TRAFFIC IMPACT ANALYSISON THE DEVELOPMENT OF JEMBER ICON USING PTV VISTRO

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Abstract

Jember Icon development will cause trip generation on the road network around it to predict trip generation, developer use Siloam Hospital and the City of Tomorrow Surabaya. Traffic characteristics of Jember different with Surabaya, so to predict trip generation of this study uses comparative buildings in Jember. Review study was conducted to determine the impact of Jember Icon and get the best alternative if there is an impact. The method in this study is observation to obtain data generation and traffic impact analysis is done with PTV Vistro software. Analysis of existing condition shows the road network performance has bad conditon, so the servant level decreases when it gets a load generation of Jember Icon. Argopuro intersection would be the one of intersections with the worst conditions. Handling should be done by re-setting the phase intersection approach of Jl. HayamWuruk, Jl. Gajah Mada, Jl. Argopuro and Jl. Imam Bonjol to 35 seconds, 36 seconds, 19 seconds and 19 seconds respectively.

***Keywords**: traffic impact analysis, trip generation, PTV Vistro, optimation,*

Abstrak

Pengembangan Jember Icon mengakibatkan bangkitan perjalanan pada jaringan jalan di sekitarnya. Untuk memprediksikan bangkitan, pengembang menggunakan Siloam Hospital dan City of Tomorrow Surabaya. Karakteristik lalu lintas Jember berbeda dengan Surabaya sehingga untuk memprediksikan bangkitan perjalanan dalam studi ini menggunakan bangunan pembanding di Jember. Penelitian ini dilakukan untuk mengetahui dampak pembangunan Jember Icon dan mengetahui alternatif terbaik jika timbul dampak. Metode pada penelitian ini yaitu observasi untuk mendapatkan data bangkitan dan analisa dampak lalu lintas dilakukan menggunakan software PTV Vistro. Analisis kondisi eksisting menunjukkan kinerja jaringan jalan sekitar lokasi pengembangan dalam kondisi buruk, sehingga kinerjanya semakin menurun ketika mendapat beban bangkitan Jember Icon. Simpang Argopuro merupakan salah satu simpang dengan kondisi terburuk. Penanganan dilakukan dengan mengatur ulang fase pendekat simpang Jl. Hayam Wuruk, Jl. Gajah Mada, Jl. Argopuro, dan Jl. Imam Bonjol menjadi 35 detik, 36 detik, 19 detik, dan 19 detik.

***Kata kunci:** analisa dampak lalu lintas, bangkitan, PTV Vistro, optimasi*

INTRODUCTION

The development of center activity in certain scale under the law No. 22/2009 Article 99 paragraph (1), PP 32/2011 Article 47 and the Prime Minister of Transportation No. 75/2015 Article 2 is required to perform traffic impact analysis. Jember Icon is an integrated building which is now being built in Jember. The building consists of several building with many different functions, they are: mall, hospital, an international standard school and a hotel. The development of Jember Icon would cause a trip generation that will increase the load of traffic on the road network in its vicinity. The analysis which has done by the developer mentioned Argopuro intersection, Melati intersection, and Tjokroaminoto intersection are intersections that will be more likely affected by the traffic impact. In the

document of the traffic impact analysis, developers use Siloam Hospital and the City of Tomorrow Surabaya to predict trip generation of Jember Icon. Jember and Surabaya as a city certainly have different in its characteristics, population and traffic conditions. The calculation analyzes traffic performance using MKJI.

This study purposes to secermine the impact of the development of Jember Icon on its surrounding road network and secermine the best alternative way if the traffic problems caused by the development of Jember Icon occurred. The prediction of trip generation in this study uses a comparative building in Jember. The traffic impact analysis included in this study is using PTV Vistro. According to Rifai, et al. (2014), the results of the analysis using PTV Vistro shows that the result was more likely close to the calculation of MKJI 1997. While Sauri, et al. (2014) stated that the results of the observation conducted by PTV Vistro and KAJI on the intersection shows the same pattern, but the results of the analysis conducted by PTV Vistro was smaller compared to the r esult of observation conducted by KAJI. PTV Vistro was using HCM method (2010 and 2000) as a basis calculation (PTV Group, 2013), in addition the use of PTV Vistro aims to speed up the analysis process and to avoid human error.

METHODS

Stages Research

The research objected to Jember Icon located in Jember Regency. Intersections which are estimated to be affected including: Argopuro intersection (signalized), Melati intersection (not signalized), and Tjokroaminoto intersection (not signalized). Stages in the study are listed bellow:

1. The data collection including the secondary data, it is a documents analysis of Jember Icon's traffic impact, while the primary data includes: survey data result of trip generation on comparison object they are is SMAK St. Paul, SMAKSatyaCendika, Kaliwateshousepital, Jember Clinic, Hotel Royal, Hotel Aston, Johar Plaza, and the Golden Market.
2. Data analysis. Secondary data and primary data were analyzed using the PTV Vistro. The analysis performance of road network was carried out the development of the road network before Jember Icon does exist and development of road network performance analysis that after the operation of Jember Icon. In the process of analysis includes the analysis of trip generation, traffic distribution analysis, and analysis of traffic loading using PTV Vistro.
3. Developing scenarios or modeling in case of impact on the performance of the road network as a result of the construction of Jember Icon.
4. Draw conclusions from the results of simulations of traffic impact analysis.

Area Development Plans and Affected Intersection

Jember Icon will be built on a wide range of area around 12 165 m2. This building is multifunctional buildings with 17 floors consist of shopping malls, hospitals, hotels and international schools inside. In the document of the traffic impact analysis, prepared by the developer of Jember Icon mentioned that the impact of the construction of this building

will affect the performance of the network traffic in the surrounding streets, namely: Argopuro is signalized intersection, for unsignalized intersection is Cokroaminoto intersection, and Melati intersection.

RESULTS AND DISCUSSION

Assuming Traffic Growth

Based on the development of Jember Sport Garden traffic impact analysis document mentioned that the growth of traffic rate in Jember is around 6.28% (PU Department of Human Settlements, 2012). The exact number of transportation growth obtained from Department of Jember District Transportation, were resulted: the amount of motorcycles (MC) up to 10.44%, passenger car (LV) 3.09% and heavy vehicles (HV) 3.25%. Input data of the transportation growth is the total amount of the transportation growth. Based on those secondary data, it obtained that the total amount of vehicle growth rate is up to 7% per year.

Existing Traffic Conditions

The volume of traffic intersections obtained from the survey on intersection's turning movement result. Traffic volume used in the analysis is the volume of the existing condition in the climax state of morning hours, top of noon hours, top of afternoon hours and evening peak hours on weekdays and holidays. The volume of existing traffic conditions are shown in Table 1 and Table 2 bellow.

Table 1. Existing Traffic Volume on Weekday (pcu/hour)

Intersection and Intersection Approach	Peak Hours											
	Morning			Afternoon			Evening			Night		
	LV	HV	MC	LV	HV	MC	LV	HV	MC	LV	HV	MC
Argopuro Intersection												
Hym.Wuruk St.	680	7	1156	831	23	673	838	33	568	732	7	597
Argopuro St.	40	0	9	36	9	13	25	1	80	26	0	9
Gajah Mada St.	656	0	713	903	16	649	984	12	523	934	0	506
Imam Bonjol St.	99	22	195	128	59	98	118	26	169	89	13	101
Melati Intersection												
Melati St	45	0	193	101	3	188	69	5	93	69	5	93
Gajah Mada St	635	0	1089	903	7	715	804	583	3	734	3	583
Cokroaminoto Intersection												
Gajah Mada St	637	0	935	738	8	879	802	8	572	794	9	563
Cokroaminoto St	1007	8	1072	1099	17	1776	1725	13	1309	1575	12	617

Tablel 2. Existing Traffic Volume on Holiday (pcu/hour)

Intersection and IntersectionApproach	Peak Hours											
	Morning			Afternoon			Evening			Night		
	LV	HV	MV	LV	HV	MV	LV	HV	MV	LV	HV	MV
Argopuro Intersection												
Hym.Wuruk St	445	17	543	865	10	476	713	10	584	826	4	469
Argopuro St	16	0	24	23	0	7	30	1	11	26	0	4
Gajah Mada St	515	14	420	908	16	443	717	10	454	804	14	424
Imam Bonjol St	81	3	104	170	0	93	90	7	91	83	4	65
Melati Intersection												
Melati St	36	0	98	96	1	116	64	7	89	55	120	0
Gajah Mada St	529	5	431	967	8	476	776	23	491	859	13	488
Cokroaminoto Intersection												
Gajah Mada St	280	0	453	1017	8	502	802	9	499	833	5	494
Cokroaminoto St	103	0	122	1006	21	652	966	3	677	416	3	899

Existing traffic volume in table 1 and table 2 is the volume of traffic intersections in 2013. According to the table it shows the volume load on CokroaminotoStreet and Gajah MadaStreetare big enough. Although the traffic volume is quite large, geometricaly and the settings on this approachment is quite helpful. The traffic arrangement of Cokroaminoto street using three lanes in one direction, while on Gajah Mada street using two-way six - lane separated by median. The analysis of load traffic not without including the development in this study carried out in 2015. Since, in the end of 2015 is estimated that Jember Icon will begin its operation. So that, the existing volume of traffic load will be projected to the volume in the year of 2015.

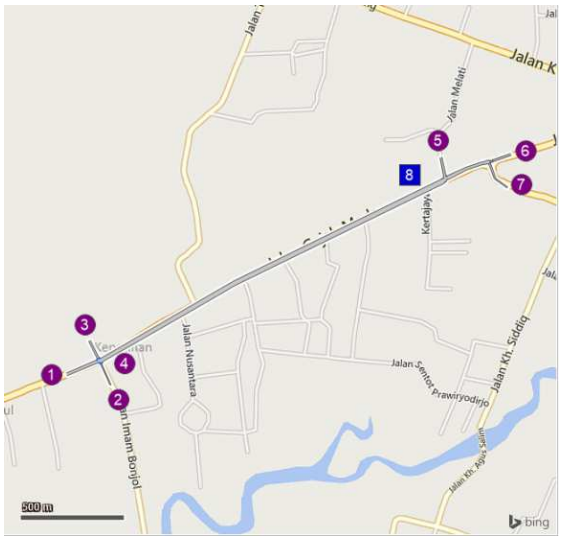
Constructing Modeling using PVT Vistro

Input Data

The data are prepared to do modeling using PTV Vistro as basic input is the data volume of the vehicle, intersection geometric data, transportation growth data, the data of trip generation, distribution of data traffic, and the data phase for the signalized intersection. These data are needed to be able to do modeling at a later stage.

Buiding Road Network

The first step in modeling using PTV Vistro is to make the road network on the map location which has been provided in Vistro PTV (PTV Group, 2013). To secermine the map locations developer may use the base map provided by Bing Map. The next stage is to secermine the intersection points which are going to be analyzed. Building a road network is done by linking intersection's one another approach.



Building Road Network on PTV Vistro

PTV Vistro Input Data

Picture 1.*Interface* PTV Vistro

Preliminary Scenario

This phase is done by performing initial settings on each intersection which will be analyzed. The conducted setting was including the intersection of geometric data,type of intersection, and phase settings. Furthermore, after the setting has already completed, it continues by entering the basic volume, which is in this study is known as the basis volume of traffic volume in 2015.

Trip Generation

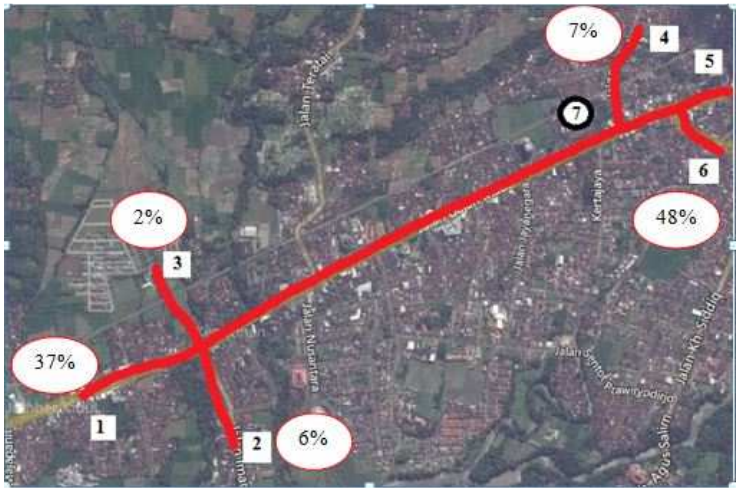
Estimated trip generation of Jember Icon obtained from the analysis of object comparison generation data in Jember. In the document shows that the traffic impact analysis conducted by the developer of Jember Icon, mentioned traffic generation for peak hours in the morning, afternoon, evening, and night is equal, ie 445.85 pcu/hour.The results obtained from traffic generation analysis based objects comparison in Jember are onweekday morning peak hours at 196 pcu/hour, day by 220 pcu/hour, an afternoon at 199 pcu/hour, and night by 292 pcu/hour. While on the holidays earned 47 pcu/hour for morning peak hours, noon at 305 pcu/hour, an afternoon at 216 pcu/hour, and 326 pcu/hour for the evening peak hours.The result analysis of Jember Icon's traffic generation is due to every different peak hour. It is occurred because Jember Icon consists of a multifunctional activity center, so it will produce different large traffic generation for each hour peak.

Trip Distribution

Trip distribution is used to secermine the distribution of travel on each generation on presecermined zone (Tamin, 2000). Travel distribution were analyzed using the data from intersection turning movement volume which subsequently obtained OD matrices for subsequent use in secermining the value of the travel distribution and towards the generation zone.

Trip Assigment

Trip Assigment due to traffic generation of Jember Icon was done gradually, because every building function inside JemberIcon does not operate simultaneously. Loading assumptions in 2016 caused by the rise of traffic activity mall and an international school, 2017 added traffic generation on hospital activities. For the year of 2018 and 2020 will be carried out thetraffic loading due to traffic generation in all building functions existing in Jember Icon. The estimated generation produced by each zone is shown in Figure 2 below.



Picture 2. Trip generation percentage from every zone

Existing Conditions Analysis

Analysis of the initial conditions is done before Jember Icon do not yet open its operation. On this analysis there is no additional traffic load due to the operation of Jember Icon. The result analysis of the initial conditions conducted in 2015 as shown in Table 3.

Table 3. Intersection performances in the year of 2015

Intersection	Peak Hour							
	Morning		Afternoon		Evening		Night	
	D (sec/pcu)	DS	D (sec/pcu)	DS	D (sec/pcu)	DS	D (sec/pcu)	DS
Weekday								
ArgopuroIntersection	141	1,00	125	0,98	135	1,00	116	0,93
Melati Intersection	9	0,95	9	0,94	7	0,86	7	0,83
Cokroaminoto Intersection	14	0,75	82	1,13	93	1,16	17	0,81
Holidays								
ArgopuroIntersection	41	0,65	94	0,86	59	0,77	52	0,73
Melati Intersection	6	0,78	9	0,89	9	0,82	9	0,80
CokroaminotoIntersection	8	0,08	13	0,69	9	0,40	9	0,38

Results of analysis on a weekday show that the performance of intersections in bad condition, especially at Argopuro intersections. The worst delays occurred in the morning with a delay up to 141 sec/pcu and the saturation degree is 1.00. MelatiIntersectionin good condition while the intersection ofCokroaminoto have large delays with the value

93sec/pcu and the saturation degree is up to 1.16 in the afternoon. The analysis intersection performance using PTV Vistro on holidays showed better performance than on weekdays. The Argopuro intersection has the largest delay value, it is 94 sec/pcu and the degree of saturation is 0.86. Melati intersection, Cokroaminoto intersection is in good state because of the delay and the degrees of saturation tend to be small.

Future Conditions Analysis

The analysis of future conditions was done in two stages, first without development and second includes development. Analysis without the development is an analysis carried out without taking into account to the development of Jember Icon. It is only calculate vehicles growth factors per year in its analysis. While in the contrary, analysis including thedevelopment takes into account to the analysis carried out by the trip generation of Jember Icon and vehicles growth factors. Imposition of traffic with development was done gradually, since the operation of any building function in Jember Icon are not performed simultaneously. The assuming analysis on traffic modeling assumptions is alike to the previous discussions.

Analysis of peak hours in the morning with the development, the biggest traffic load generation caused by the school. While the hotel and hospital traffic generation is also occured, but not too big. Total estimated peak hour traffic generation on weekday morning is up to 196 pcu/hour and on holidays only 47 pcu/hour, because on holidays there is no resurrection of the traffic generated by the school. The analysis resulted of the intersection performance(traffic delay intersection) with and without the load of development on the morning peak hours shown in Table 4.

Tabel 4. Intersection Delay Comparison on Morning Peak Hours (sec/pcu)

Intersection Name	2016		2017		2018		2020	
	Eksis-ting	Develop ment	Eksis-ting	Develop ment	Eksis-ting	Develop ment	Eksis-ting	Develop ment
Weekday								
Argopuro intersection	174	186	213	227	253	269	341	359
Melati intersection	9	9	9	9	9	9	9	9
Cokroaminoto intersection	17	18	21	24	30	35	78	82
Holidays								
Argopuro intersection	47	47	55	56	67	70	104	108
Melati intersection	9	9	9	9	9	9	9	9
Cokroaminoto intersection	8	8	8	8	8	8	8	8

Existing condition analysis results showed poor performance with a big delay at each intersection, so there is an increase in the delay size when the load gets developed. Jember Icon development caused the average number of delay in the increase of 5.9% for Argopuro intersection, 3.2% for Melati intersection and 9.8% for Cokroaminoto intersection. On holidays also showed poor performance at Argopuro intersection while at Melati intersection and Cokroaminoto intersection are in pretty good condition. Jember Icon development caused the number of delay in Argopuro intersection increased to 2.0%, 0.55% Melati intersection, and the intersection of Cokroaminoto to 0.33%. The value delay

precentage is small due to the analysis of a holiday morning there is no trip generation due to school activities.

Analysis on the afternoon peak hour, traffic generation total which was generated on weekdays is 220 pcu/hour. The rise of the trip generation value derived from the trip generation caused by malls, hospitals, and hotels where the largest trip generation value derived from the mall activity. While the generation of traffic on holidays reached over 305 pcu/hour and the biggest traffic generation also comes from the mall.Trip generation value on holiday greater than on the weekday. This is due to the holiday where the number of mall visitors is on the incnrase. The results analysis of traffic delay intersection shown in Table 5 below.

Tabel 5. Comparison of Delay Intersection on Afternoon peak hours (sec/pcu)

Intersection name	2016		2017		2018		2020	
	Eksis-ting	Develop ment	Eksis-ting	Develop ment	Eksis-ting	Develop ment	Eksis-ting	Develop Ment
Weekday								
Argopuro Intersection	153.3	165.4	188.2	205.4	225.1	243.5	307.53	328.9
Melati Intersection	9.0	9.2	9.0	9.3	9.0	9.3	9.0	9.4
Cokroaminoto intersection	118.8	130.5	163.8	179.6	211.5	228.4	321.01	341.5
Holiday								
Argopuro Intersection	115.9	133.1	142.4	163.3	171.4	195.4	243.6	269.6
Melati intersection	9.0	9.4	9.0	9.4	9.0	9.5	9.0	9.5
Cokroaminoto intersection	14.5	15.8	17.2	19.5	21.7	25.9	57.5	59.7

Based on Table 5 above, the value of delay grew in the afternoon peak hour. A large number of delay in the existing condition resulting in delays grew larger when the load gets developed. Jember Icon development causing delay in the Argopuro intersection increased to 7.4%, 3.2% Melati intersection, and the intersection of Cokroaminoto 7.8% on weekdays. While on the holiday also showed poor performance at Argopuro intersections and Cokroaminoto intersection was good in the contrary for the existing condition and the load development. Jember Icon cause the number of intersection delay at Argopuro intersection increased to 11.9%, 4.8% Melati intersection and the intersection Cokroaminoto 9.9%.

Trip generation on afternoon peak hour obtained at 199 pcu/hour for weekdays and holidays of up to 216 pcu/hour.The biggest traffic generation value caused by the mall, both for weekdays and holidays. Trip generation caused by the hotel and the hospital also slightly increasing. Afternoon peak hours is time for go back home from work and changing shifts for employees of hotels and hospitals. Results of the analysis of the performance of intersections marked with traffic intersection delay value shown in Table 6.

Tabel 6. Comparison of Delay Intersection on Evening peak hours (sec/pcu)

Intersection Name	2016		2017		2018		2020	
	Eksis-ting	Develop ment	Eksis-ting	Develop ment	Eksis-ting	Develop ment	Eksis-ting	Develop ment
Weekday								
Argopuro intersection	162.8	176.6	197.5	211.0	234.2	249.7	319.6	335.7
Melati intersection	9.0	9.1	9.0	9.2	9.0	9.3	9.0	9.3
Cokroaminoto intersection	130.5	143.7	176.3	189.1	223.4	238.5	331.7	349.2
Holidays								
Argopuro intersection	73.6	81.4	94.1	106.4	118.5	134.7	184.2	200.2
Melati intersection	9.0	9.2	9.0	9.3	9.0	9.3	9.0	9.3
Cokroaminoto intersection	9.3	9.5	9.6	9.9	10.0	10.3	10.7	11.5

The analysis resulted on Table 6 shows the Argopuro intersection and Cokroaminoto intersection have a high number of delay both existing condition or by development. Analysis on a weekday shows that Jember Icon development resulting an increasing value of Argopuro intersection delay up to 6.3%, 2.4% Melati intersection and the Cokroaminoto intersection 6.8%. Results of analysis on holiday also shows that the development of Jember Icon resulted in delays at the intersection Argopuro value increased 10.3%, 2.9% Melati intersection, and the intersection Cokroaminoto 3.8%.

Results of trip generation analysis on the evening peak hour traffic is expected to reach 292 pcu/hour on weekdays and on holidays reached 326 pcu/hour.The biggest traffic generation at night affected by mall's activity both for weekdays and on holidays. Intersection performance (traffic delay intersection) in the evening peak hours are shown in Table 7.

According to Table 7, it shows poor performance in the existing condition occurs at the Argopuro intersection and Cokroaminoto intersection where the traffic delay intersection is huge. Jember Icon development resulted the number of delay at Argopuro intersection growing up at 8.6%, 3.7% Melati intersection, and Cokroaminoto intersection at 17% on weekdays. While on holiday, traffic delays intersection are just the worst at some point especially at Argopuro intersection with high delay values in the existing condition and the development. Jember Icon development resulted the increasing number of delay on Argopuro intersection at 15.1%, 4.7% Melati intersection, and Cokroaminoto intersection 5.2%. The increasing value of delay resulted in the intersection of performance has declined.

Tabel 7. Comparison of Delay Intersection on Night peak hours (sec/pcu)

Intersection Name	2016		2017		2018		2020	
	Eksis-ting	Develop ment	Eksis-ting	Develop ment	Eksis-ting	Develop ment	Eksis-ting	Develop ment
Weekdays								
Argopuro intersection	139.6	150.5	169.6	190.3	201.6	225.0	287.3	305.8
Melati intersection	9.0	9.2	90	9.4	9.0	9.4	9.0	9.4
Cokroaminoto intersection	21.6	24.3	31.0	40.0	48.2	62.9	116.8	131.9
Holiday								

Intersection Name	2016		2017		2018		2020	
	Eksis-ting	Develop ment	Eksis-ting	Develop ment	Eksis-ting	Develop ment	Eksis-ting	Develop ment
Argopuro intersection	63.2	72.4	80.4	98.3	101.4	123.7	162.4	183.7
Melati intersection	9.0	9.3	9.0	9.5	9.0	9.5	9.0	9.5
Cokroaminoto intersection	9.2	9.4	9.5	9.8	9.8	10.2	10.0	11.3

Traffic Impact Handling (Overcoming)

Traffic management is an effort made to overcome the impacts that occur on the road network in the review of these studies. Results of the intersection performance analysis with the benchmark intersection delay value shows that Argopuro intersection delay value occurred at> 60 sec/pcu. In HCM (2010) mentioned if intersection delay value at> 60 sec /pcu it can be said that the intersection service levels in LoS F.

The increasing of intersection capacity by widening the outside closer intersection is not possible to do. The use of right and left side land of the intersection is pretty solid, so widening the mouth of the closer is not possible to do. Handling every impact which is possible to be performed only to optimaze the intersection signal phase. Traffic management is done by resetting the green light on each intersection leg of HayamWuruk street by 35 seconds, Gajah Mada street by 36 seconds, Imam Bonjol street and Argopuro street by 19 (the same phase). With the traffic management optimization of signal intersections obtained an average value of delay in 2016, 2017, 2018, and 2020 decreased 26.27% and the degree of saturation is 14.7%.

Table 8. Intersection Delay with traffic management signal pahse optimization

Intersection Name	2016		2017		2018		2020	
	D (sec/pcu)	DS	D (sec/pcu)	DS	D (sec/pcu)	DS	D (sec/pcu)	DS
Weekday								
Morning Peak Hour	145	1.10	169	1.18	220	1.27	301	1.45
Afternoon Peak Hour	126	1.08	161	1.16	195	1.24	272	1.42
Evening Peak Hour	128	1.09	137	1.12	197	1.27	275	1.46
Night Peak Hour	58	0.81	160	1.18	170	1.20	243	1.37
Holiday								
Morning Peak Hour	38	0.69	42	0.75	52	0.80	80	0.92
Afternoon Peak Hour	100	0.98	120	1.05	153	1.12	220	1.27
Evening Peak Hour	62	0.85	81	0.92	105	0.99	161	1.13
Night Peak Hour	58	0.81	79	0.89	100	0.95	154	1.08

CLOSING

Conclusion

The results of traffic impact analysis using PTV Vistro with trip generation comparator in the development of Jember Icon in Jember Regency shows:

1. Intersection performance before its development has already in poor condition, especially Argopuro intersection

2. Jember Icon Development will cause trip generation on weekday reached 907 pcu/hour and 893 pcu/hour on holiday.
3. Delays value on the intersection at the affected road network on average increased by 6.4% after the development of Jember Icon.
4. For anticipation, there should be a rearrangement at Argopuro intersection by resetting the traffic green light at HayamWurukstreet by 35 seconds, Gajah Mada street by 36 seconds, Imam Bonjol street by 19 seconds and Argopuro street by 19 seconds. With the delay value of traffic management is in the dropped average 26.27% and the degree of saturation is 14.7%.

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BIBLIOGRAPHY

Dinas PU CiptaKarya.2012. *DokumenAnalisisDampakLaluLintas Pembangunan Jember Sport Garden*.Jember: DinasPekerjaanUmumCiptaKaryaKab. Jember.

National Academy of Sciences. 2000. *Highway Capacity Manual*. United States of Amerika: Library of Congress Cataloging.

PTV Group. 2013. *PTV Vistro User Manual*. Karlsruhe Jerman: PTV AG.

Rifai, A., Sulistyono, S. danSoetjipto, J.W.. 2014. SimulasiAnalisisDampakLaluLintasMenggunakan PTV Vistro(StudiKasus : KomplekRuko Berjaya Batam), *Prosiding FSTPT, SimposiumInternasional FSTPT ke-17 di UniversitasJember, 24 Agustus 2014, Volume 2 Nomor 1, ISSN: 2356-0509*. Jember: FSTPT Indonesia danJurusanTeknikSipilUnivrsitasJember. Hal.1508-1518.

Sauri, S., Sulistyono, S. danHasanuddin, A.. 2014. AnalisisKinerjaSimpangMenggunakanPerangkatLunak KAJI dan PTV Vistro(StudiKasus: SimpangBersinyaldanTakBersinyalPerkotaanJember), *Prosiding FSTPT, SimposiumInternasional FSTPT ke-17 di UniversitasJember, 24 Agustus 2014, Volume 2 Nomor 1, ISSN: 2356-0509*. Jember: FSTPT Indonesia danJurusanTeknikSipilUnivrsitasJember. Hal.1498-1507.

Tamin, O. Z. 2000.*PerencanaandanPemodelanTransportasi*.EdisiKedua.Bandung: Penerbit ITB.