendal. This place is found to be a signaled T-Junction and belongs to education and housing area. Looking at its function, it connects Jl. Tentara Pelajar with Jl. Soekarno-Hatta, the main road of North Beach (Pantura). In the rush hours, especially in the Morning and in the Afternoon, this site becomes crowded and vulnerable to conflict due to being located on the area of Jl. Soekarno-Hatta, the main road of North Beach (Pantura). In order to meet the need of this research, surveys on the flow of traffic, type of vehicle, Geometry of road, and phase of traffic on the T-Junction were conducted. These surveys were made on Sundays, Mondays and Wednesdays at 06.00 to 18.00. The T-Junction performance analyses were made by referring to MKJI where it included the level parameter of saturation, postponement, and T-Junction services. Of the data analyses, the intersection performance values at the peak condition were found to be at the south area of Jl. Tentara Pelajar with the level of saturation (DS) 0.937, and the total of delay 61.827 seconds/unit of passenger car that it belonged to service level D. For the west area of Jl. Soekarno-Hatta, this had the level of saturation (DS) 0.937, and the total of delay 57.528 seconds/unit of passenger car, where this belonged to level D in term of service. For the east area of Jl. Soekarno-Hatta, the level of saturation (DS) was 0.937, and the total of delay was 80.374 seconds/unit of passenger car. It means, the average of intersection delay in the T-junction, Purin, Kendal was 34.27 seconds. This further explains that the service level of Purwokerto Indah (Purin) T-Junction, Kendal belonged to level D.

Keywords : *MKJI; Signaled T-junction, Service Level*

1. Introduction

The district of Kendal is situated in main road of North Beach (Pantura) where it becomes one of the reasons why this city grows exceptionally fast. It is obviously observed from the development of hotel, housing and industrial area, education facilities, mainly higher education institution in the district of Kendal. In addition, educational facilities, and property business are noted to rapidly grow where it is proven from the rising demand of housing construction. Along with this rapid development, it is undeniable that the traffic condition starts to increase time to time.

Purwokerto Indah (Purin) T-junction is one of the crossroads in the district of Kendal. This place is found to be a signaled T-junction, situated around the education and housing areas. Looking at its function, this junction connects Jl. Tentara Pelajar with Jl. Soekarno-Hatta, the main road of North Beach (Pantura). In the rush hours, especially in the Morning and in the Afternoon, this site becomes crowded and vulnerable to conflict as it is located on the area of Jl. Soekarno-Hatta where it is the main road of North Beach (Pantura) in Kendal. As a result of this, there grows another sensitive problem around the

area that directly impacts to society, primarily one happening in the effective hours such the commute time either for workers, or university and high-school students.

2. Research Method

Quantitative data processing of this research was conducted by referring to Indonesia road capacity manual (MKJI) issued by Directorate General of Highway, Ministry of Public Works, Year 1997. To meet the goal of the research, the following steps were made to be procedurally obeyed:

1) Preparation
   The initial step of this research included doing initial survey at the signaled T-junction to get to know the real condition in the field. This was aimed at helping make strategies for placing the surveyors for sake of the primary data collection. In order to precisely getting the expected data for the benefit from survey plan and data analysis, the aim of this research should be made clear within this phase.
2) Literature Review
   Literature review was another initial step in selecting goal, method of research, method of analysis or discussion about the research. This step was expected to generate initial idea about the topic or issue, could be discussed before it was further interpreted through the existing literatures supported the research.
3) Survey
   Method of survey was made by doing direct observation towards the real condition in the field. Primary data of this research would be from the ones collected from the survey. There were several surveys made to gain the required data. Among which were:
   - Initial Survey (site visit)
   - Existing Condition Survey (site visit)
   - Detailed Survey (site visit)

   Site visit (Survey) would be made at Purwokerto Indah (Purin) T-junction, Kendal on Sunday, Monday and Wednesday at 06.00 to 18.00. By doing this visit (survey) on the traffic within the specified time, it was expected to get to know the traffic performance of the signaled T-junction.
4) Data Processing and Analysis
   This step discussed about processing and analyzing the data made based on the data acquired before it was then placed in a graph for classification made according to type of the problem in order to generate result expected to provide effective and directed solution towards the existing problems. Data processing and analysis within this step were made by referring to the collected data on the traffic performance in Purwokerto Indah (Purin) T-junction, including *Capacity*, *delay*, *length of queue*, *level of saturation* and *level of service*.

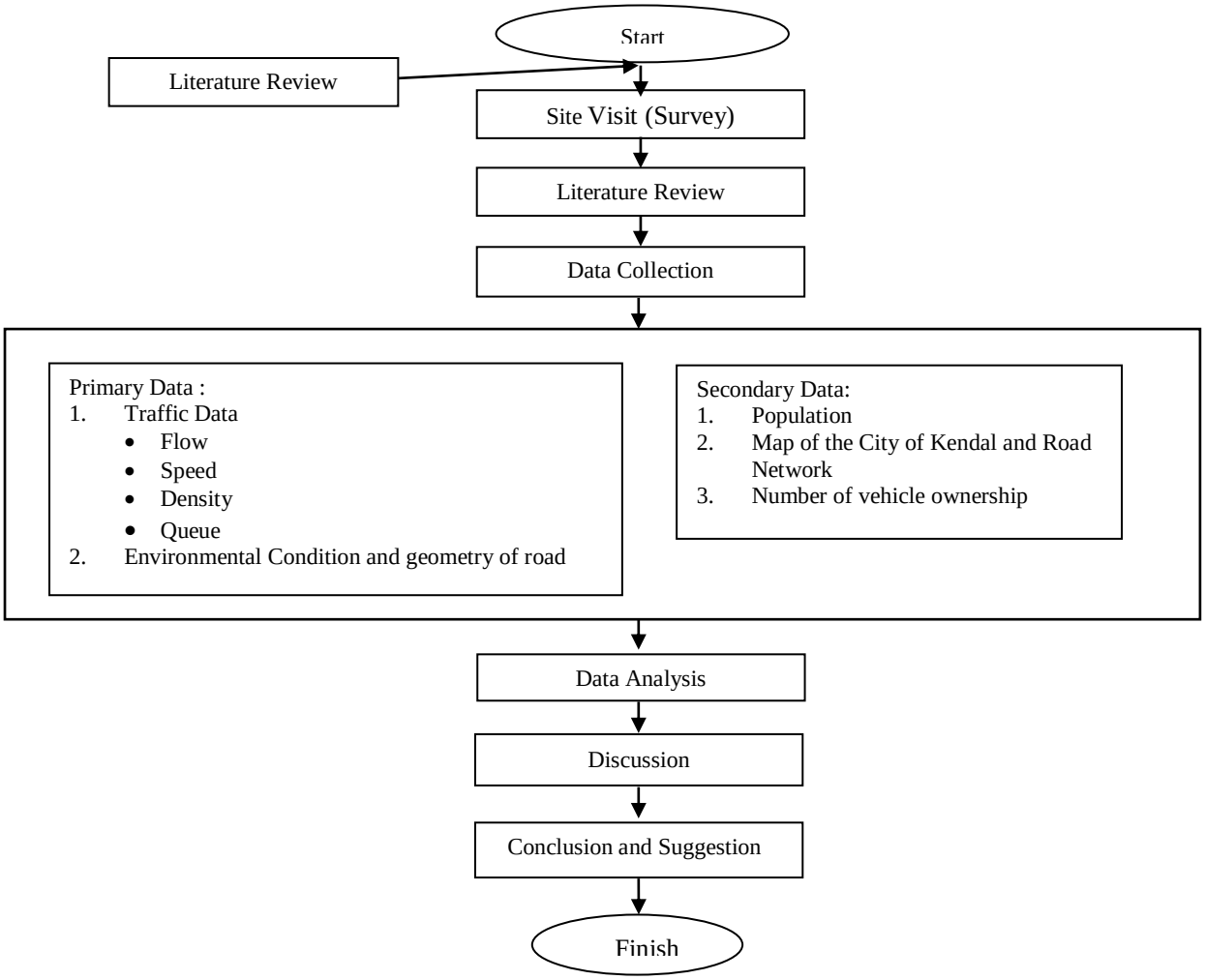


Figure 1. Flow Chart of Research

3. Result and Discussion

a. Data Processing

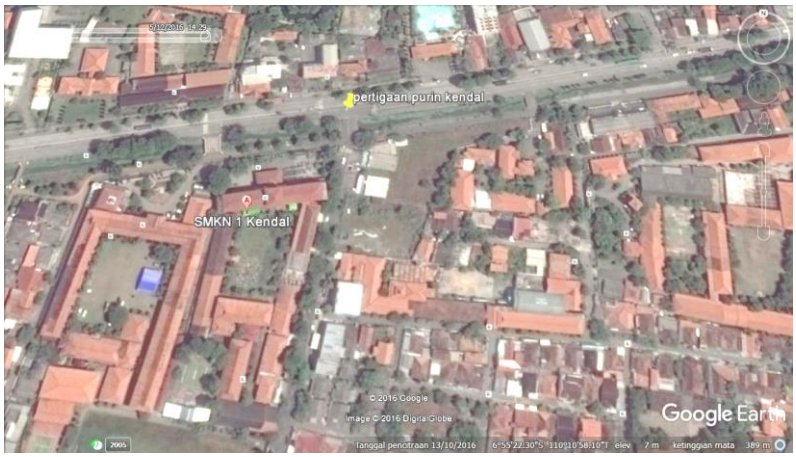


Figure 2. Site of Research

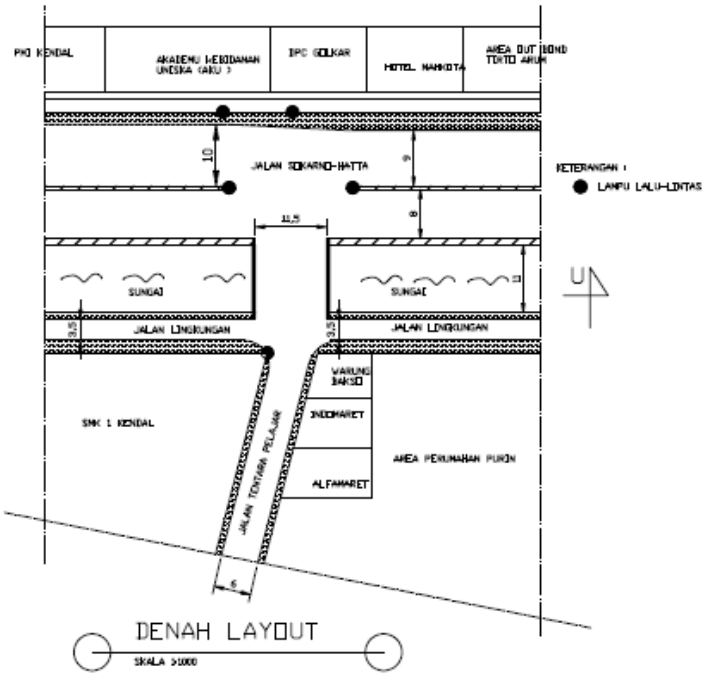


Figure 3. Site Map of Purin T-junction, Kendal

The following data were collected from the site visit and research held in Purwokerto Indah (Purin) T-junction, Kendal.

Table 1. Field Data

Code of Width of Route	Traffic Flow (Q) Unit of Passenger Car/Hour	Width of Route (W_A) m	Width of Entrance Route ($W_{Entrance}$) M	Allowed to Turn Left Immediately (W_{LTOR}) m	Width of Exit Route (W_{Exit}) m
South	556	6,19	3	0	5
West	3281	10	10	0	10
East	1991	8,25	5,25	3	8,25

Source : Survey made in 2017

Below are data related to the amount of vehicles passing by Purin T-junction, Kendal on Sunday, Monday, and Wednesday began at 06.00 – 18.00.

Table 2. Summary of Traffic Flow at Purin T-junction Kendal

Time	Day (Vehicle/Hour)			TOTAL (Vehicle/Hour)
	Sunday/ Day-Off	Monday	Wednesday	
06.00-07.00	2640	14604	14868	32112
07.00-08.00	3312	7084	7451	17847
08.00-09.00	3783	6384	7421	17588
09.00-10.00	3004	5972	4868	13844
10.00-11.00	3930	5904	5605	15439

Time	Day (Vehicle/Hour)			TOTAL (Vehicle/Hour)
	Sunday/ Day-Off	Monday	Wednesday	
11.00-12.00	3445	5636	4735	13816
12.00-13.00	3987	6278	5199	15464
13.00-14.00	4751	5480	5517	15748
14.00-15.00	3450	5089	5781	14320
15.00-16.00	3663	6314	6359	16336
16.00-17.00	4577	8342	8222	21141
17.00-18.00	4666	7277	7360	19303
TOTAL	45208	84364	83386	212958

Source : Data Processed in 2017

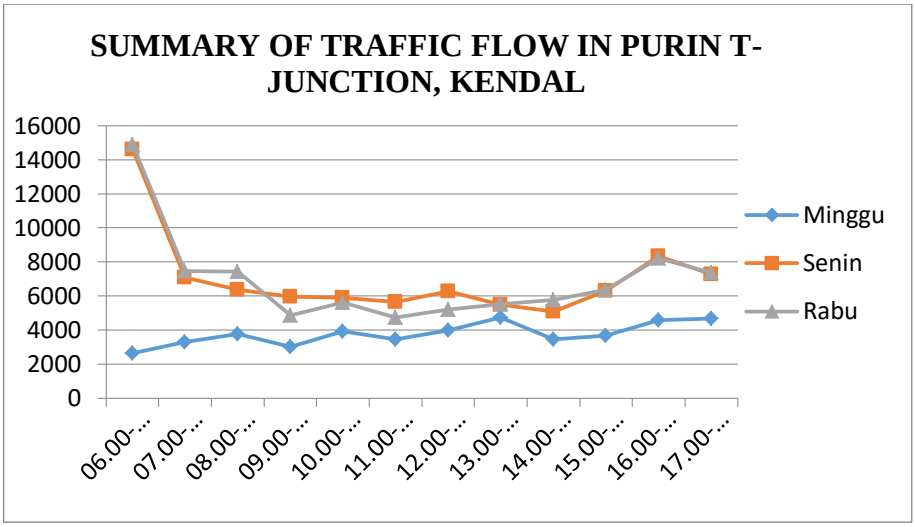


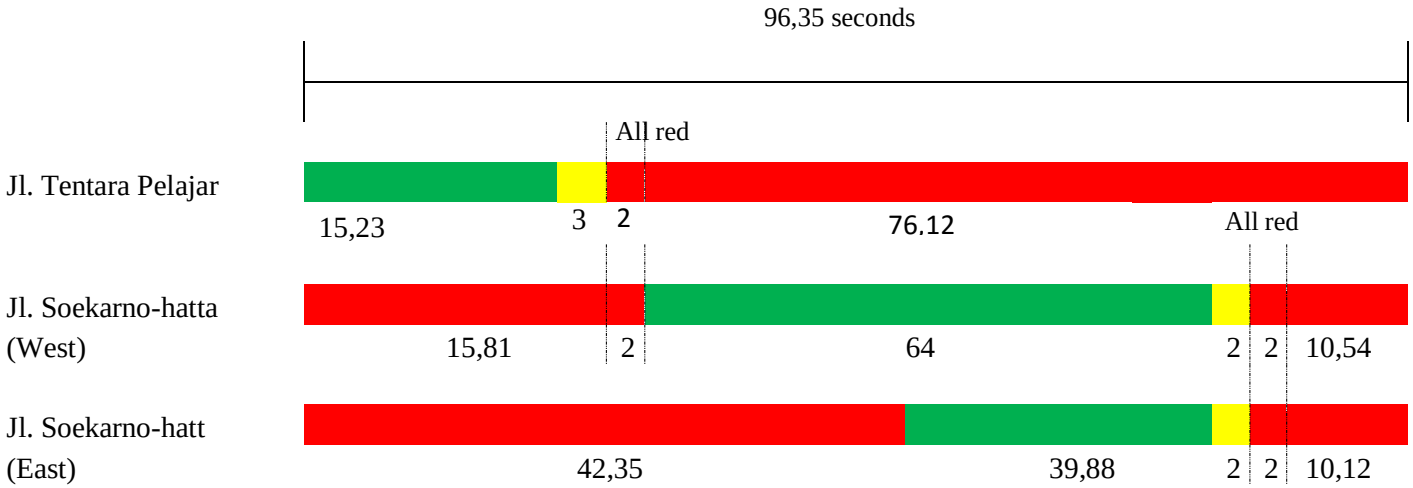
Figure 4. Graphic Summary of Traffic Flow in the area of Purin T-junction, Kendal

From the above tables and graphs, the traffic flow passed through Purin T-junction, Kendal on Sundays or holidays of 45,208 Vehicles. For Monday, as the beginning day of a week and the beginning of the activity at work or school, the number of passing vehicles was 84,364. For Wednesday, the number of passing vehicles was 83,386. Thus, it was observable that the mostly dense day of these three days taken as a sample of the research was Monday, with the number of vehicles passing by are 84,364.

To capture the data of signal timing at APILL in Purin T-junction, Kendal, stopwatch was used to calculate the green, yellow and red time with total cycle about 96,35 second. The results of this timing survey on each approach are shown in the table below

Tabel. 3. Data of Traffic Light Survey (APILL)

No.	Jl. Tentara Pelajar				Jl. Soekarno-Hatta (West)				Jl. Soekarno-Hatta (East)			
	G (sec.)	Y (sec.)	R (sec.)	All Red (sec.)	G (sec.)	Y (sec.)	R (sec.)	All Red (sec.)	G (sec.)	Y (sec.)	R (sec.)	All Red (sec.)
1	15,23	3	76,12	2	66	2	26,35	2	39,88	2	52,47	2



Source: Data processed in 2017

b. Discussion

The traffic performance of Purwokerto Indah (Purin) T-junction, Kendal is observable from the results of analysis and calculation of data obtained from the field. The performance of the intersection was indicated by the level of capacity of each road sign at the studied intersection. Thus, it was expected, that the level of intersection service of each entering traffic road in term of serving traffic passing through the intersection.

Table. 4. Relationship between Capacity, Traffic Flow and Degree of Saturation

Road	Capacity (C) Unit of Passenger Car/Hour	Traffic Flow (Q) Unit of Passenger Car/Hour	Level of Saturation (DS) (Q/C)	Remark of Service
Jl. Tentara Pelajar (South Road Sign)	593,82	556	0,937	Level D
Jl. Soekarno-hatta (West Road Sign)	3501,97	3281	0,937	Level D
Jl. Soekarno-hatta (East Road Sign)	2125,18	1991	0,937	Level D

Source: Data processed in 2017

The table above presents the level of road service on each road sign. On the southern part of this junction, Jl. Tentara Pelajar, this had the level of saturation of 0,937, including the level of service (D). It means that the flow of traffic to Kendal or to Jakarta around this area was obviously forced as a result in the high flow of traffic passing through the road where it exceeded the capacity of this highway. Therefore, the traffic speed was relatively low. Traffic flow often stalled and caused a long queue of vehicles. For the western entering traffic road, Jl. Soekarno-Hatta, the traffic flow from Jakarta to Kendal had been experiencing from slowdown, but this did not experience from a long congestion. It was evidenced by the results of research on the volume of vehicles passing by this road (3281 unit of passenger car/ hour), while the capacity of the road were 3501,97 unit of passenger car/hour with the comparative ratio between the traffic flow and the road capacity where it shows the level of saturation of 0.937. It means by considering the level of western road service

condition, the service belonged to level D. It explains that the traffic flow was approaching unstable, the operating speed decreased relatively quick thanks to the obstacles, and the space of movement was relatively small. For the eastern entering traffic road of Jl. Soekrano-Hatta, the traffic from Kendal to Jakarta and Purwokerto Indah (Purin) had experienced a traffic slowdown, it did not experience a long congestion as evidenced by the result of the study in the vehicle volume passing this road (1991 unit of passenger car/hour), as the road capacity was about 2125,18 unit of passenger/ hour, with the comparative ratio between traffic flow and road capacity. By referring to this, it helps explain that the level of saturation was 0.90. It means, the level of western entering traffic road services belonged to level D. It can be inferred that the traffic flow was not stable, the operating speed decreased relatively quick due to the rising obstacles, and space of movement was relatively small.

Table. 5. Calculation of Delays

Code of Entering traffic road	Traffic Flow Q (Unit of Passenger Car/Hour)	DT Traffic Delay (Sec./Unit of Passenger Car)	DG Geometric Delay (Sec./Unit of Passenger Car)	D=DT+DG Average of Delay (Sec./Unit of Passenger Car)	DxQ Total Delay (Sec./Unit of Passenger Car)
South	556	107,02	4,123	111,14	61.827
West	3281	14,15	3,381	17,54	57.528
East	1991	36,76	3,614	40,37	80.374
∑	5828				199.729

Source: Data processed in 2017

The average delay of intersection at Purin T-junction, Kendal was obtained using the following formula:

$$D_t = \frac{\sum(QxD)}{\sum Q} = \frac{199.729}{5828} = \mathbf{34,27\ seconds/unit\ of\ passenger\ car}$$

Of the calculation of the data, it is noted that the capacity of the road had experienced a slowing of traffic that contributed to congestion or queue of vehicles passing by the area of Purin T-junction Kendal. This is observable that the result of average delay was 34,27 sec./ unit of passenger car, this means the level of service of Purin T-junction was in the level D.

4. Conclusion

After processing the data, analyzing the results and discussing the problems occurred at the T-junction of Purwokerto Indah (Purin), Kendal, it can be concluded that:

1) Based on the calculation result, it is identified that the capacity of Purin T-junction, Kendal for southern entering traffic road was 593,82 unit of passenger car/ hour, with traffic flow of 556 unit of passenger car/hour. For western entering traffic road, the capacity was 3501,97 unit of passenger car/ hour, with the traffic flow of 3281 unit of passenger car/hour. For eastern entering traffic road, the capacity was2125,18 unit of passenger car/ hour, with traffic flow of 1991 unit of passenger car/hour. These values indicated that the road had a long congestion on the southern entering road as the traffic flow exceeded the existing road capacity, on the western and eastern entering traffic road, the solid flow was unstable at low speed despite it did not experience from long congestion.

2) For the performance level of T-junction of Purwokerto Indah, Kendal, based on the result of calculation, the southern entering traffic road had the level of saturation (DS) as much as 0,937; 0.937 for western entering traffic road; and for the eastern entering traffic road, the level of saturation was observed to be 0.937. In accordance with these results, the southern entering road service was categorized to be at level D with the criteria of traffic; forced, relatively low speed, frequently stopped, experiencing long queue. For western and eastern area, it indicated that the service belonged to level D with the criteria of traffic flow approaching unstable, experiencing relatively rapid decrease in operation speed due to the rising obstacles, and the space for movement was relatively small. It means the road capacity of Purin T-junction, Kendal had been experiencing high saturation exceeding normal (DS>0.85). Based on the result of analysis, it was reported that the average intersection delay in the area of Purin T-junction Kendal was 34,27 sec./unit of passenger car. It means the intersection service was categorized to be at level D. It further explains that the services had been experiencing from traffic slow-down that caused congestion.
3) To overcome the traffic congestion, it is necessary that the primary problems need to be resolved. Public transports on the daily basis activity where they are taking and dropping passengers at random place due to there are no specific areas they can drop and take the passengers. Therefore, evaluation and construction of the facilities are essentially needed to minimize the complexity of traffic in the area. Besides, placing traffic officers in the rush hours either from the relevant institution or police department are required in order to manage the public transports, particularly while they are dropping and taking the passengers. For Jl. Tentara Pelajar, the road needs broadening in order to meet the need for traffic for sake of minimizing the traffic. Intersection signal coordination (APILL) needs to be reset with regard to this high traffic.

References

Gland Y.B. Lumintang, L.I.R. Lefrandt, J.A. Timboeleng, M.R.E. Manoppo, 2013. *Kinerja Lalu Lintas Persimpangan Lengan Empat Bersignal (Studi Kasus: Persimpangan Jalan Walanda Maramis Manado)*, Jurnal Sipil Statik.

Manual Kapasitas Jalan Indonesia (MKJI) Tahun 1997, Republik Indonesia Dirjen Bina Marga, Direktorat Bina Jalan Kota (Binkot).

Peraturan Menteri Perhuhungan No 14 Tahun 2006 tentang Manajemen dan Rekayasa Lalu Lintas di Jalan

Peraturan Pemerintah Repuplik Indonesia Nomor 34 Tahun 2006, Tentang Jalan.

Peraturan Pemerintah Republik Indonesia Nomor 43 Tahun 1993, Tentang Prasarana dan Lalulintas Jalan

Sigit Priyanto, Ahmad Munawar, Bambang Hari Wibisono dan J.Dwijoko Ansusanto, 2014. *Pengaruh Perubahan Guna Lahan Terhadap Pembebanan Jaringan Jalan Perkotaan Yogyakarta*. The 17th FSTPT International Symposium, Jember University, 22-24 August 2014

Tamin, Ofyar z, 2000. *Perencanaan dan Pemodelan Transportasi*, Edisi kedua, Jurusan Teknil Sipil, Institut Teknologi Bandung.

Undang-undang Republik Indonesia Nomor 38 Tahun 2004, Tentang Jalan