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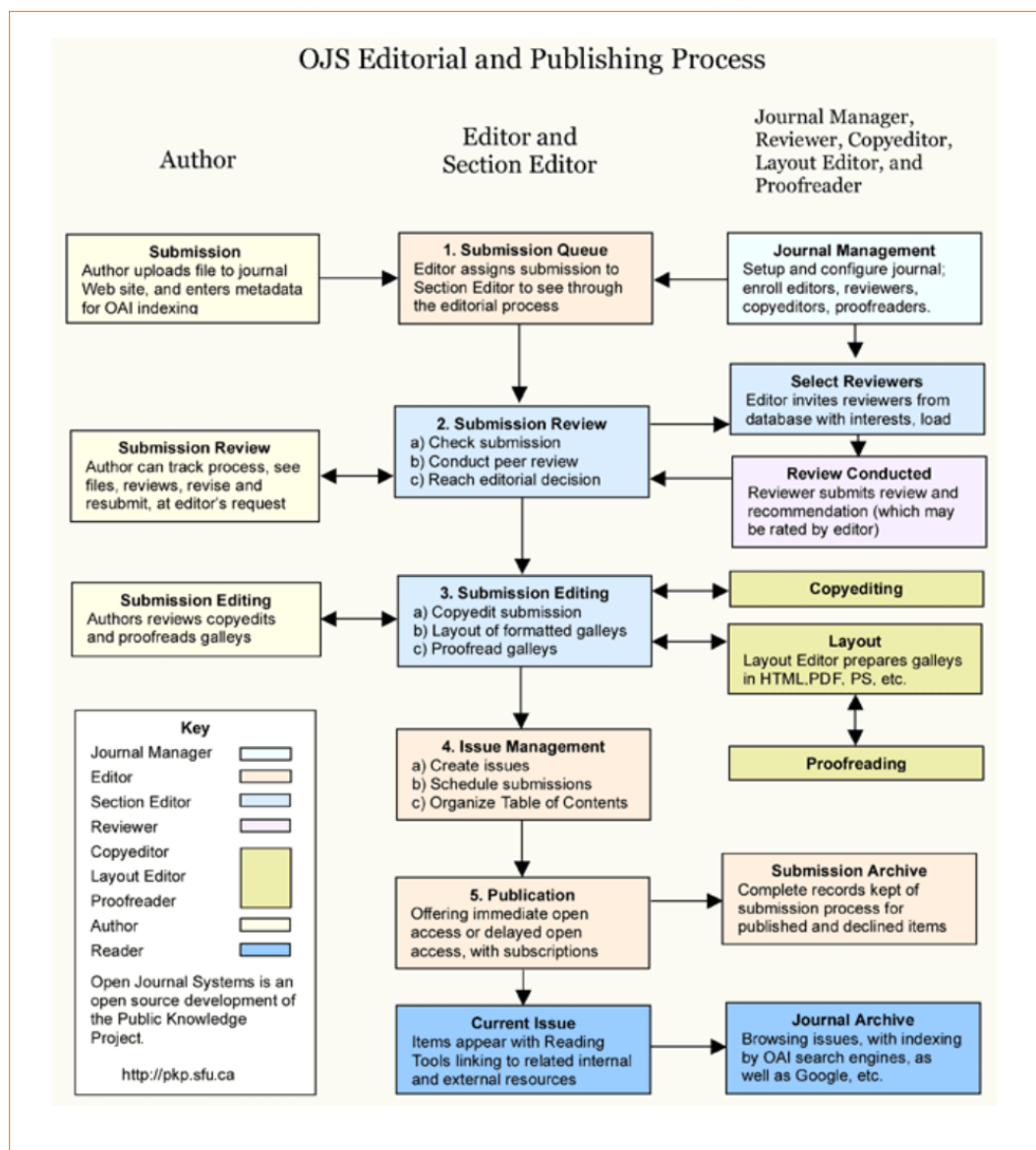
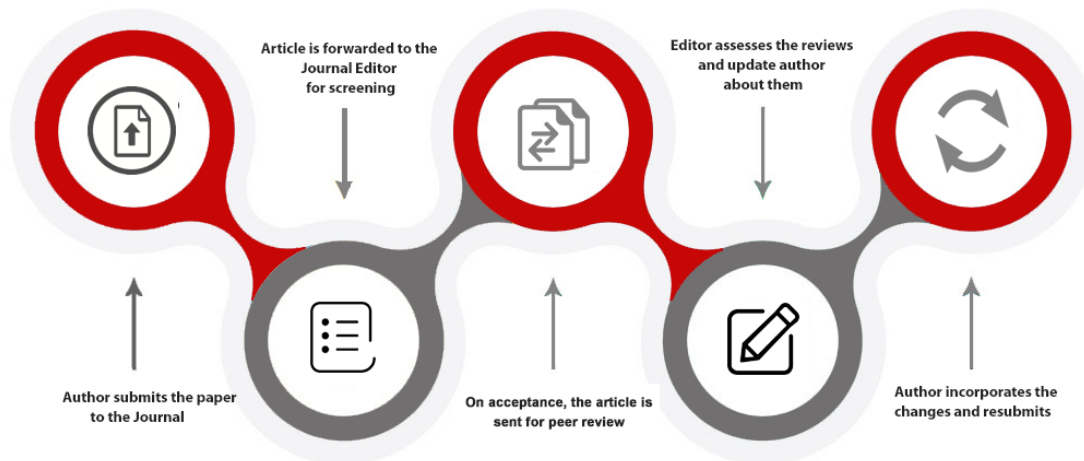
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Table of Content

Analysis of Accident-Prone Areas in Bekasi City

Fikri Ramdani, Widodo Budi Dermawan, Muhammad Isradi, Amar Mufhidin, Joewono Prasetyo
315-324

The Tourism Awareness Education in Supporting The Tourism Development of Muaro Jambi Temple

A D Nugroho
325-330

Leadership Function in Employee Placement Process at PT. Duta Mandiri Palembang

Ahmad Yani Kosali
331-335

Calculation and Mapping of Water Demand Balance in Pacal Bojonegoro Irrigation Area

Agung Setya Budi
336-341

Crashing Analysis on the Construction of The First Its Tower Building Using Time Cost Trade Off Method

Lindah Sri Aminingtiyas, Koespiadi, F Rooslan Edy Santosa
342-348

Analysis of Drainage System Planning in Newtown Park Housing Development Sidoarjo District

Moh Rizqy Hidayanto, F Rooslan Edy Santosa, Ronny Durrotun Nasihien
349-356

Analysis of Boezem Kalidami Pump Capacity To Cope With Floods East Surabaya Region

R. Dandy Jurindra Pratama, Adi Prawito, Farida Hardaningrum
357-365

Analysis of Flood Control Plan in Cibitung Kertagraha Housing, Bekasi District

Acep Hidayat, Siti Nur Azizah
366-378

Analysis of the Causes of Waste with the Lean Construction Method on the 1700 Units Apartment Algeria Project

Novika Candra Fertilia, Dian Andaka
379-395

Legal Aspects Of Electronic Signatures In E- Commerce Transactions

Enny Agustina, Muhamad Adystia Sunggara
396-400

Analysis of Accident-Prone Areas in Bekasi City

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Abstract

The most highlighted transportation problem at this time is traffic safety. In Bekasi City, traffic accidents often occur, ranging from minor accidents, serious accidents to accidents that cause casualties due to various factors. The objectives of this study are: To determine the characteristics of accident-prone areas, the factors causing accidents and to analyze the locations where accidents often occur in those areas. The location of this research was conducted on Jalan Raya Narogong Bekasi City. The data used in this study are primary data and secondary data. The primary data used includes the volume of passing vehicles, vehicle speed, is the road geometry, namely the absence of road markings, road capacity, land use and traffic signs. The author divides 10 segments on this road based on coordinate points. The coordinate point with the highest AEK and EPDO values is at the coordinate point -6.280222 to -6.28175 with AEK 103 and EPDO also 103 which caused 8 deaths, 0 serious injuries, 0 minor injuries and with material loss of Rp. 5,000,000. The most types of accidents are front - front with 17 victims, the number of accident victims and material losses is obtained from IRSMS data provided by Bekasi City traffic officers.

Keywords:

Accident, AEK, Characteristics, EPDO

1. Introduction

Transportation is a very important part of life, especially transportation by vehicle, both for human needs and for the transportation of goods. The population in Bekasi City has increased every year, thus of course the need for transportation facilities will also increase every year due to travel or transportation activities that increase along with population growth. In line with this, the number of vehicles will increase rapidly. This will require an increase in the quality of transportation facilities and infrastructure and a growth in the number of vehicles per day (Andri et al., 2016).

One of the most highlighted transportation problems is regarding traffic safety. In Bekasi City, traffic accidents often occur, ranging from minor accidents to accidents that cause casualties caused by various factors, such as human factors, road factors, environmental conditions and vehicle factors. Human factor is the most dominant factor in accidents. Almost all accidents are preceded by violation of traffic signs. Violations can occur due to deliberately violating, ignorance of the meaning of the applicable rules or not seeing the provisions that are applied or pretending not to know. In addition, humans as road users are often negligent and even reckless in driving a vehicle (Muhammad Fakhuriza Pradana et al., 2019).

To overcome this, it is necessary to conduct a study of the analysis of accident-prone areas that often occur in Bekasi City. Referring to several previous studies that analyzed traffic accidents in several other areas which can produce things that are used as evaluation materials in reducing the accident rate, such as what has been done by the government, by the police or the transportation agency that studied this matter. With the hope that this examination can be carried out analysis and identification of the things that cause the accidents that occur, which in the end can be found the right solution and carried out according to the study of the traffic accident problems that occurred. (Ramadhon & Arliansyah, 2019).

2. Methodology

This discussion will explain the methods or work steps of research on the Analysis of Accident-Prone Areas in Bekasi City. The objective of this research method is to determine the characteristics of accident-prone areas, their causative factors and to analyze the locations where accidents often occur. The method used in this research is to use primary data and secondary data.

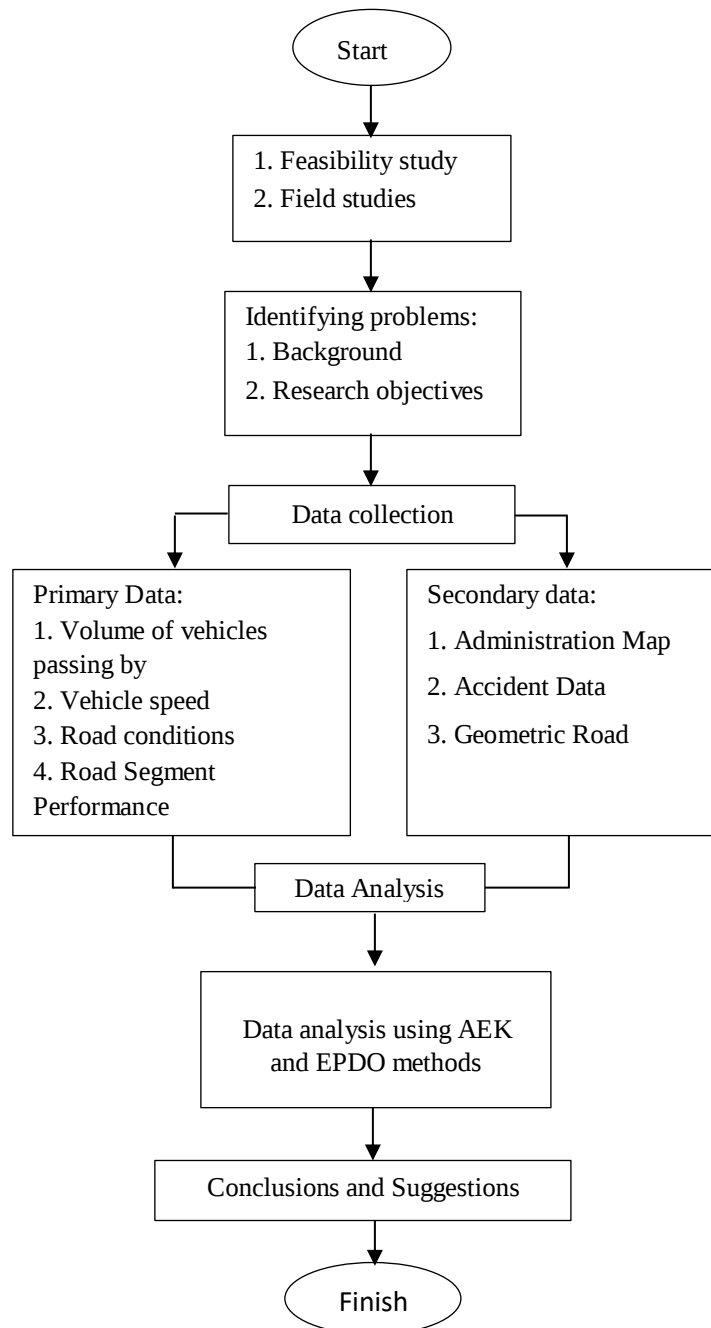


Figure 1. Research Flow Framework

The research was conducted in Bekasi City, namely on Jalan Raya Naragong. The first step the writer took was collecting secondary data, namely accident data in Laka Lantas, Bekasi City. The data that will be used are data for 3 years, namely 2016, 2017 and 2018. After obtaining the data, the data will then begin to be grouped according to research needs, based on location, time, types of victims and accident losses. Of all the roads in Bekasi City, the writer chose to take Jalan Raya Naragong because it has the highest number of accident victims.

The next data is road condition data, namely primary data. In this study, there is 1 road segment which will later be divided into 10 segments which are divided based on the level of coordinates. The data of the road conditions that will be taken are road geometric, traffic volume data and traffic signs conditions at the research location.

3. Result and Discussion

3.1 Characteristics of Accident-Prone Areas

The characteristics of traffic accident-prone areas at this black spot or black spot are influenced by the large number of accidents involving humans with vehicles, besides that it is also seen from road conditions, road

slope, vehicle volume, road capacity, and road geometry which includes road width, length, roads and road medians. From these data, it is used as an illustration of the tendency of accidents that occur on Jalan Raya Narogong.

3.2 Accident Type Data

Data on the number of accidents will focus on the death toll that often occurs on Naragong Highway.

Table 1. Accident Types of Death Victims

Accident Type	Year			amount
	2016	2017	2018	
Single	2	3	0	5
Front - Front	3	6	1	10
Front back	9	5	3	17
Front - Side	3	0	0	3
Sides- side	0	1	0	1
Hit Humans	4	3	1	8
amount	21	18	5	44

Source: IRSMS data

Table 2. Number of Deaths and Losses

Year	MD	Total Events	Amount of Material Loss
2016	21	21	IDR 23,000,000
2017	18	18	IDR 7,700,000
2018	5	5	IDR 3,000,000
Amount	44	44	IDR 33,700,000

Source: IRSMS data

3.3 Segment Division Data

The coordinate segment on Jalan Raya Narogong extends from the coordinate point -6,368.858 to -6,360.083. The segment will be divided into 10 to be included in the AEK and EPDO calculation methods.

Table 3. Segment Division

No.	Segment		GPS coordinates - Latitude	GPS Coordinates - Longitude	Accident Rate	M D	L B	L R	Total	Material Loss
m1	-6.27766	-6.27957	-6.277664	107.006217	1	1	0	0	1	500000
			-6.278183	106.991708	1	1	0	0	1	5000000
			-6.278567	106.991483	1	1	0	0	1	1000000
			-6.279136	106.99125	1	1	0	0	1	500000
			-6.279572	106.991042	1	1	0	0	1	1500000
			amount			5	0	0	5	8500000
			-6.280222	106.99075	1	1	0	0	1	1000000
2	-6.28022	-6.28175	-6.280447	106.990656	1	1	0	0	1	1000000
			-6.280706	106.990533	1	1	0	0	1	1000000

			-	6,280783	106,990497	1	1	0	0	1	0
			-	6,281369	106,990236	1	1	0	0	1	500000
			-	6,281869	106,990164	1	1	0	0	1	500000
			-	6,281706	106,990089	1	1	0	0	1	500000
			-6,28175	106,990067	1	1	0	0	1	500000	
			amount				8	0	0	8	5000000
			-	6,283819	106,989075	1	1	0	0	1	200000
3	-6,28382	-	6,28382	6,283819	106,989075	1	1	0	0	1	300000
			amount				2	0	0	2	500000
			-	6,284203	106,988597	1	1	0	0	1	3000000
			-	6,284492	106,988497	1	1	0	0	1	500000
4	-6,2842	-6,2846		-6,2846	106,988406	1	1	0	0	1	500000
			amount				3	0	0	3	4000000
			-	6,315728	106,987142	1	1	0	0	1	500000
			-	6,286303	106,987069	1	1	0	0	1	500000
			-	6,287339	106,986286	1	1	0	0	1	500000
5	-6,31573	-	6,31765	6,317394	106,986075	1	1	0	1	2	200000
			-6,31765	106,986025	1	1	0	0	1	1000000	
			amount				5	0	1	6	2700000
			-	6,319828	106,985386	1	1	0	0	1	500000
			-	6,289408	106,985181	1	1	0	0	1	500000
6	-6,31983	-	6,31107	6,311067	106,985144	1	1	0	0	1	1000000
			amount				3	0		3	2000000
			-	6,298117	106,984669	1	1	0	0	1	1000000
			-	6,322447	106,984556	1	1	0	0	1	1000000
			-	6,298744	106,984528	1	2	0	0	2	500000
7	-6,29812	-	6,30942	6,322908	106,984406	1	1	0	0	1	500000
			-	6,309422	106,9842	1	1	0	0	1	500000
			amount				6	0	0	6	3500000
8	-6,32469	-	6,30763	6,324689	106,983789	1	1	0	0	1	200000

			-	6,307156	106.983669	1	1	0	0	1	500000
			-	6,308122	106.983586	1	1	0	0	1	1000000
			-	6,302008	106.983517	1	1	0	0	1	500000
			-	6,307633	106.983347	1	1	0	0	1	500000
			amount				5	0	0	5	2700000
			-	6,328578	106.981464	1	1	0	0	1	500000
			-	6,342469	106.978667	1	1	0	0	1	500000
9	-6.32858	-6.3454	-	6,342258	106.978639	1	1	0	0	1	1500000
			-	6,345403	106.978169	1	1	0	0	1	500000
			amount				4	0	0	4	3000000
			-	6,348056	106.977472	1	1	0	0	1	500000
			-	6,350161	106.976878	1	1	0	0	1	1000000
10	-6.34806	6.36008	-	6,360083	106.976586	1	1	0	0	1	300000
			amount				3	0	0	3	1800000

Source: IRSMS data

3.4 Accident Equivalent Rate Analysis (AEK)

Accident Equivalent Rate (AEK) is calculated by the formula of adding up the incidence of accidents in one kilometer or one segment of road length then with the weight value according to the severity. Below is the calculation of the Accident Equivalent Value (AEK) value on the Narogong Highway (Segment 1):

$$AEK = 12MD + 3LB + 3LR + 1K$$

$$AEK = 12 (5) + 3 (0) + 3 (0) + 1 (5)$$

$$AEK = 65$$

$$AEK \text{ average (C)} = 65/10$$

$$= 6.5$$

Table 5. Calculation of the Accident Rate using the AEK method

Segment	Coordinate		Victim				AEK value				Total AEK	C (Average)
			MD	L B	L R	K	MD * 12	LB * 3	LR * 3	K * 1		
1	6.277664	6.279572	5	0	0	5	60	0	0	5	65	6.5
2	6.280222	-6.28175	8	0	0	7	96	0	0	7	103	10.3
3	6.283819	6.283819	2	0	0	2	24	0	0	2	26	2,6
4	6.284203	-6,2846	3	0	0	3	36	0	0	3	39	3,9
5	6.315728	-6.31765	5	0	1	5	60	0	3	5	68	6.8
6	6.319828	6.311067	3	0	3	3	36	0	9	3	48	4,8
7	6,298117	6.309422	6	0	0	5	72	0	0	5	77	7,7
8	6.324689	6.307633	5	0	0	5	60	0	0	5	65	6.5
9	6.328578	6.345403	4	0	0	4	48	0	0	4	52	5,2
10	6.348056	6.360083	3	0	0	3	36	0	0	3	39	3,9

Source: IRSMS data

3.5 Analysis of Equivalent Property Damage Only (EPDO)

To determine accident-prone areas, you can use Equivalent Property Damage Only (EPDO) by knowing the weight of the accident rate with the ratio of death times 12, serious injuries multiplied by 6, minor injuries multiplied by 3 and material losses multiplied by 1. Below is the calculation of the Equivalent value. Property Damage Only (EPDO) from Jalan Raya Narogong (segment 1):

$$EPDO = 12M + 6B + 3R + 1K$$

$$EPDO = 12 (5) + 6 (0) + 3 (0) + 1 (5)$$

$$EPDO = 65$$

Table 6. The calculation of the Accident Rate uses the EPDO method

Segment	Coordinate		Victim				EPDO value				Total EPDO	Rating
			MD	LB	LR	K	M * 12	B * 6	R * 3	K * 1		
1	-6.277664	6.279572	5	0	0	5	60	0	0	5	65	4
2	-6,280222	-6.28175	8	0	0	7	96	0	0	7	103	1
3	-6.283819	6.283819	2	0	0	2	24	0	0	2	26	8
4	-6,284203	-6,2846	3	0	0	3	36	0	0	3	39	7
5	-6.315728	-6.31765	5	0	1	5	60	0	3	5	68	3
6	-6.319828	6.311067	3	0	3	3	36	0	9	3	48	6
7	-6,298117	6.309422	6	0	0	5	72	0	0	5	77	2
8	-6.324689	-6.307633	5	0	0	5	60	0	0	5	65	4
9	-6.328578	-6.345403	4	0	0	4	48	0	0	4	52	5
10	-6.348056	-6.360083	3	0	0	3	36	0	0	3	39	7

Source: IRSMS data

3.6 Field Survey Data

Based on the results of the field survey for safety indicator data, the authors summarize in table form:

Table 7. Safety Indicator Survey Data

No.	Safety Indicator	Completeness		Information
		There is	Not	
1	Road signs	√		There are road signs but not in some areas The sign is blocked by a tree Red light not working
2	Road markings		√	There are no road markings
3	Safety Fence / Sidewalk		√	There are no safety fences or walkways
4	Road Damage	√		Many roads are potholed and cracked There was no notice of any potholes Bumpy road
5	Street Lighting	√		There was some street lighting but it was blocked by a tree, turning off and starting to dim

Source: Observation Results 2021

3.7 Road Condition and Land Use

Road conditions on Jalan Raya Narogong.

1. Roadway Width : 8 m
2. Side Track Width : 4 m
3. Street Type : 2 Lines / 2 Directions
4. Roadside : There is
5. Drainage : There is
6. Road markings : There is no
7. Traffic signs : There is

Land uses on Jalan Raya Narogong include shops, factories, minimarkets, gas stations (petrol stations). However, this road is dominated by factories, food stalls and tire repair shops for trucks.

3.8 Traffic Volume

The author conducted a survey on Friday, February 5, 2021 in order to see the peak of the highest traffic flow (Morning, Day and Night) in the area. The condition of the field at the time of the survey was drizzling. After knowing the peak traffic flow, the Passenger Car Equivalent (EMP) value is obtained and this road uses the type 2 lane 2 undivided direction (2 / 2UD):

Table 8. Vehicle Volume

Naragong Highway									
Time	Hour	Vehicle			Total	LV	EMP		Total
		LV	HV	MC	Kend / Hour	1	1,2	0.25	EMP / Hour
Morning	07.00 - 07.15	100	43	255	398	100	51.6	63.75	215.35
	07.15 - 07.30	110	31	295	436	110	37.2	73.75	220.95
	07.30 - 07.45	170	75	310	555	170	90	77.5	337.5
	07.45 - 08.00	187	60	396	643	187	72	99	358
	Total	567	209	1256	2032	567	250.8	314	1131.8
Noon	13.30 - 13.45	70	75	265	410	70	90	66.25	226.25
	13.45 - 14.00	80	90	200	370	80	108	50	238
	14.00 - 14.15	105	46	190	341	105	55.2	47.5	207.7
	14.15 - 14.30	95	64	325	484	95	76.8	81.25	253.05
	Total	350	275	980	1605	350	330	245	925
Night	21.00 - 21.15	125	94	319	538	125	112.8	79.75	317.55
	21.15 - 21.30	110	85	280	475	110	102	70	282
	21.30 - 21.45	98	68	205	371	98	81.6	51.25	230.85
	21.45 - 22.00	95	49	225	369	95	58.8	56.25	210.05
	Total	428	296	1029	1753	428	355.2	257.25	1040.45

Source: Analysis Results 2021

From the traffic volume table on Friday, February 5, 2021 with drizzling field conditions, it can be seen that the largest number of vehicles passing Naragong Highway is in the morning, namely 07.00 - 08.00 with a total of 1131.8 Smp / hour.

3.9 Side Barriers

The side friction data below is obtained after conducting a direct survey by observing the types of side friction events along the 200 meter road segment in the vicinity are as follows:

 Table 9. Side obstacles of Naragong Highway
 Jalan Raya Naragong

No.	Time	Pedestrian		Parking Vehicles Stop		Vehicle in and out		Slow Vehicle		Total	Class
		PED	0.5	PSV	1	EEV	0.7	SMV	0.4	Frequency	Resistance
		Freq.	Freq.	Freq.	Freq.	Freq.	Freq.	Freq.	Freq.	Weight	Side
		Gen / Hour	Weight	Gen / Hour	Weight	Gen / Hour	Weight	Gen / Hour	Weight		
1	Morning	32	16	26	26	85	59.5	56	22.4	123.9	L
2	Noon	19	9.5	32	32	89	62.3	79	31.6	135.4	L
3	Night	11	5.5	26	26	45	31.5	123	49.2	112.2	L

Source: Analysis Results 2021

3.10 Vehicle Free Flow Speed (FV)

Based on the MKJI 1997, the free flow speed of a vehicle has the following equation:

$$FV = (FV_0 + FVW) \times FFVSF \times FFVCS$$

1. Light Vehicle (LV)

$$FV = (44 + 3) \times 0.99 \times 1.03$$

- = 47.9 Km / hour
- 2. Heavy Vehicle (HV)
 $FV = (40 + 3) \times 0.99 \times 1.03$
 = 43.8 Km / hour
- 3. Motorcycle
 $FV = (40 + 3) \times 0.99 \times 1.03$
 = 43.8 Km / hour
- 4. All Vehicles / Average
 $FV = (42 + 3) \times 0.99 \times 1.03$
 = 45.8 Km / hour

3.11 Capacity of Roads

Based on (MKJI, 1997), the calculation can determine the capacity of a road section, at this time it will focus on the Naragong Highway by using the following formula (MKJI, 1997):

$$C = C_0 \times FCW \times FCSP \times FCSF \times FCCS \text{ (smp / hour)}$$

$$= 2900 \times 1.14 \times 1 \times 0.97 \times 1.03$$

$$= 3303,025$$

3.12 Road Service Level

The service level of the Naragong Highway is classified based on volume (Q) per capacity (C). Based on the Regulation of the Minister of Transportation Number: KM 14 of 2006, the level of service (LOS) can be seen from the formula for degree of saturation (DS) as follows:

$$DS = Q / C$$

Table 10. Road Service Levels

Time	Q smp / Hour	C smp / Hour	Q / C	LOS
Morning (07.00 - 08.00)	1131.8	3303,025	0.3426556	A
Afternoon (13.30 - 14.30)	925	3303,025	0.2800463	A
Evening (21.00 - 22.00)	1040.45	3303,025	0.3149991	A

Source: Analysis Results 2021

From the table above the service level on Friday, February 5, 2021 with drizzling field conditions, it can be concluded that in the morning, 07.00 - 08.00 has a service level of A, which means that in high-speed free flow conditions, the driver can choose the desired speed without a hitch. such as 2 duration of time after that, namely at noon at 13.30 - 14.30 and at night 21.00 - 22.00 which has service level A which means free flow conditions as before.

4. Conclusion and Suggestion

4.1 Conclusion

Based on the research that has been done, the following conclusions can be drawn:

1. Characteristics that affect road sections identified as accident-prone areas on the Naragong Highway is a road geometry that does not have road markings, road capacity, land use and traffic signs.
2. The causes of accidents on the Naragong Highway include:
 - a. Inadequate traffic signs, present but not functioning properly and absence of road markings.
 - b. Lack of lighting on the road has resulted in several accidents.
 - c. There are several potholes and bumpy roads that make the driver unable to control the vehicle.
 - d. There is no road divider with the shoulder of the road which makes road users / pedestrians less safe.
3. Based on the results of the analysis of accident-prone locations on Jalan Raya Naragong for the period 2016-2018 using the Accident Equivalent Number (AEK) method and the Equivalent Property Damage Only (EPDO) value. And there are relatively high AEK and EPDO scores along this road. The author divides 10 segments on this road based on coordinate points. The coordinate point with the highest AEK and EPDO values is at the coordinate point -6.280222 to -6.28175 with AEK 103 and EPDO also 103 which caused 8 deaths, 0 serious injuries, 0 minor injuries and with material loss of Rp. 5,000,000. The most types of

accidents were front - front with 17 victims, the number of accident victims and material losses was obtained by the author from the IRSMS data provided by Laka then Bekasi City.

4.2 Suggestions

Suggestions submitted based on the research results obtained include:

1. For accident-prone areas, warning signs for dangerous areas where accidents often occur should be installed. Usually the placement of these traffic signs can be installed at least 50 meters before the area that often occurs accidents. Adding road markings, Repairing traffic signs that are not functioning properly and adding zebra crossings.
2. Repairing bumpy roads and potholes, as this can cause a single accident and provide distraction tape or notification of any identified accident-prone locations.
3. Provide traffic safety education to the surrounding community so that they are always careful in driving and obey all traffic regulations.
4. It is necessary to provide education or outreach to the public regarding traffic safety regulations and always be careful when driving.
5. Further research is needed after the Covid-19 pandemic ends.

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Biography

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The Tourism Awareness Education in Supporting The Tourism Development of Muaro Jambi Temple

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Abstract

Muaro Jambi Temple is one of the largest Hindu-Buddhist temple complexes in Southeast Asia, in the residential area of Jambi Malay community. In the beginning, the community assumed that the existence of the temple complex was only a historical heritage, which was nothing more than ancient buildings. They haven't realized that the historical heritage is an international tourism destination that has the potential to improve the economy of local communities. With the efforts of some parties to educate, to provide tourism awareness education to the community, eventually grew the awareness that the existence of the temple can be a new source of income to improve the welfare of their lives. Not a few local community who initially worked as a garden farmer, gradually turned into an entrepreneurs of lodging, restaurants, souvenirs, entertainment, and others. Surely the phenomenon becomes one of the *attractiveness* for foreign and domestic tourists to visit Muaro Jambi temple. Thus, the tourism awareness education that is done play a role in supporting tourism development of Muaro Jambi Temple.

Keywords

Muaro Jambi Temple, Muaro Jambi Temple, Tourism Awareness Education

1. Introduction

Indonesia is a country that has a lot of historical relics, including a complex of Muaro Jambi Temple ever became a center of worship and Buddhist education in the Ancient Sriwijaya Malay Kingdom in the 7th century until the 14th century (Munoz et al., 2006). In addition, the history also notes that, Muaro Jambi Temple is a center of education (University) is the oldest and largest Buddhist religion in Southeast Asia that holds an important role for a little over seven centuries (Sirait, 2012). This ancient University has close links with the University of Nalanda in India which also functioned as the Centre of the leading Buddhist religious education (Wahid, 2011).

In addition to the value of history is so large, complex of Muaro Jambi Temple also meets the 3 (three) than 10 (ten) criteria of a cultural heritage that is considered to have outstanding universal value, so it meets the criteria to be registered to UNESCO and have been entered in the UNESCO Tentative List number: 5465 Cultural categories in the proposed World Heritage nomination as the masterpiece of Adi Luhung (Outstanding Universal Value) (Ancient Relics Preservation Hall Jambi, 2012).

Historic building and cultural heritage in fact is something that is very close to the world of tourism. The value of history and identity the past stored on these buildings became the attraction for tourists (Hoffman et al., 2002). So is the case with complex of Muaro Jambi Temple has a potential value of tourism very special to the people of Indonesia, especially for local communities where the temple is located. Muaro Jambi Temple will become an icon, and pride for the people of the province of Jambi.

But based on the phenomenon, local people initially assumed that the existence of the temple only as a historical heritage, which is nothing more than ancient buildings. They have not realized that the history will be International tourism destinations can potentially increase in the economy. Along its development until recently, not a few local people who originally worked as a farmer's garden, are gradually turning into entrepreneurs of lodging, restaurants, crafts, entertainment, souvenirs and others around complex of Muaro Jambi Temple. So at the moment, around a complex of Muaro Jambi Temple many popping up a variety of small businesses conducted by local people who can become a new source of income to improve the welfare of their lives. Certainly the phenomenon became one of the attractions for foreign and domestic tourists to visit Muaro Jambi Temple, which will greatly contribute to the development of the tourism Muaro Jambi Temple.

The development of tourism Muaro Jambi Temple, according to Choirinnisa (2010), when the analysis of the institution using of Tourism Organization and institutional theory Cheema Mill, then the GTO (Indonesia Depbudpar), RTB (Disbudpar), and the LTB (Disbudparpora) that has the authority in the development program destinations Muaro Jambi. However, in addition to the three aforementioned Tourism Organization, the results showed there were two nongovernmental organization tourism plays a role in this program, namely the regional development planning Board (Bappeda) province of Jambi and Preservation Hall Relics of the Ancient Region of South Sumatera, Bengkulu, Bangka Belitung, and Jambi province (BP3).

In addition to the institutions mentioned above, (Eriansyah & Febriansyah, 2014) explained that the two *tengganai* in the village Muaro Jambi overall provide an important role in providing an understanding and awareness to the community how important keeping and preserving the region's Muaro Jambi. An important aspect in this preservation will certainly give a positive impact towards the enhancement of the community's economy around. Public awareness around the Muaro Jambi Temple grows naturally in addition to the knowledge and information they get from the opinion leader. The designation of the two *tengganai* in an effort to preserve the Muaro Jambi is as an effective communications strategy, because two *tengganai* in the community of the village of Muaro Jambi tend not to be contaminated by the individual interests and group.

In addition to the efforts made by the parties in accordance with the capacity and authority, the local youth participated and have a large role in the development and preservation of the tourism Muaro Jambi Temple. This paper will present the educational process is factually realized tours conducted by the youth of the village of Muaro Jambi to the community in support of the tourism development of Muaro Jambi Temple.

2. Methodology

This paper is written using a descriptive qualitative approach related to the phenomenon of youth's participation in providing education to the local community tourism conscious in support of tourism development of Muaro Jambi Temple. Data collection techniques used are observation and in-depth interviews. The informant is determined by a snowball technique, and local youth leaders as key informants. As a supporter of the analysis, this article also uses secondary data about the various references related to the focus of this article.

3. Result and Discussion

3.1. The Condition of The Villagers Muaro Jambi

Muaro Jambi Temple complex has the widest area is located in the village of Muaro Jambi. The old village has a natural sandbar where its territory divided by the flow of rivers that flow from the upstream Batanghari downstream villages along 2 kilometers. Astronomically it is 1030 22 villages 'BT up to 1030 45 'E and 10 24 10 33 to 'LS' LS. On the whole territory of the village is situated at an altitude of 8 to 12 meters above sea level. Based on this height, the natural environment of this village is the lowlands.

Villagers Muaro Village is a reality of a very dynamic community. The condition of the society before the complex of Muaro Jambi Temple developed into a tourism destination, as a living community province of Jambi, that farmer's Garden, and fishing. But as the development of the tourism of Muaro Jambi Temple, increasingly diverse professions suffered. From the start the entrepreneurs of lodging, craftsmen souvenirs, food and beverages, up to a bicycle rental service, mat, and tricycles.

In the life of the community of the village of Muaro Jambi, an important actor is Head Countryside who encouraged the formation of the character of the community through social interaction and communication. Cultural values rooted in the life of the community of the village of Muaro Jambi is also a factor that resulted in the formation of a social system that values the ancestral heritage, and holding fast to values and cultural norms. The living conditions of the villagers of the estuary of Jambi who continue to maintain the values and traditions that they had inherited from generation to generation until today. Although this time the villagers of Muaro Jambi is led by a Head Countryside who was appointed through a village head elections in a democratic way by the community, but the community remains upholding the custom prevailing in their community. Even so, the villagers of Muaro Jambi is also not close themselves against progress and modernization (Eriansyah & Febriansyah, 2014).

With the model of social life in the village of Muaro Jambi as aforesaid is a potential to realize the village into a tourist village, where the values of the local traditions are still maintained and preserved in everyday life well as one attraction of tourists to visit the village. In addition, conditions that likewise is an authorized capital which is owned by the villagers Muaro Jambi that must be maintained and developed to contribute actively in the efforts of the development and preservation of the cultural heritage of Muaro Jambi Temple as a heritage and cultural richness, as well as the leading tourism destination.

3.2. The Development of Tourism Candi Muaro Jambi

Cultural heritage is the cultural wealth of the nation as a manifestation of the thinking and behavior of human life which are important for the understanding and development of the history, science, and culture in the life of society, nation, and State, so that needs to be conserved and managed appropriately through the efforts of shield cover, development, and utilization in order to advance the national culture for most people's prosperity (Law Number 11 Year 2010).

So is the case with Muaro Jambi Temple in the concept of management and development, not just seen as a cultural heritage Building (BCB), but should be seen as an indicator of a trigger and create tourism growth, and vice versa Tourism is able to create a Fund for the preservation of BCB, and the surrounding community (Muhammad Chawari, 2012). Similar with those concepts, (Engelhardt, 2005) and (Matsuura, 2008)

says that the heritage management paradigms should not evolve into purely for preservation, but also to the improvement of the welfare of the community.

Choirinnisa (2010) explained that physically, Muaro Jambi deserves to be developed as a tourism destination in its flagship. This caused has three charms, namely history, geology, and agriculture can be a capital to attract tourists. In addition, he added that in the institutional, skill organizations that manage development Program Destinations Muaro Jambi is enough. It is visible from the Division of authority between any organization, coordination between the mechanisms of each organization, and adequate funds both from the Central Government, as well as a GRANT from the provincial government and municipalities. However, the institutional aspects of the feasibility of the program also exposed some problems such as the quantity and quality of human resources and ancillary tourism business growing yet small, medium, and large

The attraction is owned by Muaro Jambi in accordance with expressed by Mathieson and Wall (Yoeti, 2006), that there are three forms of attraction of tourist destinations, namely: first, the form of culture which are inanimate or which do not directly involve human activity. Second, the form of culture reflected in the normal daily life of destination. Third, the form of culture which are specially animated and may involve special events or depict historic, festivals, reflecting old traditions and behavior, a reenactment of battles, and displays of old machinery.

Having regard to the appeal, the tourism Muaro Jambi Temple will have an attraction for tourists to visit it, so that as time goes on, the development of the tourism Muaro Jambi Temple. Certainly the phenomenon will have contributed to the improvement of the welfare of the local community. Look at the area around the complex of Muaro Jambi Temple found various businesses who are increasingly growing today, such as: lodging, tourist/arena entertainment, bike and mat rental, pedicab, crafts stalls souvenirs, food and beverages.



Figure 1. This is a figure of a souvenir shop



Figure 2. This is a figure of a bicycle rental business

Muaro Jambi also became the location for the holding of some celebration/festival of culture in the province of Jambi. Two of them were the celebrations of Vesak by Buddhists and Muaro Jambi Temple Festival which held annually. On such occasions, the young men who joined in the porch Creations Muaro Jambi organize Youth hunting durian. Where the tourists can enjoy the event besides the celebration/festival held at the complex of Muaro Jambi Temple, they can also enjoy hunting durian.

Associated with a variety of efforts are being made for the development of complex of Muaro Jambi Temple, Millar (Kausar & Devi Roza K, 2013) reminds that the context of heritage tourism is very different with tourism in General, because it uses a resource that is not replaceable so that preservation is an important component of heritage tourism. Therefore in the development of complex of Muaro Jambi Temple that aims to increase the welfare of society should pay attention to aspects of the preservation of the temple site. All activities/events that occur in a complex of Muaro Jambi Temple is not allowed which will cause damage to the temple site.

Thus, the need for clear rules in the management and development of the complex of Muaro Jambi Temple, and intense coordination from all relevant parties related to the various development efforts while paying attention to the aspects of preservation cultural reserve.

3.3 The Tourism Awareness Education for the Local Communities of Muaro Jambi Temple

The development of community-based tourism is a perfect concept applied in the development of the tourism of Muaro Jambi Temple, because community-based tourism according to Beeton (2006) tourism is an activity in which the local communities play a role as an active perpetrator of, among other things as a maintainer area, employers, employees, decision makers, as well as of the region. Thus, it will be created a more sustainable tourism industry, since it always pays attention to and involve local communities in the planning and development of its tourism activities (Beeton, 2006).

The developments were seen in the area of Muaro Jambi Temple as pre-eminent destination in Jambi province can be realized is inseparable from the role of various parties in giving understanding and awareness to the community to participate in the development and conservation efforts. In doing so, many of the parties involved, including the youth of the local area to provide the tourism awareness education to the community.

According to Hasibuan (2008) "characters that appeared in the political scene in the early independence is their struggle since the young". The tourism sector requires development; also require the young men who fought the conscious education efforts in order to develop tourism Muaro Jambi Temple.

The tourism awareness education conducted by the youth aims to establish community awareness about tourism of Muaro Jambi Temple can as subjects and beneficiaries of the development of tourism. In addition, the tourism awareness education are also expected to be able to answer the problems relating to understanding the awareness and *Sapta Pesona* to local communities so they can consciously to build, develop, and preserving the tourism of Muaro Jambi Temple, and utilize the existing potential. With the tourism awareness education, the communities can understand the value of *Sapta Pesona* as the basis of a good host in serving tourists.

Based on interviews with Abdul Haviz other wise called Ahok (2017), that the initial steps undertaken by several young men of the village in the year 2003 is to do a promotion, and introduced the Muaro Jambi Temple to the tourists as ancestral heritage filled with historical values and culture. It is done by the youth so that tourists can see not only an ancient building Temple, but be aware of its cultural and historical value, so it will grow awareness tour in conservation support.

The activities carried out by the youth that is actually the activity guide (tourist guide), but at that time they do not know and realize that its activities it is the activity of a tourist guide, which in addition aims to assist in the preservation of cultural heritage, will also be able to contribute to the improvement of the welfare of the local community. But as time goes on, and with the ever increasing insight into society, they are increasingly aware of the matter.

In addition, the Youth Associations Muaro Jambi Temple (PPCMJ) in collaboration with the cooperative Heritage Preservation Hall (BPCB) Jambi development concept-based tourism initiated the welfare of local communities. An effort initiated at that time was a bicycle rental. See the development of the work done by the youth associations 'increasingly growing, then it becomes attraction for the local community to take part in the opening effort. But the youth associations provide referrals to the community that by opening up effort around Muaro Jambi Temple should be accompanied by awareness to safeguard the sustainability of cultural heritage. The direction of youth associations were ever done to people who open businesses, such as lodging, tourist/arena entertainment, bike rental and a mat, pedicab, crafts stalls souvenirs, food and beverages.

Furthermore the youth in the Muaro Jambi village founded the Organization *Saramuja* (*Sekolah Alam Raya Muaro Jambi*), which was initiated by the local youth named Mukhtar Hadi (Borju), one of the alumni of the Islamic University of Sultan Thaha Saifuddin Jambi (UIN Jambi). *Saramuja* is a container of a non-formal education that one program is an introduction to students at local schools against Temple and a wealth of cultural heritage.

At the school, students are directed to can learn to build a sense of community, discussion about the preservation of the environment, history, culture and other general knowledge. The Organization was motivated by the fact that many young people, especially school students who do not understand the history and the important role that was once run by Muaro Jambi in the development of world civilization. Introduction of activities carried out by the *Saramuja* heritage includes visits to the temples while listening to the explanation of the supervisor,

the temple drawing and painting, live music, and filmmaking for education conscious and environmentally conscious to the community.

In addition, in the expansion, lately sprung arena-arena tour around the complex of Enshrinement Muaro Jambi, such grounds is maintained by the community. And since May 2017, also tourist Muaro Jambi village, which offers tours of the presence, among others, trekking or rock climbing, cycling visit the eight temples in the heritage area of Muaro Jambi Temple, wading through Rivers Batanghari towards Muaro Jambi. There is also a tourist Village cuisine Muaro Jambi, learning the craft of weaving mats. Then there is also the attraction of art masks, plant a tree on the banks of Sungai Batanghari and learning the art and culture of the local people.

The groundbreaking of the tourist village is a form of tourism awareness education to society to preserve the history, traditions, culture of the local community which will become an attraction for tourists visiting the Temples, as well as be Muaro Jambi improves the level of welfare. Another case with the opinions expressed by Ahok (2017) which says that the emergence of arena-arena tours and tourist villages around complex Enshrinement Muaro Jambi is one effort broke the crowd the tourists so as not centered on site the temple, as is not uncommon with the hectic tourist visit impact damage to the buildings of the temple.

Various forms of education are aware of the above tour is done in principle is inseparable from the concept of community empowerment, which according to Noor (2011) consists of three aspects: firstly, that of creating an enabling allows the potential of the community can thrive. Empowerment is an effort to build up power by encouraging, motivating, and raised awareness of the potential which is owned by the community as well as efforts to develop it. Second, empowering, that strengthen the potential of the community through real measures that concern the provision of a wide range of inputs and the opening in the range of opportunities that would have made the public increasingly powerless. Thirdly, protecting, that of protecting and defending the interests of the community are weak. To increase public participation in the decision-making process relating to self and society is an important element, so that the community empowerment is very closely related to the establishment, enculturation process, and experience democracy.

4. Conclusion

The management and development of tourism Muaro Jambi Temple in principle not only see Temples as buildings of cultural heritage (BCB), but should be seen also as an indicator of the trigger in creating tourism growth, and vice versa tourism able to create a Fund for the preservation of BCB, and surrounding communities. The tourism awareness education to the local community is a concept that is right thing to do in order to the development of tourism Muaro Jambi Temple. So they can consciously participate to build, develop, and preserve the tourism Muaro Jambi Temple, and take advantage of the potential that exists to improve well-being.

Growing and development of various business services and trade conducted the local community became one of the attraction for tourists to visit the temples of Muaro Jambi. The local community's effort certainly is not necessarily only will have an impact on the welfare improvement, but will also have an impact on the development of tourism Muaro Jambi Temple.

Efforts are being made in the development of the Muaro Jambi Temple was a concept of community-based tourism development, where local communities serve as active perpetrators, as well as of the region. Thus, it will be created a more sustainable tourism industry, since it always pays attention to and involve local communities in the activities of the planning and development of its tourism.

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Leadership Function in Employee Placement Process at PT. Duta Mandiri Palembang

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Abstract

This research was conducted to determine the function of leadership in the process of placing employees at PT. Duta Mandiri Palembang, of course, requires a variety of instruments, ranging from facilities and infrastructure to human resources, as well as the character of a leader. The character of a leader and the function of a leader itself is one of the main factors in the management of an organization, both government and private. The method used in this research is descriptive qualitative research method, in which the researcher collects data obtained from the sources studied through observation, interviews, and documentation related to the research title. From the research results, it is known that employees at PT. Duta Mandiri Palembang has been able to describe the policies given by the leadership in the form of a positive response to the duties and responsibilities given to them.

Keywords :

Behavior, Job Placement, Leadership

1. Introduction

Leadership is the process of influencing people's behavior, where behavior is not only visible, but thoughts, beliefs and mental attitudes are also dominant factors. A leader must be trustworthy and must be able to communicate his vision, meaning that he must be able to transform this vision to his subordinates. A leader must be able to carry out functions related to the duties of a leader, including: making decisions, setting goals, formulating policies, placing employees, and coordinating activities, both vertically and horizontally, including the ability to supervise the work of subordinates.

Placement is one of the important aspects in the human resource planning process, because it has a close relationship with efficiency and fairness, where each employee is given the same opportunity to develop, including the process of assigning tasks / jobs to employees to be carried out in accordance with the scope that has been defined. In addition, employees must be able to take responsibility for all risks and possibilities that will occur with these tasks and jobs. This placement must be based on a predetermined job description and job specifications, and guided by the principle of "Placing the right people in the right place and placing the right people for the right positions". The right placement consists of: suitability of academic abilities, suitability of experience, and fitness for both physical and mental health so that the company's goals will be achieved.

From the description above, the researcher sees that the problems that occur at PT. Duta Mandiri Palembang is that the leadership function has not been carried out properly, this can be seen from the poor job placement process in the company. On this basis, researchers are interested in knowing the leadership function and job placement of employees at PT. Duta Mandiri Palembang.

2. Literature Review

Most leaders are highly motivated people. They voluntarily strive to achieve high goals and set standards of achievement for them. They want to know many things and problems that are not resolved around them, (Atmosudirdjo, 2007).

George, (2006) "suggests that leadership is a relationship in which one person, namely the leader, influences other parties to work together voluntarily in an effort to carry out related tasks to achieve what the leader wants. This influence arises from the relationship between the leader and a group member. In addition, there is also interaction or reciprocal reactions of people in a group".

According to David, (2006) the interaction of a leader and group members connects the leader with certain group members, it depends on what is to be achieved, the behavior of the people in the group, the knowledge and ideas that can be achieved. Contributed by each party towards solving problems and environmental conditions in general. A leader has a mission or goal to achieve.

There are several approaches that can be done related to leadership, Hani, (1994) as follows:

1. The trait approach.
2. Behavioral approach.

3. Contingency / situational approach.
4. Approach the path goal.
5. Cyclical approach.

What is very important in an organization / company is the placement of employees, because employee placement is a process of collecting and examining work activities in a position and the qualifications (skills, knowledge, abilities, and individual characteristics) needed to carry out activities.

Employee placement is basically a tool for the leadership of an organization or company in solving employment problems in a professional and humane manner, (Sihotang, 2007).

According to Winardi, (2000) employee placement provides benefits, including:

1. In the recruitment, selection, and placement of workers.
2. In workforce education and training.
3. In assessing position and work performance.
4. In improving the terms of position and employment.
5. In a placement, transfer, transfer, or promotion.

With the appropriate placement of employees, the qualifications of the required workforce personnel can be known and predicted. In order to educate or train prospective workers to be able to hold certain positions, it is necessary to first know the specific skills needed. Appropriate employee placement can benefit from improving job and position requirements. A manpower planning in an organization will be easier if it is known precisely and clearly the boundaries of each job so that duplication of tasks can be avoided.

Several principles that need the attention of the leadership in placing employees, namely:

1. Employee placement must provide accurate facts relating to the position or type of work. The results facts will be used for further purposes.
2. The placement of employees must be able to provide the facts needed for various jobs.
3. The results of this placement must always be reviewed and if necessary corrected. In a large company, the position or job is not static, but there are changes in both processes, methods and other aspects. Thus, employee placement is an activity that must be carried out continuously.
4. Employee placement must be able to show the important elements and be able to provide clear, thorough and reliable information. For that we need human resources who are experts in their respective fields.

3. Methods

The perspective of this research approach uses a qualitative descriptive approach, to determine the function of leadership in the work placement process of employees at PT. Duta Mandiri Palembang. This approach is essentially trying to understand the interpretation of what happened.

The dimensions of the leadership function George, (2006) with the following indicators: planning, developing loyalty, forward-looking functions, decision making, monitoring, and providing motivation. While the dimensions of work placement with the following indicators: level of education and expertise, work knowledge, work experience, work skills, and age factors.

The research informants in this study were 5 people related to the research conducted. Data collection techniques are carried out by: observation, interviews, and literature study.

4. Result

The leadership function is the most important factor in the progress and development of a government and private agency. Leadership is guiding, guiding, guiding, building, giving or working motivation, directing the organization, establishing a good communication network, providing efficient supervision, and bringing followers to the target they want to aim for in accordance with the provisions of time and planning. If an agency / company does not carry out a leadership function, the company cannot develop. The leadership function is the most important factor in the progress and development of an agency, both government and private.

Muhammad Annan, as Sales Marketing Officer at PT. Duta Mandiri Palembang stated that "the problem in the leadership function that is in PT. Duta Mandiri Palembang, which is a plan that is not in accordance with the work situation and the supervision is not given to employees ", (interview 3 September 2020).

The results of observations by researchers at PT. Duta Mandiri Palembang found that the planning and supervision had not been carried out properly. This can be seen from employees in completing their work who tend to delay completing the next day, thus slowing down the work process.

Based on the results of interviews and observations, it can be explained that planning and supervision have not been carried out properly, it is better if the leadership of PT. Duta Mandiri Palembang must pay more attention to how it works in making plans that should be adjusted to the existing work situation and the leadership also

provides tighter supervision of the work results of employees, both in terms of work neatness and from the side of timeliness.

Dyah, as Administration Staff at PT. Duta Mandiri Palembang stated that “the real leadership function in a company is to do: planning, developing loyalty, monitoring, making decisions, and providing motivation. However, the functions mentioned at PT. Duta Mandiri Palembang has not done well”, (interview 15 September 2020).

The results of observations by researchers at PT. Duta Mandiri Palembang found that the planning made by the leadership was still not in accordance with the goals of the organization, the decision making was still not firm, the development of loyalty and supervision needed to be improved again and the leadership had to provide more motivation to its employees.

Based on the results of interviews and observations, it can be explained that the implementation of the leadership function has not been carried out properly. This can be seen from: planning, decision making, developing loyalty, and monitoring employees who are still less than optimal where employees are limited in using their creations at work. Likewise with motivation, company leaders have not provided the right motivation to employees in meeting work targets. Instead, this leadership function should be carried out as well as possible because this can affect the progress and development of the company, especially PT. Duta Mandiri Palembang.

Novi Astuti, As Administration Staff at PT. Duta Mandiri Palembang stated that “the planning made by the leadership of PT. Duta Mandiri Palembang has not done well. This can be seen from the organizational goals that have not been achieved in accordance with the plans made”, (interview, 17 September 2020).

The results of observations by researchers at PT. Duta Mandiri Palembang found that the planning made by the leadership was not in accordance with the goals of the organization, still not in accordance with the work situation at PT. Duta Mandiri Palembang, and could not reach the target to be achieved.

Based on the results of interviews and observations of researchers, it can be argued that the planning made by the leadership has not been able to achieve organizational goals. Preferably, the planning must be made in accordance with the work situation, goals, and targets to be achieved. If the planning has been carried out properly, the company's goals can be achieved.

Muhammad Annan, as Sales Marketing Officer at PT. Duta Mandiri Palembang stated that “the development of loyalty is not implemented in the company, so that the development of employee loyalty has decreased”, (interview, 18 September 2020).

The results of the author's observations at PT. Duta Mandiri Palembang found that the development of loyalty was not implemented properly, this can be seen from the attitude of its employees on a daily basis that it is not good. The leader does not set a good role model for employees so that the development of loyalty decreases.

Based on the results of interviews and observations of researchers, it can be explained that the development of loyalty needs to be improved. Preferably, the development of this loyalty is not only among followers, but also for the lower and middle level leaders in the organization. To achieve this loyalty, a leader himself must set an example, both in his thoughts, words and daily behavior shown to employees. Then the leader himself never denies and deviates from loyalty because things will not go well without developing loyalty.

Dyah, as Administration Staff at PT. Duta Mandiri Palembang stated that “the supervision carried out by the leadership of PT. Duta Mandiri Palembang has not done well”, (interview 15 September 2020).

The results of observations by researchers at PT. Duta Mandiri Palembang found that the supervision given by the leadership had not been implemented optimally. This can be seen by employees at PT. Duta Mandiri Palembang, in completing his work, was not disciplined and on time.

Based on the results of interviews and observations of researchers, it can be explained that the supervision carried out by company leaders still needs to be improved. This supervision is an indicator of the leadership function where supervision is carried out to constantly examine the ability to implement plans. With supervision, obstacles can be immediately identified and resolved so that all activities can resume according to the predetermined plan.

Afgan, as the Sales Team at PT. Duta Mandiri Palembang stated that “the leadership in the company is less assertive in making decisions when the company is facing a problem”, (interview, 20 September 2020).

The results of observations by researchers at PT. Duta Mandiri Palembang found that the company's leadership in making decisions was not firm, so that the existing problems could not be resolved quickly.

Based on the results of interviews and observations of researchers, it can be explained that the company leadership in this case PT. Duta Mandiri Palembang is less firm in making decisions. Instead, a leader must be even more assertive in dealing with existing problems. This decision making is an indicator of the leadership function. If a leader is not brave and is not quick to make a decision, this can lead to new problems in the company.

Muhammad Annan, as Sales Marketing Officer at PT. Duta Mandiri Palembang stated that “the leadership at PT. Duta Mandiri Palembang still has not maximally provided work motivation to its employees”, (interview, 18 September 2020).

The results of observations by researchers at PT. Duta Mandiri Palembang, it is known that the leadership has not provided motivation to its employees, so that employees do not have high enthusiasm in completing work which results in a choke in the work process.

Based on the results of interviews and observations of researchers, it can be stated that the leadership is still not optimal in providing work motivation to employees. Work motivation is the most important factor in improving employee work results. Therefore, the leadership at PT. Duta Mandiri Palembang should pay more attention to employees by providing good motivation so that employees can carry out their duties or jobs better so that company goals can be achieved.

Thamrin, SE. as the Operations Manager at PT. Duta Mandiri Palembang explained that "employee job placement at PT. Duta Mandiri Palembang is not yet in accordance with educational background and work experience (interview 03 September 2020).

The results of the researcher's observations found that employee job placement was still not appropriate based on the level of education and expertise, employee work knowledge, employee work experience, employee job skills and age factors.

Based on the results of interviews and observations of researchers, it can be explained that employee job placement has not been carried out in accordance with existing procedures at PT. Duta Mandiri Palembang, where the written work placement procedure for employees must be based on the level of education and expertise, work knowledge and experience, job skills, and age factors. It is better if the implementation of the workforce placement must be in accordance with the procedures owned by the company because this job placement is a factor in determining the work results / work productivity of the company. If the employee job placement process has been carried out in accordance with existing procedures in the company, then the employee can carry out his job properly and on time.

Muhammad Annan, as Sales marketing officer at PT. Duta Mandiri Palembang stated that "the problems experienced at PT. Duta Mandiri Palembang in employee job placement is not based on education level and expertise as well as age factors ", (interview, 18 September 2020).

The results of the researchers' observations show that job placement in this company is not carried out based on education level and age factors. This can be seen from the employee feeling uncomfortable with the assigned position and also seen from the way employees complete their work.

Based on the results of interviews and observations of researchers, it can be explained that the level of education and expertise as well as age factors play an important role in job placement because this greatly affects the work results of employees. It is better if job placements are carried out based on the level of education and skills possessed by employees, as well as age factors which must also be considered optimally for the progress of the company.

Thamrin, SE., As Operations Manager at PT. Duta Mandiri Palembang stated that "employee job placement at PT. Duta Mandiri Palembang has been carried out based on the level of education and expertise of each employee ", (interview 02 September 2020).

The results of the observations of researchers in this company, it is that the company in placing employees is not in accordance with the level of education and expertise possessed by employees. This can be seen from the employees who work not in accordance with their expertise.

Based on the results of interviews and observations of researchers in this company, it can be explained that employee job placement has not been carried out based on the level of education and expertise, because there are still employees who hold positions that are not in accordance with the level of education and expertise. Preferably, employee work placement must be in accordance with the level of education and expertise, if this work placement is in accordance with the level of education and expertise, then the employee can carry out his work according to the existing division of labor.

Thamrin, SE., As Operations Manager at PT. Duta Mandiri Palembang stated that "employee job placement in the company is based on the employees' working knowledge, but the work knowledge that employees have at the company is still not optimal", (interview 02 September 2020).

The results of the researchers' observations show that the work placement in this company is not in accordance with the employees' knowledge, so that employees have difficulty completing their work.

Based on the results of interviews and observations of researchers at PT. Duta Mandiri Palembang can be explained that the work placement of employees in this company is based on the employees' working knowledge, but the knowledge possessed by these employees is still not optimal. Work knowledge is very important for employees because with knowledge, employees can know and understand how to work at PT. Duta Mandiri Palembang.

Thamrin, SE., As the company's Operations Manager explained that "employee job placement at PT. Duta Mandiri Palembang is implemented based on the work experience of employees, but has not been optimally supported by the employees themselves ", (interview 02 September 2020).

The results of observations by researchers at the company found that employee work placements were not in accordance with the work experience of the employees, so that employees felt uncomfortable with their positions and resulted in these employees having difficulty completing their work.

Based on the results of interviews and observations of researchers in the company, it can be argued that the job placement of employees at PT. Duta Mandiri Palembang has not been implemented based on employee work experience, so that employees experience difficulties in carrying out their duties or jobs. It is better if this employee job placement is carried out based on the employee's work experience. This is of course to make it easier for employees to carry out their work and achieve the goals set by the company.

Thamrin, SE., As the company's Operations Manager stated that "employee job placement at PT. Duta Mandiri Palembang is carried out based on employee job skills, but the skills possessed by employees are still not optimal", (interview 02 September 2020).

The results of observations by researchers at PT. Duta Mandiri Palembang found that the job placement of employees was not in accordance with the job skills possessed by these employees. This can be seen from the employees who are not yet skilled in using the existing work facilities in the company.

Based on the results of interviews and observations of researchers at PT. Duta Mandiri Palembang can be explained that the job placement of employees in this company is carried out based on the work skills of the employees, but the skills possessed by employees are still not perfect, especially in the results of their work. This is a result of the lack of knowledge that employees have. We recommend that, when employees have been accepted to work at the company, the company must immediately provide additional training to support the skills they previously had, so that it can affect company performance.

Thamrin, SE., As the company's Operations Manager stated that "employee job placement at PT. Duta Mandiri Palembang has not been implemented based on the employee's age factor ", (interview 02 September 2020).

The results of observations by researchers in this company found that employee job placement did not pay attention to the age factor at the position of each job.

Based on the results of interviews and observations of researchers at PT. Duta Mandiri Palembang can be explained that employee work placement in the company has not been based on the age factor. Preferably, this job placement must be seen from the age factor, even though the employee has passed the test in the recruitment selection. To avoid low work productivity, it is necessary to consider the age factor when recruiting employees, especially the placement of these employees in existing positions in the company.

5. Conclusion

From the description above, the researcher will conclude the following:

1. The leadership function at PT. Duta Mandiri Palembang has not performed well, both in terms of planning, developing loyalty, and supervision carried out by the leadership. There are indications that the leadership seems less assertive in making decisions related to company activities and the leadership does not provide motivation to employees in working.
2. Employee job placement is not in accordance with existing procedures, especially those related to education and expertise, so this has an impact on the results obtained by the company.

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Calculation and Mapping of Water Demand Balance in Pacal Bojonegoro Irrigation Area

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Abstract

This research describes the problems that exist in the Pacal Bojonegoro Irrigation Area, that in the dry season farmers often experience difficulties in irrigating their fields, therefore it is necessary to calculate a balance to know how much water is short. needed during the dry season. The water balance is calculated in a theoretical way, namely by calculating using the Global Planting Plan data as water demand data, while the existing water balance uses the existing discharge data. The research location is in the Bojonegoro Regency area using rainfall data at 3 stations for 10 years, discharge data for 7 years, climatological data for the last 1 year and crop data for the last 1 year. Rainfall data is calculated to be effective rainfall data, while discharge data is calculated using the weibul formula, for climatological data it is calculated to be evapotranspiration and percolation data, while plant data is used to calculate global cropping plans. Conclusions and suggestions for use as a reference are taken from the calculation results obtained and then forwarded as input to farmers using water and the Government of the Public Works Service. SDA Bojonegoro Regency to be used as an operational evaluation of the Irrigation Network.

Keywords:

Irrigation Area, Water balance, Bojonegoro Regency, Data Processing, Evaluation.

1. Introduction

1.1 Background

Water is one of the natural resources that has a very important function for human life because all the activities of living things cannot be separated from water. Not only that, because water can also be used to promote public welfare so that it is one of the basic assets and main factors in development that must be managed, preserved and maintained, especially river water.

In the concept of the hydrological cycle, the amount of water in a certain area on the earth's surface is influenced by the amount of water that enters (input) and leaves (output) at a certain time. The faster the hydrological cycle occurs, the more dynamic the water balance will be.

One of the problems that occur in Indonesia is the increasing need for basic foodstuffs caused by the very rapid population growth of Indonesia, so it is necessary to think about efforts to further increase agricultural output and prevent a high gap between the level of demand and the level of fulfillment of foodstuffs and also increase standard of living of farmers. (Satri Utama, SE, 1999)

Efforts are made to increase agricultural yields in each unit area, namely by meeting the needs of good irrigation water, so that the determination of the amount of water needed is known with certainty. Therefore, adequacy in meeting irrigation water needs should be carried out effectively and efficiently.

The use of irrigation water in East Java Province, especially Bojonegoro Regency, is still considered ineffective, this can be seen when there is a shortage of water during the dry season. Regulation of irrigation water needs has not been done accurately and optimally.

To increase agricultural yields in the Pacal Irrigation Network, Bojonegoro Regency, a mapping of the irrigation network is needed to be able to manage water use optimally. This is based on the so-called Global Planting Plan (RTTG). And it is hoped that farmers will be able to work on their fields throughout the year without the problem of water shortages.

Therefore, it is necessary to calculate and map the water balance. This aims to obtain data on the results of existing water needs to be used as a reference and can be used in the development and management of water resources for a certain period. Based on this explanation, it is necessary to conduct a study on "calculation and mapping of water balance in the Pacal Bojonegoro irrigation area".

1.2 Problem Formulation

Based on the above background, the formulation of the problem is as follows:

- a. What method is used to calculate the balance of water demand in the Pacal Bojonegoro Irrigation Area.
- b. What is the water demand during the dry season in the Pacal Bojonegoro Irrigation Area.
- c. How to display the results of the water demand balance calculation on a map.

2. Literature Review

2.1 Previous Studies

In this study, the presentation of previous research relevant to the topics discussed, namely:

1. Analysis of the Das Renggung Surface Water Balance to Meet the Domestic and Irrigation Water Needs of the Population of Central Lombok Regency, was presented by Zulkipli, Widandi Soetopo and Hari Prasetyo, Universitas Brawijaya Malang, 2011. The steps of research activities begin with conducting surveys and observations as well as collecting the necessary data including a map of the research location, rainfall data at 5 stations, AWLR Renggung-Ponggong discharge data, Climatological data for Kupang Station, socio-economic data, population of sub-districts included in the Renggung watershed. Data analysis begins with calculating evapotranspiration using the modified Penman method. Calculation of water availability with discharge from AWLR. After obtaining data on monthly water availability in a certain year, it is continued by determining the mainstay discharge of 80% (Q80). The mainstay discharge (Q80) is used as the basis for determining water availability and is the potential water available in the Renggung watershed. (Cahyo Adi Wibowo, 2012)
2. Analysis of the Water Balance of the Upper Solo Watershed, Sub Das Bengawan Solo Hulu 3, Journal created by Julian Wahyu Purnomo Putro, student of Sebelas Maret University, Surakarta, in 2013. The availability of irrigation water is obtained from the intake discharge data of the weir that irrigates the irrigation network. The mainstay discharge is the amount of water available throughout the year with a calculated risk of failure. The reliability probability used is 80%, this means that there will be a risk of small debits from the mainstay discharge of 20% of the number of observations. In calculating the monthly land water balance, input data are required, namely monthly rainfall, monthly evapotranspiration, field capacity, and permanent wilt point. The values obtained from this land water balance analysis are the assumption prices of flat land covered with grass vegetation, land in the form of soil where the water that enters the land only comes from rainfall, only homogeneous soil conditions, homogeneous soil profile conditions so that the field capacity and the permanent wilt point represent the entire layer and stretch of land. Water balance in rivers and application of certain methods to analyze water availability, sometimes have different results. This is because each method has different assumptions, but the most important thing is to do the calibration for each method of water balance analysis so that the method can be used accurately.
3. Simulation of Water Balance at Das Rejoso Pasuruan, East Java Post-Umbulan Regional Spam Raw Water Intake, Journal made by Sheilla Barrina, Donny Harisuseno and Ery Suhartanto, Brawijaya University Malang, in 2016. In the water balance analysis method, there is a calculation of the raw water discharge for SPAM performed with 3 scenarios, namely,
 - a. Scenario 1 (2500 liters / second)
 - b. Scenario 2 (3000 liters / second)
 - c. Scenario 3 (3500 liters / second)
 The analytical method used in determining the mainstay discharge is the Monthly-Based Characteristic Flow Method. and Annual Based Flow Characteristic Method. The area of the irrigation area in the Rejoso watershed used for this study is 2617 Ha. The calculation of irrigation water needs in this study uses the FPR / LPR method.
4. Analysis of the Ground Water Balance of the Center for Rice in Parigi Moutong Regency, Central Sulawesi Province, Journal made by Wenas Ganda Kurnia and Laura Prastika, Global Atmospheric Monitoring Station Lore Lindu Bariri Palu, 2016. The water balance can be calculated at a certain area and time period according to its needs general water balance equation is: $\text{Rainfall} = \text{Run off} + \text{Evapotranspiration} \pm \text{KAT change}$. The water balance calculation procedure is based on the Thornwaite and Mather (1957) bookkeeping system with units of water height (mm or cm) for all elements and units of time daily, weekly, dasarian or monthly according to their needs. Groundwater availability is an estimate of surface groundwater conditions that can be explored by plant roots, information on groundwater availability aims to consider the suitability for rainfed land agriculture based on the availability of groundwater and adjust the planting schedule and harvest schedule and regulate the provision of irrigation water both in quantity and time. as needed. (Sheilla Barrina, 2016)

3. Research Methodology

3.1 Researchresearch

Locations The locations were in Pacal Irrigation Channel, Gondang Village, Sanganten Village, Sambongrejo Village, Jari Village, Pragelan Village, Krondonan Village, Pajeng Village, Kec. Gondang, Kab. Bojonegoro

3.2Flow Chart

In this research, all primary and secondary data that have been collected will be processed and analyzed to determine the amount of water availability in the Pacal Irrigation Area so that the right solution can be found if the calculation results are deficit.

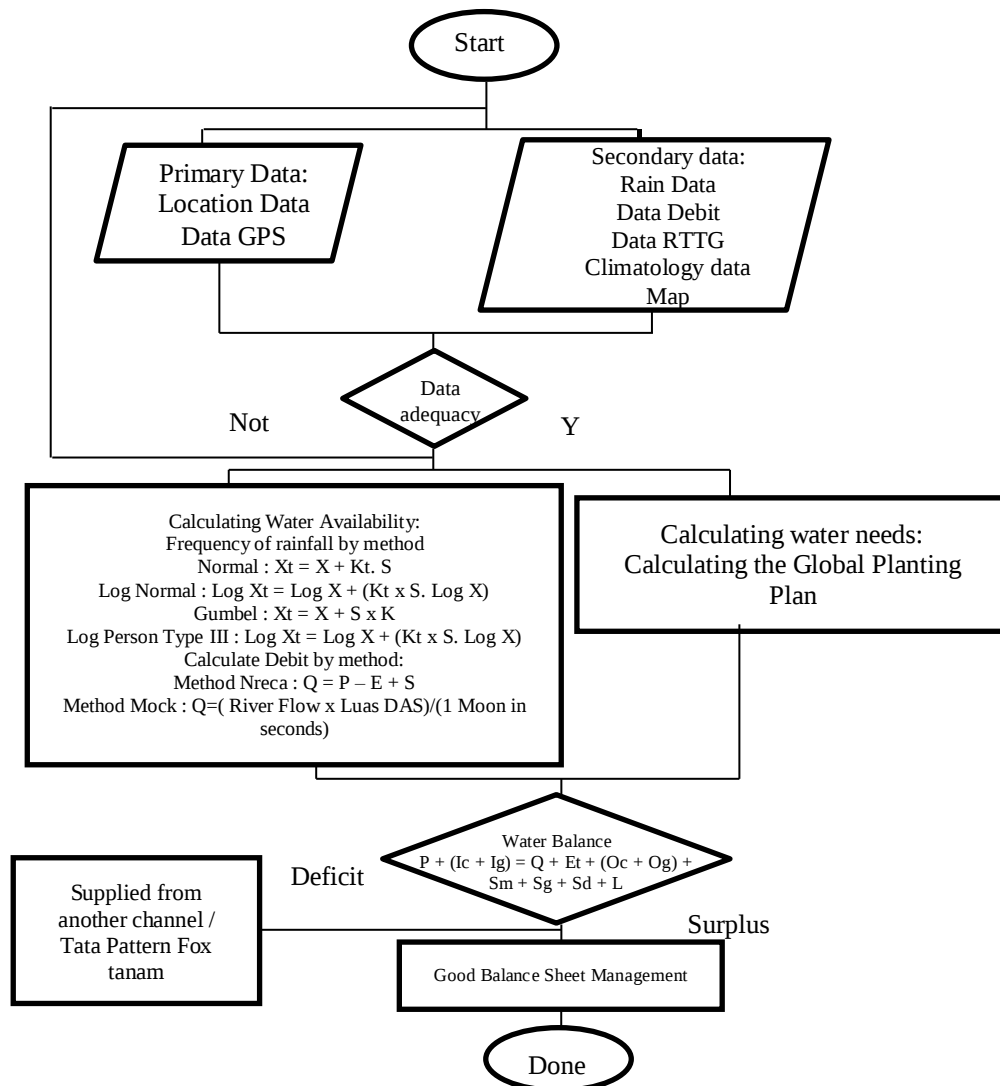


Figure 1: Flowchart

4. Analysis And Discussion

4.1 Data The

Data used in the analysis and discussion are rainfall data for 10 years from 2010 to 2019 from the 3 closest stations from the research object as initial data. Rainfall data were obtained from the Public Works Office for Water Resources of Bojonegoro Regency. This study uses data from Gondang Rain Station, Sukun Rain Station and Tretes Rain Station.

4.2. Processing Data The

Data that has been collected as above will be calculated one by one until it reaches the water balance.

4.2.1. Effective Rain

How to find effective rain by averaging the three rain stations over a period of 10 years of observational data then the data is sorted from largest to smallest. The 80 ranking sequence taken is then included in the effective rain count.

4.2.2. Mainstay Discharge

How to find a reliable debit, namely by averaging the debit data for seven years from 2013 to 2019, then the data is ranked from the largest data to the smallest data then ranked and ranked 80.

4.2.3. Evapotranspiration The

data required when calculating evapotranspiration is temperature, humidity, brightness and wind speed. The data was obtained from BMKG Karangploso Malang in 2018.

4.2.4. Water Needs in Paddy Fields (NFR)

Water needs in paddy fields include water needs for land processing, water needs for nurseries / nurseries, water needs for replacing water layers, and water needs for plants.

4.2.5 Water Balance

From the results of the above calculations, it can be directly used to calculate the balance of water demand in the Pacal Irrigation Area. These data, among others, can be exemplified in November period I as follows:

Table 1. Water Balance Calculation Results

Moon	Period	Availability of Irrigation Water (Lt/Dt)	Availability of Irrigation Water (M ³ /Dt)	Irrigation Water Needs (M ³ /Dt)	Irrigation Water Needs (M ³ /Dt)	Lack of Irrigation Water (M ³ /Dt)	Information	Water Delivery System
November	1	188	0,188	0.583	-0.395	0.395	Not Fulfilling	Rotation
	2	180	0,180	0.680	-0.500	0.500	Not Fulfilling	Rotation
	3	266	0,266	0.569	-0.304	0.304	Not Fulfilling	Rotation
December	1	274	0,274	0.000	0.274	0.000	Fulfil	Continuously
	2	275	0,275	0.077	0.198	0.000	Fulfil	Continuously
	3	284	0,284	0.241	0.044	0.000	Fulfil	Continuously
January	1	742	0,742	0.169	0.573	0.000	Fulfil	Continuously
	2	949	0,949	0.091	0.859	0.000	Fulfil	Continuously
	3	1026	1,026	0.083	0.943	0.000	Fulfil	Continuously
February	1	1059	1,059	0.000	1.059	0.000	Fulfil	Continuously
	2	1045	1,045	0.000	1.045	0.000	Fulfil	Continuously
	3	1441	1,441	0.000	1.441	0.000	Fulfil	Continuously
March	1	1045	1,045	0.312	0.733	0.000	Fulfil	Continuously
	2	1045	1,045	0.367	0.677	0.000	Fulfil	Continuously
	3	1023	1,023	0.294	0.729	0.000	Fulfil	Continuously

April	1	882	0,882	0.402	0.480	0.000	Fulfil	Continuousl y
	2	946	0,946	0.221	0.726	0.000	Fulfil	Continuousl y
	3	986	0,986	0,305	0.680	0.000	Fulfil	Continuousl y
May	1	852	0,852	0.262	0.589	0.000	Fulfil	Continuousl y
	2	784	0,784	0.408	0.376	0.000	Fulfil	Continuousl y
	3	820	0,820	0.129	0.691	0.000	Fulfil	Continuousl y
June	1	722	0,722	0.310	0.411	0.000	Fulfil	Continuousl y
	2	710	0,710	0.192	0.518	0.000	Fulfil	Continuousl y
	3	710	0,710	0.284	0.426	0.000	Fulfil	Continuousl y
July	1	716	0,716	0.530	0.185	0.000	Fulfil	Continuousl y
	2	649	0,649	0.651	-0.001	0.001	Not Fulfilling	Rotation
	3	463	0,463	0.638	-0.174	0.174	Not Fulfilling	Rotation
August	1	346	0,346	0.613	-0.267	0.267	Not Fulfilling	Rotation
	2	355	0,355	0.396	-0.041	0.041	Not Fulfilling	Rotation
	3	287	0,287	0.450	-0.163	0.163	Not Fulfilling	Rotation
September	1	140	0,140	0.550	-0.410	0.410	Not Fulfilling	Rotation
	2	140	0,140	0.513	-0.373	0.373	Not Fulfilling	Rotation
	3	140	0,140	0.371	-0.231	0.231	Not Fulfilling	Rotation
October	1	140	0,140	0.415	-0.275	0.275	Not Fulfilling	Rotation
	2	140	0,140	0.567	-0.427	0.427	Not Fulfilling	Rotation
	3	140	0,140	0.308	-0.168	0.168	Not Fulfilling	Rotation

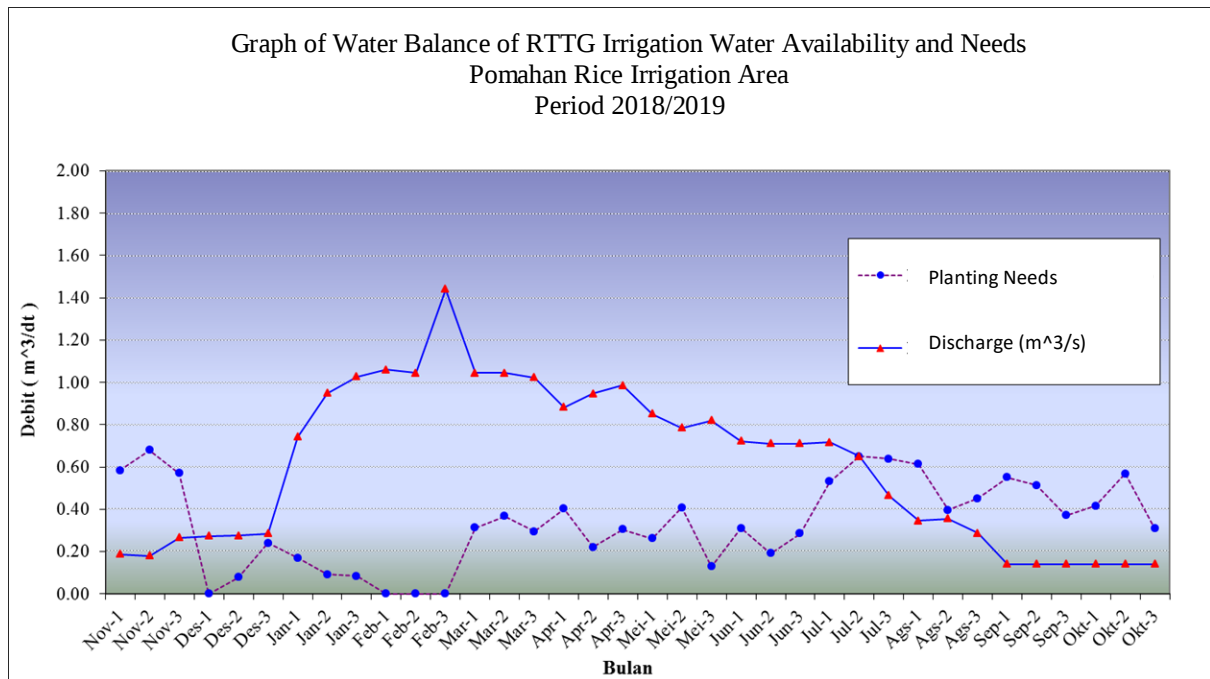


Figure 2. Water Supply Balance Graph

5. Conclusion and Recommendation

5.1. Conclusion

- The method used in calculating the water balance:
 - Rainfall using effective rainfall
 - For Rice: $0.7 \times R_{80}$
 - For Polowijo: $FD (1.25 \times (\text{Average2}) 0.824 - 2.93) (100.0095 \times E_{to})$
 - $FD = 0.53 + 0.0116.D - 8.94.10^{-5}.D^2 + 2.32.10^{-7}.D^3$
 - Discharge using reliable discharge
 - $Q = Q_{80 \text{ min}}$
 - Evapotranspiration using the Penman method
 - $E_{to} = c_x E_{to}^*$
 - water balance
 - $\Sigma \text{Availability} - \Sigma \text{needs} \geq 0$
- Results of water balance calculations indicate the dry season irrigation water demand in the area Pacal is 7304 m³/sec.
- The basic map of the Bojonegoro Regency area that has entered the GIS application is added with the location of the irrigation building and rainfall station by adding information to the legend.

5.2. Suggestion

- The results of the calculation of the balance of water needs in the Pacal Irrigation Area can be used by farmers to change cropping patterns because in the season there were plant pests when MK I switched to MK II, shortage of farmer labor, work aids in agriculture and the need for planting. land to match the acidity level of the land.
- As input for the Public Works Agency. Water Resources in Bojonegoro Regency to always regulate the operation of the water distribution system so that farmers can get water.

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Crashing Analysis on the Construction of The First Its Tower Building Using Time Cost Trade Off Method

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Abstract

A construction project is a series of activities carried out with a specific scope of work, time and expense according to the agreement between the project owners and the contractors. In the case of a project, it is necessary to file a task so that it can run smoothly and carry out according to plan times.

An optimum time and expense analysis of the job involved time cost trade off for case studies of the advanced construction of the tower's 1 (one) located on the campus of ITS Sukolilo - Surabaya. Analysis runs to speed up project time that is tardiness with minimal costs added and should be noted on the other hand that the emphasis on activities that are on critical trajectories and have the lowest cost slope on those tracks. Steps made in this acceleration are identifications of job activity, arranging network diagrams, specifying acceleration scenarios, crashing duration and crashing cost, calculating cost slope, and do the iteration phase. After a time cost trade off analysis, it would provide output with multiple time and cost alternatives to the new project. Of the many alternatives, selected the time and expense of the completion of the project optimum.

From the analysis, to complete the work at completion time according to plan, the cost increased by IDR 474.268.897,00 from IDR 9.919.982.348,00 to IDR 10.394.251.245,00 with a 32 day reduction from 180 days to 148 days so that the project could be completed as expected on March 2, 2021.

Keywords:

Crashing Analysis, critical path, cost, time first tower of ITS Campus and Time Cost Trade Off.

1. Introduction

In building construction, the delay in completing the building construction project means that the implementing contractor must pay a penalty (penalty) for the delay in accordance with the contract agreement with the project owner which is not small in number. In addition, project delays also result in decreased confidence of project voters to cooperate again with implementing contractors in the future, especially if the project owner is a government agency. For this reason, it is necessary to have a planning and scheduling for building construction so that it is accepted by the project owner on time.(Chusnia Idawati, 2019)

It is inevitable that every implementation practice has various possibilities that can cause delays, for example delays in implementation, design changes, weather effects, delays in material supply, construction failures, and planning errors. If this happens, the supervisory consultant in the field must quickly and accurately provide a solution to the delay.

To do an acceleration, it is necessary to learn about the existing network and the relationship between time and cost in carrying out an acceleration. By utilizing the optimal time, the alternatives used to support the acceleration carried out are to increase working hours, increase labor force, or add construction equipment. One of the methods that can be used to analyze the project acceleration is Time and Cost Exchange Analysis.

The purpose of this method is to accelerate the time of project completion and to analyze the extent to which time can be shortened by adding minimum costs to activities that can be accelerated by the time of work. So that we can know the maximum acceleration and the minimum cost. This method provides an alternative solution for project planners to arrange the best planning so as to optimize the time and cost in project completion.

In the continued project of the construction of the ITS Tower 1 stage V located at the ITS Sukolilo Campus, Surabaya, East Java, this starts on September 4, 2020 with an implementation period of 6 months or is planned to be completed on March 2, 2021. However, until November 2020 the development progress is still running at around 10%, where the project should have been 27%. The continued project for the construction of the ITS Tower 1 Building experienced delays in architectural and mechanical electrical work.

There are several alternative ways to overcome this delay, namely by increasing the number of workers, working groups, having overtime hours, and adding work equipment. Therefore, the contractor needs to do a careful rescheduling so that the project can still be completed faster at optimum cost. Based on the literature and

problems that occur in the field, the author conducted research on the Analysis of the Acceleration of Further Work for the Construction of the ITS Tower Building 1 (One) with the Time Cost Trade Off Method.

2. Methodology

2.1 Research Concept

This type of research is a descriptive approach quantitative because this research is demanding use of numbers, starting from data collection, interpretation of these data, as well as appearance and the result. In this study, the type of non-test instrument was used because one of the data collection techniques used was using interviews, observation, and documentation to collect data.

2.2. Collecting data

Microsoft Excel Project schedule obtained from PT. Citra Mandiri Cipta as a Constructor. With the data obtained from the project implementation time, then determine the relationship between activities based on the sequence of work in the field and based on a predetermined project schedule. The relationship between these activities is adjusted to when this activity must be started and when it must be completed. The relationship between activities is obtained from the schedule in the field, which is then translated into sub-jobs. In determining the relationship between activities, it has been consulted with the implementer in the field so that the relationship between activities becomes more in line with the reality on the ground.

2.3. Network Diagram

After primary and secondary data are completed the next step is to develop a network diagram to identify the work and establish a critical path by using the MS. Project Application. This program can assist in setting up a network even with a large number of work items. From the results of scheduling carried out with Microsoft Project, it will be known the lists of activities that are included in critical activities.

Table 1. Critical Activities

Code	Activities	Duration
1	Preparation	31 days
2	Coloumn	5 days
3	Brick wall	6 days
5	Brickwall layering + finishing	4 days
13	Homogeneous Tile 60x60cm (HT1)	10 days
16	Gypsumboard 9mm (PG) + Hollow Galvalume frame	8 days
17	Acoustic Gypsum Tyle 600x1200 (PG1) + Acoustic Cross Tee Main Tee frame	5 days
19	Interior Painting	6 days
25	Clear Glass 12mm (KC1)	3 days
27	Clear Glass for partition	3 days
28	Doors and windows	10 days
39	Main stairs Railling	3 days
40	Void Railling	3 days
45	Floor Drain TX 1 AV1N + Closet, TOTO Type CW 421 J + Urinal Body, TOTO Type UW 447 JT1M	2 days
46	Shower Spray, TOTO Type TX 423 SMCRB	2 days

2.4. Time Cost Trade Off Analysis

In determining the acceleration of the work time of a project, a scenario is made by increasing the number of tools, the number of workers and the number of groups of workers so that the productivity of tools and labor increases. After the selected the scenario, calculate analysis is required to crash cost and crash duration. (Andi Maddepungeng, 2015)

For Example adding manpower :

Brickwall, 1 Pc : 2 Ps ; Citicon (PC2)

Volume : 655,373 m²

Unit Price : IDR. 239.195,00 x 655,373 m² = IDR. 156.762.181,00

Material Unit Price : IDR 83.065,00

Material Cost : IDR 83.065,00 x 655,373 m² = IDR 54.438.531,00 m²/day

Normal Duration : 6 days

Total Manpower : 10 Man Power

Normal Productivities := (655,373 m²)/(6 days) = 109,23 m²/day = (109,23 m²/day)/(10 man)

$= 10,923 \text{ m}^2/\text{day}/\text{man}$
 Wage Unit Price : IDR 156.130,00
 Normal wage per day : IDR 156.130,00 x 655,373 m² = IDR 102.323.650,00 /day
 It is planned to add a workforce of 10 people with the same number of productivities at 10,923 m²/day/man which resulted in an additional fee of Rp. 500,000.00 / man.

So that productivity crashing : $= (10,923 \text{ m}^2/\text{day}/\text{man} \times 10 \text{ man}) + (10,923 \text{ m}^2/\text{day}/\text{man} \times 10 \text{ man})$
 $= 218,458 \text{ m}^2/\text{day}$

Crash Duration $= \frac{\text{Volume}}{\text{Crashing Productivities}} = \frac{655,373 \text{ m}^2}{218,458 \text{ m}^2/\text{day}} = 3 \text{ days}$

Crash Cost $= (\text{Normal wage} \times \text{total manpower} \times \text{crash duration}) + \text{fee by adding manpower} \times \text{material cost}$
 $(\text{IDR}.102.323.650,00 \times 10 \text{ man} \times 3 \text{ day}) + (\text{IDR}.500.000,00 \times 5 \text{ man}) + \text{Rp. } 54.438.531,00,00 = \text{Rp. } 161.762.181,00/\text{day}$

So that it can be summarized :

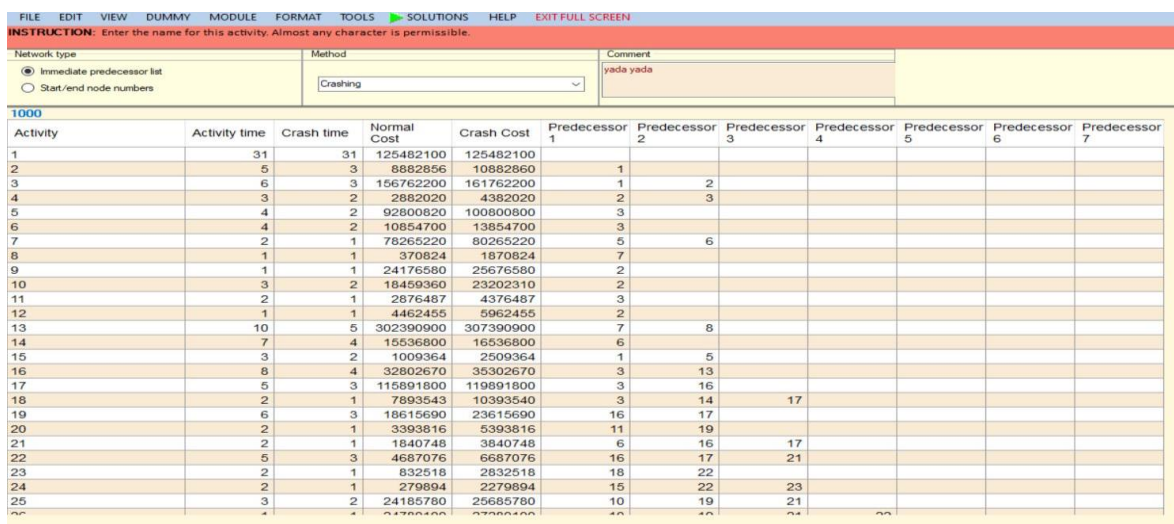
Normal Cost = IDR. 156.762.181,00

Crashing Cost = IDR. 161.762.181,00

Normal Duration = 6 Days

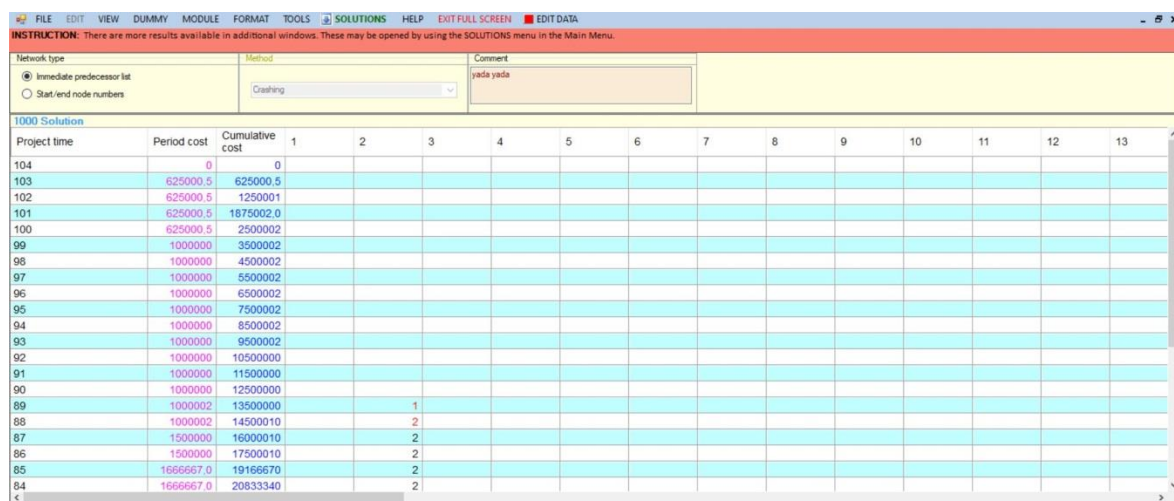
Crashing Duration = 3 Days

After calculating the duration and cost, the next step is to determine which activities will be accelerated along with the time and costs using the Quantitative Method For Windows Application. This application helps make it easier to analyze automatically by inputting the normal duration, crash duration, normal cost and crash cost of each activity into the Application. Normal duration and normal cost data are obtained directly from the project, so no more calculations are made to determine these costs. Output data from this analysis by using QM For Windows is total crash cost, crash duration and cost slope.



Activity	Activity time	Crash time	Normal Cost	Crash Cost	Predecessor 1	Predecessor 2	Predecessor 3	Predecessor 4	Predecessor 5	Predecessor 6	Predecessor 7
1	31	31	125482100	125482100							
2	5	3	8862856	10882856	1						
3	6	3	156762200	161762200		2					
4	3	2	2882020	4382020			3				
5	4	2	92800820	100800800				3			
6	4	2	10854700	13854700					3		
7	2	1	78265220	80265220			6				
8	1	1	370824	1870824							
9	1	1	24176580	25676580							
10	3	2	18459360	23202310							
11	2	1	2876487	4376487							
12	1	1	4462455	5962455							
13	10	5	302390900	307390900							
14	7	4	15536800	16536800							
15	3	2	1009364	2509364							
16	8	4	32802670	35302670							
17	5	3	115891800	119891800							
18	2	1	7893543	10393540							
19	6	3	18615690	23615690							
20	2	1	3393816	5393816							
21	2	1	1840748	3840748							
22	5	3	4687076	6687076							
23	2	1	832518	2832518							
24	2	1	279894	2279894							
25	3	2	24185780	25685780							

Figure 1. Input data QM For Windows



Project time	Period cost	Cumulative cost	1	2	3	4	5	6	7	8	9	10	11	12	13
104	0	0													
103	625000.5	625000.5													
102	625000.5	1250001													
101	625000.5	1875002.0													
100	625000.5	2500002													
99	1000000	3500002													
98	1000000	4500002													
97	1000000	5500002													
96	1000000	6500002													
95	1000000	7500002													
94	1000000	8500002													
93	1000000	9500002													
92	1000000	10500000													
91	1000000	11500000													
90	1000000	12500000													
89	1000002	13500000													
88	1000002	14500010													
87	1500000	16000010													
86	1500000	17500010													
85	1666667.0	19166670													
84	1666667.0	20833340													

Figure 2. Output data QM For Windows

2.5. Indirect Cost

A reduction in the duration of the project will result in an increase in direct costs, but the indirect costs of the project will be reduced. In this project, indirect costs consist of fixed costs and variable costs. Where the costs included in the fixed cost consist of the cost of temporary project facilities, the cost of risk of damage and others. Meanwhile, the costs included in the variable cost are office overhead costs and field overhead costs. Office overhead costs are all costs for planning and executing personnel consisting of project heads, site managers, civilians, architects, engineering staff, project administration staff, security staff, and others. Meanwhile, costs for field overhead consist of reporting costs to directors, cleaning costs for equipment maintenance, field meeting costs, and others. (Andi Maddepungeng, 2015)

3.Result

After obtaining all the required time and cost compression data from the QM For Windows program, the next step is to calculate the optimum time and cost of the crashing. To find out more about the results of crashing, one of the ways is to create a table with the following formula.

$$\text{Total Cost} = \text{Direct Cost} + \text{Indirect Crash Cost}$$

Table 2. Total Cost

Duration (day)	Direct Cost (IDR)	Indirect Cost (IDR)	Total Cost (IDR)
104	9.919.982.348	604.026.127	10.524.008.475
100	9.922.482.350	580.794.353	10.503.276.703
95	9.927.482.350	551.754.636	10.479.236.985
90	9.929.482.354	522.714.918	10.452.197.272
88	9.931.482.358	511.099.031	10.442.581.389
87	9.932.982.358	505.291.087	10.438.273.445
86	9.934.482.358	499.483.144	10.433.965.501
85	9.936.149.025	493.675.200	10.429.824.225
83	9.941.149.026	482.059.313	10.423.208.339
80	9.946.149.027	464.635.483	10.410.784.509
79	9.948.149.027	458.827.539	10.406.976.566
77	9.952.149.027	447.211.652	10.399.360.679
76	9.954.149.027	441.403.708	10.395.552.735
75	9.959.579.335	435.595.765	10.395.175.100
73	9.970.579.319	423.979.878	10.394.559.197
72	9.976.079.311	418.171.934	10.394.251.245
71	9.982.079.311	412.363.991	10.394.443.301

The charts between project completion time and total project cost is used to compare the alternative additional costs for the benefits. In general, this line can be considered as a straight line. If we know the shape of the time curve of an activity, meaning by knowing some o slopes or slope angles, it can be calculated how much it will cost to shorten the time and cost of one day

The result from the calculation by using Time Cost Trade Off Method.

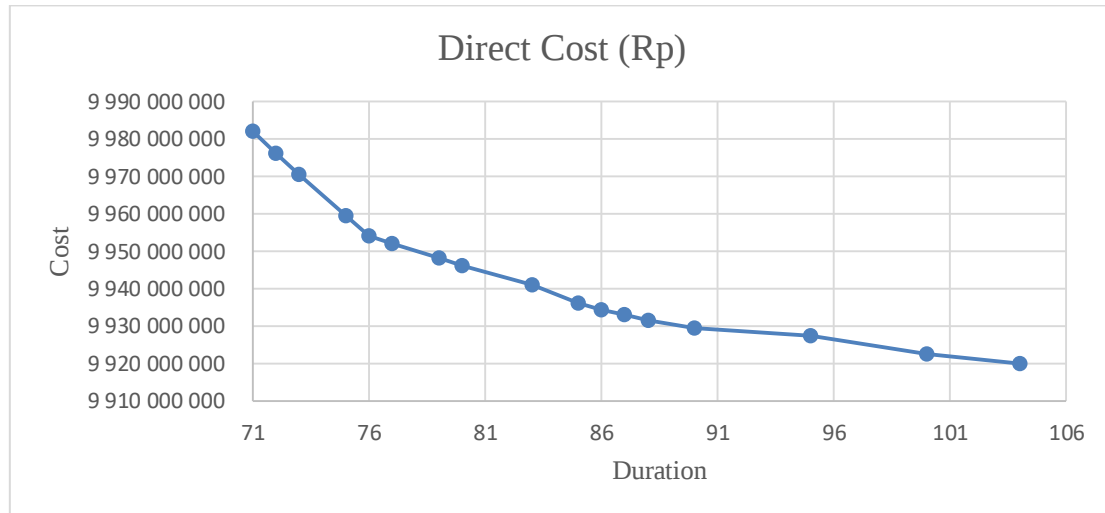


Figure 3. Direct Cost Curve

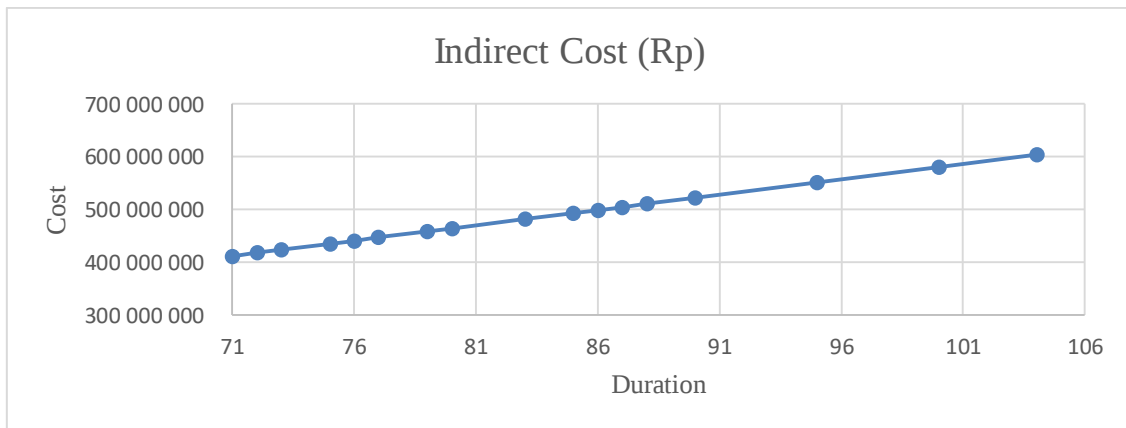


Figure 4. Indirect Cost Curve

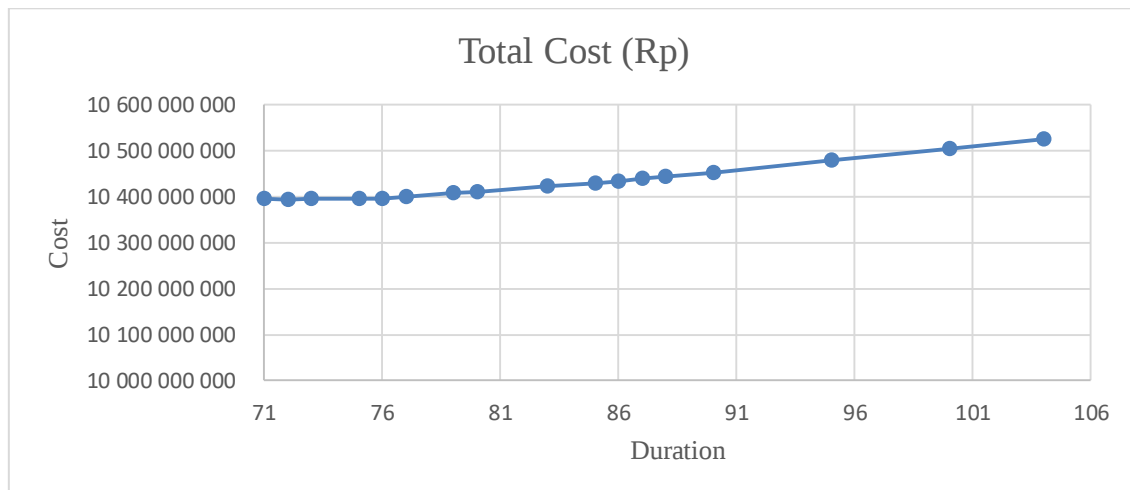


Figure 5. Total Cost Curve

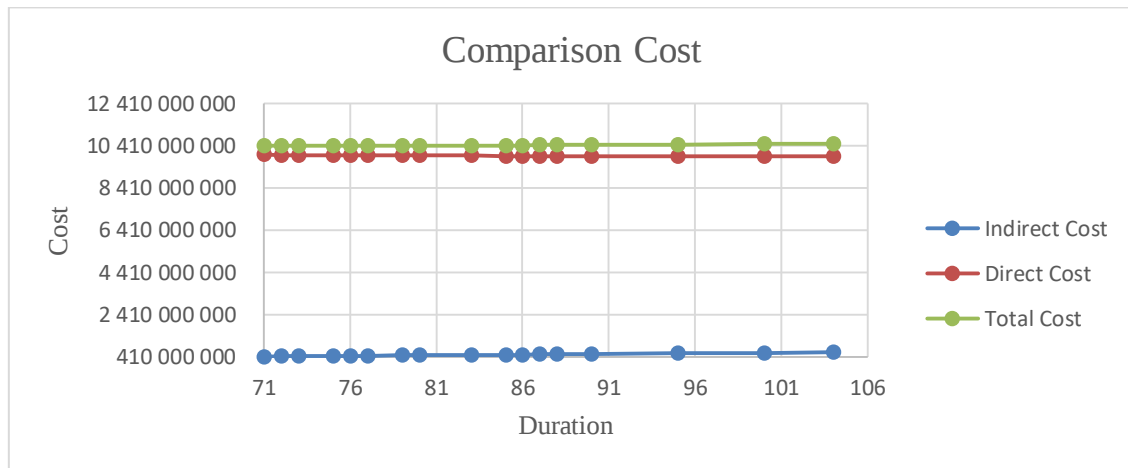


Figure 6. Comparison Cost Curve

3.1. Duration

Based on the table 7. Total Cost the optimum time is taken by the optimum cost which is the duration which have minimum cost at 72 days. The total normal duration of the Continuation work of the ITS Tower 1 (First) Building is 180 days and the duration after acceleration is 148 days. Then the total acceleration duration of the Continuation work of the ITS Tower 1 (One) Building is 32 days. (Andi Maddepungeng, 2015)

3.2. Cost

Based on the table 7. Total Cost the normal cost of the Continuation work of the ITS Tower Building 1 (First) is Rp. 9,919,982,348.00 and the cost after acceleration is Rp. 10,394,251,245.00. Then it can be determined for the total acceleration price of the Continuation work of the ITS Tower Building 1 (First) is Rp. 474,268,897.00. (Andi Maddepungeng, 2015)

4. Conclusions

Based on the analysis of the calculations that have been carried out in the discussion, then the things that can be concluded from this final project include :

The work that will be carried out is accelerated by applying the Time Cost Trade Off method, namely architectural work. Critical works on this research are :

Table 3. conclusion

Code	Activities
1	Preparation
2	Coloumn
3	Brick wall
5	Brickwall layering + finishing
13	Homogeneous Tile 60x60cm (HT1)
16	Gypsumboard 9mm (PG) + Hollow Galvalume frame
17	Acoustic Gypsum Tyle 600x1200 (PG1) + Acoustic Cross Tee Main Tee frame
19	Interior Painting
25	Clear Glass 12mm (KC1)
27	Clear Glass for partition
28	Doors and windows
39	Main stairs Railling
40	Void Railling
45	Floor Drain TX 1 AV1N + Closet, TOTO Type CW 421 J + Urinal Body, TOTO Type UW 447 JT1M
46	Shower Spray, TOTO Type TX 423 SMCRB

From the results of the rescheduling of the Continuation Work for the Construction of the ITS Tower 1 (One) Building with the Time Cost Trade Off (TCTO) method, it was found that the completion time due to acceleration was 148 days from the duration of completion of 180 days, so 32 days of acceleration was needed so that the project could be completed according to the planned target.

The total cost due to acceleration is Rp. 10,394,251,245.00 from the previous cost of Rp. 9,919,982,348.00, there is an additional cost of Rp. 474,268,897.00

5. Suggestions

1. In the Continuation Work of the ITS Tower 1 (One) Building, the progress of the work is delayed by 17%, it is necessary to accelerate the time so that the completion time of the work can be completed as planned, namely on March 2, 2021
2. By analyzing the acceleration of work using the time cost trade off method, it can produce the optimum acceleration time and cost of a job.

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Analysis of Drainage System Planning in Newtown Park Housing Development Sidoarjo District

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Abstract

Some areas in Indonesia often experience flood problems, therefore it is necessary to have an adequate and good drainage system planning so that community activities in an area are not disturbed. The location of this research is located in the newtown park housing development in Damarsih Village, Buduran District, Sidoarjo Regency. with land area $\pm 72.548 \text{ m}^2$. Rain station data used were from Bono, Sruti, Sedati, Banjarkemanten in the period 10 years 2009-2019. The direction of discharge of water from the study site was directed at small afv pepe, then continued to afv pepe. With the analysis of HSS Nakayashu at the 25 year return period, the discharge that occurred was not greater than the carrying capacity of Small afv pepe and afv pepe. The maximum discharge that occurs at the research location with the Rational method is $17,404 \text{ m}^3/\text{s}$, the maximum discharge in the Weduwen method is $27,917 \text{ m}^3/\text{s}$. Rational Discharge was chosen because the calculation of the length of rain can be known for sure so as to strengthen the level of certainty of the results obtained. For the capacity requirements in the research location with the rational method, the peak discharge for the 5-year return period is $1,858 \text{ m}^3/\text{s}$ and the volume of capacity required during high rain (27 minutes) is 3009 m^3 and can be accommodated with a drainage channel of 5217.43 m^3 and bozem. with a capacity of 720 m^3 which has an area of 400 m^2 with a depth of 1.8 m .

Keywords:

Flood, Discharge, Rational, Weduwen,

1. Introduction

1.1. Research Background

Housing is an area designated as a residence where there are many human activities such as education, religion, culture, etc. In order for the activities carried out in the area not to be disturbed, it is necessary to fulfill adequate facilities and infrastructure. One of the aspects is a good drainage channel to avoid flooding problems.

Flooding is one of the consequences of environmental pollution which is influenced by human activities, starting from land conversion and the lack of rainwater catchment areas and this is exacerbated by the lack of human awareness to maintain environmental cleanliness. In the rainy season, many drainage channels already exist but the existing condition cannot accommodate water due to a high accumulation of sediment and garbage, which will cause puddles or flooding in the area.

Drainage is one of the ways that can be done to minimize the occurrence of flooding by processing rainfall data obtained from the nearest rain station in the area under review so that the average rainfall that occurs in a certain area is obtained and the calculation of the planned discharge with several methods including Rational and Weduwen. it can be obtained that the maximum discharge that occurs in the area under review. So that it can be calculated the required drainage channel capacity required.(Fachmi Irawan, 2015)

1.2. Problem Formulation

1. What determinants can cause flooding in the area?
2. How is the Maximum Debit Calculation using the Weduwen and Rational Method in Newtown Park Housing?
3. What is the Need for Channel Dimensions to accommodate the Maximum discharge that occurs at Newtown Park Housing?

2. Literature Review

2.1. Drainage

Drainage is a water network system that is useful for avoiding the area from inundation or flooding. Drainage means draining, draining, removing, or diverting water. (Eldo Fikri Alvin, 2017)

2.2. Stages of Calculation

In this research, the calculation stages include :

1. Calculation of the average rain Polygon Thiesen $R = \frac{(A1.R1 + A2.R2 + \dots + An.Rn)}{A1 + A2 + \dots + An}$ (1)

2. Calculation Log Person Tipe III $Y = Y - k S$ (2)

3. Distribution Test Chi-Square $\chi^2 = \sum_{i=1}^G \frac{(Of - Ef)^2}{Ef}$ (3)

4. Smirnov-Kolmogorov distribution test, the maximum value of D is not greater than the table Smirnov-Kolmogorov

5. Rain Intensity Analysis $I = \left(\frac{R24}{24}\right) \times \left(\frac{24}{A}\right)^{2/3}$ (4)

6. Calculation of Concentration Time $Tc = \left(\frac{0.87 \times L^2}{1000 \times So}\right)^{0.385}$ (5)

7. Calculation of the maximum debit by the Rational Method

$$W = 72 \times \left(\frac{H}{L}\right)^{0.6}$$
 (6)

$$Tc = \frac{L}{W}$$
 (7)

$$I = \frac{R24}{24} \times \left(\frac{24}{Tc}\right)^{\frac{2}{3}}$$
 (8)

$$Qt = \frac{(C \times I \times A)}{3.6} = 0.278 \times C \times I \times A$$
 (9)

8. Calculation of the Maximum Debit of the Weduwen Method

$$\beta = \frac{120 + \frac{t+1}{t+9}A}{120 + A}$$
 (10)

$$\alpha = 1 - \frac{4.1}{\beta \times qn + 7}$$
 (11)

$$I = \frac{Rn}{240} \times \frac{67.65}{t + 1.45}$$
 (12)

$$t = 0.25 \times L \times Q^{-0.125} \times I^{-0.25}$$
 (13)

$$Q \text{ Maks} = \alpha \times \beta \times qn \times A$$
 (14)

9. Selection of maximum debit

Comparing the results obtained from the results of the Weduwen and Ratioanal methods in order to get the most appropriate results.

10. Calculation of Channel Dimensions

$$V = \frac{1}{n} \times R^{\frac{2}{3}} \times S^{\frac{1}{2}}$$
 (15)

$$R = \frac{A}{P}$$
 (16)

$$A = B \times H$$
 (17)

$$P = B + (2 \times H)$$
 (18)

$$Q = V \times A$$
 (The channel discharge must be greater than the planned debit) (19)

11. Volume Run Off Calculation

The Run off volume must not be greater than the total capacity of the channel

3. Methodology

3.1. Data source

This study uses two types of data namely. Primary data obtained from observations of existing canal measurements and mapping of existing drainage networks at the research location. Secondary data were obtained from several related agencies as well as the Sidoarjo Regency Construction Service.

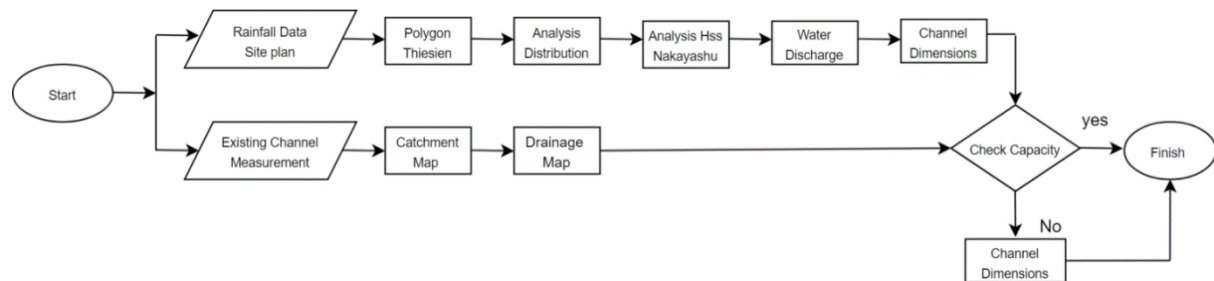


Figure 1. Flow Chart

3.2. Research sites



Figure 2. Research Location

The research location is located on Margo Utomo Street, Damarsih Village, Buduran District, Sidoarjo Regency. With a land area of $\pm 72,548 \text{ m}^2$ with many locations directly adjacent to the rice fields and ponds.

4. Result and Discussion

Rainfall data was taken from four rain stations namely Bono, Sruti, Sedati, Banjarkemanten. Daily rainfall data were taken from 2009-2019 with a total area of Drainage area small afv pepe of 18.75 km^2 and an area of Drainage area afv pepe 21 km^2 , with a total impact of 39.75 km^2 . Bono rain station (with an area of 5.73 km^2), Sruti rain station (with an area of 3.66 km^2), Sedati rain station (with an area of 21.90 km^2), Banjarkemanten rain station (with an area of 8.46 km^2). (Melisa Permatasari, M. Candra Nugraha, 2020)

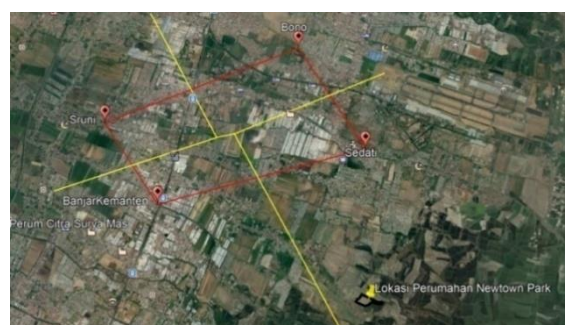


Figure 3. Rain Station map with Polygon Thiessen Method

Table 1. Average Rainfall With Polygon Thiessen Method

Year	Date	Rain Measuring Station				Total
		Bono	Sruni	Sedati	Banjarkemanten	
		0.144	0.092	0.551	0.213	
2009	23-Feb	10.80	8.74	44.08	13.85	77.465
2010	15-Oct	15.12	10.67	50.69	24.50	100.979
2011	17-Dec	20.16	14.81	83.75	26.63	145.349
2012	15-Jan	14.40	6.72	54.00	22.58	97.692
2013	02-Jan	16.56	8.37	78.24	26.63	129.799
2014	08-Mar	22.61	15.64	60.61	25.56	124.418
2015	19-Mar	14.40	15.64	52.35	20.87	103.259
2016	12-Feb	12.24	13.80	36.92	31.52	94.481
2017	30-Mar	7.92	6.81	22.04	14.91	51.678
2018	08-Mar	0.00	7.18	0.00	5.33	12.501
2019	23-Feb	10.08	8.37	33.06	21.30	72.812

Source : Calculation Results

After obtaining the maximum rainfall data using the Thiessen Polygon method, the frequency distribution is calculated as in the table below:

Table 2. Determination of Frequency Distribution

No	x	$\bar{x}$	$x - \bar{x}$	$(x - \bar{x})^2$	$(x - \bar{x})^3$	$(x - \bar{x})^4$
1	12.501	91.856	-79.355	6297.216	-499,715.58	39654929.67
2	51.678	91.856	-40.178	1614.272	-64,858.21	2605873.07
3	72.812	92.856	-20.044	401.7619	-8,052.92	161412.6532
4	77.465	91.856	-14.391	207.1009	-2,980.39	42890.77491
5	94.481	93.856	0.625	0.390625	0.24	0.152587891
6	97.692	91.856	5.836	34.0589	198.77	1160.008397
7	100.979	94.856	6.123	37.49113	229.56	1405.584754
8	103.259	91.856	11.403	130.0284	1,482.71	16907.38715
9	124.418	95.856	28.562	815.7878	23,300.53	665509.8064
10	129.779	91.856	37.923	1438.154	54,539.11	2068286.723
11	145.349	96.856	48.493	2351.571	114,034.73	5529886.398
Total	1,010.413	-	-	13327.83	-381,821.43	50748262.22

Source : Calculation Results

Get the value :

Cs = - 0.95 Get the value Cs = $\neq 0$ then the distribution selection used is Log Person Tipe III

Table 3. Calculation Log Person Tipe III

No.	X(mm)	Log X	$(\text{Log} x - \text{Log} x)$	$(\frac{\text{Log} x - \text{Log} x}{\text{Log} x})^2$	$(\frac{\text{Log} x - \text{Log} x}{\text{Log} x})^3$	$(\frac{\text{Log} x - \text{Log} x}{\text{Log} x})^4$
1	145.349	2.1624	0.2610	0.0681	0.0178	0.0046
2	129.779	2.1132	0.2118	0.0449	0.0095	0.0020
3	124.418	2.0949	0.1935	0.0374	0.0072	0.0014
4	103.259	2.0139	0.1125	0.0127	0.0014	0.0002
5	100.979	2.0042	0.1028	0.0106	0.0011	0.0001
6	97.692	1.9899	0.0885	0.0078	0.0007	0.0001
7	94.481	1.9753	0.0739	0.0055	0.0004	0.0000
8	77.465	1.8891	-0.0123	0.0002	0.0000	0.0000
9	72.812	1.8622	-0.0392	0.0015	-0.0001	0.0000
10	51.678	1.7133	-0.1881	0.0354	-0.0067	0.0013
11	12.501	1.0969	-0.8045	0.6472	-0.5206	0.4188
Total	1,010.413	20.92	0.000	0.8712	-0.4892	0.4285

Source : Calculation Results

Get the value $C_s = -2.3$ then look for the value in the K Factor table for the distribution of Type III Log Person indicated by the calculations and tables in the table below

Table 4. Rain Various Times with Log Person Tipe III

No.	Tr (year)	K	Log x	X (mm)
1	1.01	-3.705	0.8078	6.425
2	2	0.341	2.0021	100.47
3	5	0.739	2.1195	131.68
4	10	0.819	2.1431	139.04
5	20	0.43	2.1502	141.32
6	25	0.855	2.1538	142.48
7	50	0.964	2.1859	153.44
8	100	0.867	2.1573	143.65

Source : Calculation Results

Table 5. Distribution of Rain by Hour Log Person Tipe III Method

Time Hour	Ratio (%)	Rainfall Every Hour							
		1.01 Th	2th	5th	10th	20th	25th	50th	100th
		6.425	100.470	131.680	139.040	141.320	142.480	153.440	143.650
1	0.55	2.652	41.468	54.350	57.387	58.807	58.807	63.331	59.290
2	0.35	1.671	26.123	34.238	36.152	37.046	37.046	39.896	37.351
3	0.26	1.275	19.936	26.129	27.589	28.272	28.272	30.446	28.504
4	0.22	1.052	16.457	21.569	22.774	23.338	23.338	25.133	23.529
5	0.19	0.907	14.182	18.587	19.626	20.112	20.112	21.659	20.277
6	0.17	0.803	12.559	16.460	17.380	17.810	17.810	19.180	17.956

Source : Calculation Results

4.1. Calculation Rasional Method

Data :

Difference in elevation is viewed from the upstream area (H) = 0.044 Km

The length of the area is reviewed with the Hulu Area (L) = 76.2 Km

Data $R_{24 \text{ 5 Year}}$ = 131.68 mm/day

Drainage Area = $18.75 + 21$ = 39.75 Km^2

$W = 72 \times \left(\frac{H}{L}\right)^{0.6} = 72 \times \left(\frac{0.044}{76.2}\right)^{0.6} = 0.82$

$$T_c = \frac{L}{W} = \frac{76.2}{0.82} = 92.93$$

$$I = \frac{R_{24}}{24} \times \left(\frac{24}{T_c}\right)^2 = \frac{131.68}{24} \times \left(\frac{24}{92.93}\right)^2 = 2.25$$

$$Q = \frac{(C \times I \times A)}{3.6} = 0.278 \times C \times I \times A$$

$$Q = \frac{(0.7 \times 2.25 \times 39.75)}{3.6} = 17.404 \text{ m}^3/\text{s}$$

Table 7. Maximum Discharge Rational Method

Year	Q maksimum (m3/s)
1.01	0.839
2	13.125
5	17.404
10	18.163
20	18.461
25	18.612
50	19.914
100	18.675

Source : Calculation Results

4.2. Calculation Weduwen Method

Data :

 Drainage Area = 18.75 + 21 = 39.75 Km²

River Length = 9.38 + 10.05 = 19.88 Km

The mean slope of the river = 0.0012

 Data R₂₄ 5 Year = 131.68 mm/day

 t trial = **25.68 Hour**

$$\beta = \frac{120 + \frac{25.68+1}{25.68+9} 39.75}{120+39.75} = 0.942$$

$$\alpha = 1 - \frac{4.1}{0.942 \times 131.68 + 7} = 0.545$$

$$q_n = \frac{131.68}{240} \times \frac{67.65}{25.68+1.45} = 1.368$$

$$t = 0.25 \times 19.88 \times 0.942^{-125} \times 0.0012^{0.25} = 25.68 \text{ Hour (Corect)}$$

$$Q_t = Q_t = \alpha \times \beta \times q_n \times A = 0.545 \times 0.942 \times 1.368 \times 39.75 = 27.917 \text{ m}^3/\text{s}$$

Tabel 8. Debit Maksimum Metode Weduwen

Year	1.01 Th	2th	5th	10th	20th	25th	50th	100th
Qn	0.044	1.006	1.368	1.455	1.482	1.496	1.615	1.510
Beta	0.958	0.944	0.942	0.944	0.942	0.942	0.941	0.942
Alfa	12.784	0.383	0.545	0.572	0.58	0.584	0.614	0.588
Q (m3/s)	21.420	14.458	27.917	31.230	32.186	32.714	37.091	33.246
T (hour)	39.42	26.68	25.68	25.48	25.42	25.39	25.15	25.36

Source : Calculation Results

From the table above, it can be seen that the results of the discharge calculation using two different methods, namely the Rational Method and the Weduwen Method. Based on the results of calculations and considerations, safety and efficiency as well as the uncertainty of the amount of flood discharge that occurs in the area, the existing methods use a maximum return period of 5 years. Due to the consideration of the accuracy of the calculation results, the Rational Method design flood discharge was determined to be 17.404 m³ / s, because the length of rain (t) in the Rational Method was clearly known, thereby strengthening the level of certainty of the results obtained.

4.3. Calculation Drainage Dimension

Channel Length = 20.80 m

Channel Slope = 0.001

Channel Catchment Area = 0.0050 km²

Data R₂₄ 5 Year = 131.68 mm/hour

$$\text{Concentration time (tc)} = \left(\frac{0.87 \times L^2}{1000 \times s} \right)^{0.384} = \left(\frac{0.87 \times 0.02080^2}{1000 \times 0.001} \right)^{0.384} = 0.049 \text{ hour}$$

$$\text{Rain intensity (I)} = \left(\frac{131.68}{24} \right) \times \left(\frac{24}{0.049} \right)^{2/3} = 340.192 \text{ mm/hour}$$

Discharge return period flood plan 5 year

Planned Flood Discharge = 0.278 x 0.7 x 340.192 x 0.0050 = 0.331 m³/s

Planned Channels :

B = 0.80 m = 0; s = 0.00096 ; n = 0.013 (concrete mate)

Formula H = 1.00 m

A = B + (m x h) x h = 0.80 + (0 x 1.00) x 1.00 = 0.800 m²

P = B + (2xh) x ((m²+1)^{0.5}) = 0.80 + (2x1.00)x((0²+1)^{0.5}) = 2.800 m

$$R = \frac{A}{P} = \frac{0.800}{2.800} = 0.286$$

$$V = 1/n \times R^{2/3} \times s^{1/2} = 1/0.013 \times 0.286^{2/3} \times 0.00096^{1/2} = 1.035 \text{ m/s}$$

$$Q = V \times A = 1.035 \times 0.800 = 0.8278 \text{ m}^3/\text{s}$$

Q Plan / Q Chanel x 100%

$$0.8278 \times 100\% = 39.99 \%,$$

So that the Width (B) and height (H) of the Plan Channel are Appropriate, because the calculated discharge results are the same or greater than the rainfall plan discharge for the 5 year return period.

4.4. Calculation Capacity Channel

Land area = 72548 m² = 0.0725 km²

Flow Coefficient = 0.7

R₂₄ 5 Year = 131.68 mm/hour

Peak Discharge = 0.278 x C x I x A = 0.278 x 0.7 x 131.68 x 0.072 = 1.858 m³/s

In high rain (Tc) the volume of water that has occurred

$$T_c = \left(\frac{0.87 \times L^2}{1000 \times s} \right)^{0.384} = \left(\frac{0.87 \times 1.250^2}{1000 \times 0.01} \right)^{0.384} = 0.46 \text{ Hour} = 27 \text{ Minute}$$

$$\text{Volume Run Off} = 27 \text{ minute} \times 1.858 \times 60 = 3009 \text{ m}^3$$

$$\text{With a channel capacity of} = 5217.43 \text{ m}^3$$

Volume Bozem =

Large = 400 m²

$$\text{depth} = 1.8 \text{ m} = 400 \times 1.8 = 720 \text{ m}^3$$

Then the total capacity that can be accommodated becomes

$$5217.43 \text{ m}^3 + 720 \text{ m}^3 = 5937.43 \text{ m}^3$$

Then the capacity is greater than the volume run off of 3009 m³ The channel dimensions are in accordance and meet the requirements.

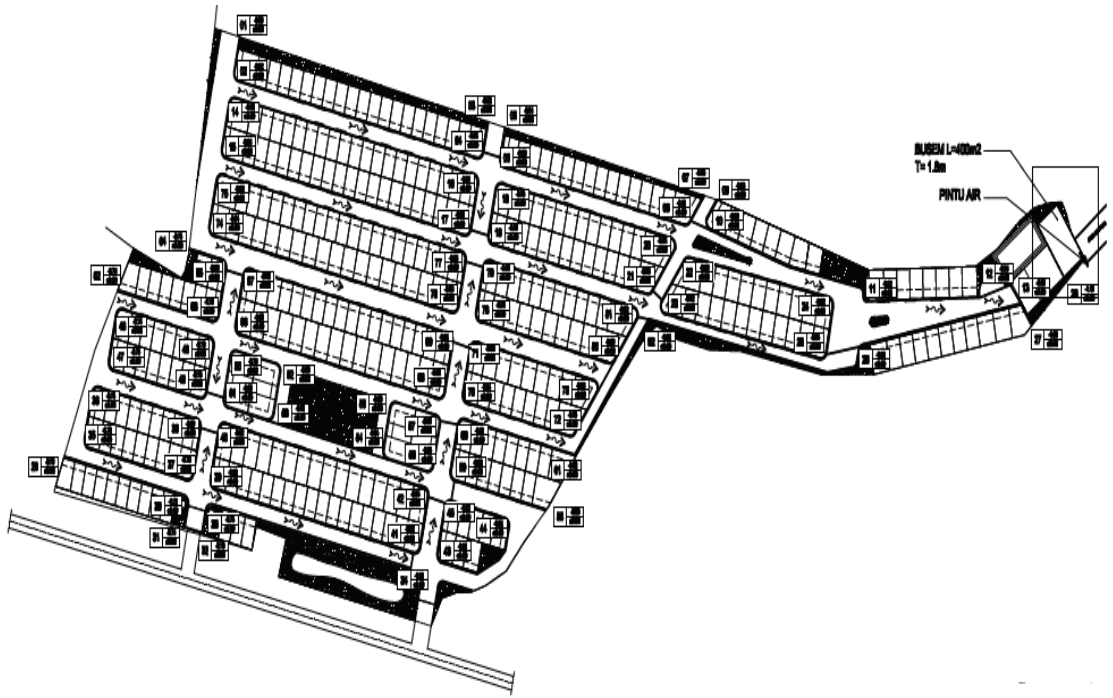


Figure 4. Site Plan

4. Conclusion and Suggestions

Based on the result of analysis of the research above it can concluded. Factors that can cause flooding in the Newtown Park Housing Development area. namely the lack of maintenance of drainage conditions and disposing of trash that is not in its place. The maximum debit with a return period of 5 years, the value obtained by the Rational Method is 17,404 m³/s and the maximum debit with a 5 year return period is obtained by using the Rational Method of 27,917 m³/s. With a channel capacity of 5217.43 m³ and a bozem of 720 m³, the total capacity is 5937.43 m³. So with a run off volume of 3009 m³, the channel dimensions have met the requirements. Based on the above conclusions, it is necessary to implement the following

- Maintenance of drainage channels is required so that there is no accumulation of sediment so as not to obstruct the channel.
- There needs to be a re-assessment within 5 years if the channel is not able to accommodate and causes flooding due to land subsidence and other natural factors.
- Increase public awareness about the importance of protecting the surrounding environment so that the area inhabited is free from flooding.

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Analysis of Boezem Kalidami Pump Capacity To Cope With Floods East Surabaya Region

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Abstract

Kalidami river has a length of 4.2 kilometers with a stretch of channels from the Airlangga, Manyar, Kertajaya, to Kejawan Putih Tambak areas. Boezem Kalidami is located at the downstream of the Kalidami river which is also equipped with a pump house and a water gate. The Log Pearson III method produces a design rainfall of 127.38 mm / 24 hours so that the rainfall is very heavy. So that it will produce a maximum flood discharge of 40.3 m³ / s and when compared to the capacity of Boezem Kalidami which is only 49,440 m³, Boezem Kalidami will fill very quickly. Coupled with the total efficient pump capacity of only 15.33 m³ / s, Boezem is only able to accommodate the first 2 hours and an overflow of 1.58 meters from Boezem Kalidami's riverside at 2.14.

Keywords:

Boezem, Drainase, Flood, Kalidami, Pump Efficiency.

1. Introduction

1.1. Research Background

The general concept of drainage used in Indonesia is the conventional drainage concept, namely drainage "ditching area". This conventional drainage is an attempt to remove or drain excess water as quickly as possible to the nearest river. In this concept, rainwater that falls into an area must be discharged as quickly as possible into the river and then flows into the sea. This concept is used thoroughly in residential, rural, agricultural areas, and others. (Syarifudin, 2017)

The most effective way to maximize drainage is to widen and deepen the drainage channel. However, for a metropolitan city like Surabaya is not easy to conduct land acquisition for widening the river. So a possible solution is to maximize the performance of the drainage pump. It takes careful planning to the selection of appropriate drainage pump capacity can be maximized so that its performance with regard to the calculation of rainfall plans to return period of 10 years.

1.2. Problem Formulation

From the above description, due to the capacity requirements planning adequate drainage pumps, the issues to be discussed at the Final are as follows:

- 1) What is the maximum runoff discharge for the planned rainfall of 2, 5, and 10 years?
- 2) How big is the capacity of the existing boezem as temporary overflow storage?
- 3) How much capacity and effectiveness of the drainage pump needed to speed up water flow so that water does not overflow when compared to the current condition of the drainage pump?

2. Literature Review

According to Abduh, (2018) drainage or it can be referred to as ditching, can be interpreted as the process of disposing of water naturally or it can be man-made by humans from a place. Disposal methods also vary as to how to drain, drain, remove, and can also be also to divert the water.

Kodoatie & Sjarief, (2010) made a sequence of water flow in the drainage. This can be explained as follows:

1. Rain falls evenly on the residential area (settlement) R, to the office area K, to industrial area I, and also to the factory area P, as well as other places and locations. Rainwater enters the area's quaternary drainage system;
2. From the quaternary drainage system, the water then flows into the tertiary drainage channel (St), or some of it is collected first in a new polder (Po) to St;

3. Ideally, dirty water can be collected in the polder (Po) first, then cleaned in the waste water treatment (Tw), very emphasis is placed on areas that dispose of new liquid waste and then flow it to a clean water pond (Ka), and finally the new excess water in drainage to the sewer (can be via St, Ss, then Sp);
4. From the tertiary drainage system (St) is drained to the secondary drainage channel (Ss);
5. All flows from the secondary drainage channel are channeled to the primary drainage channel (Sp).

3. Research Method

3.1. Flow Chart

The method used to process the data in this paper is descriptive and quantitative methods, namely by collecting data in the field of primary and secondary data from relevant agencies, as well as collecting the literature related to this research. Data analyzed in such a manner consistent with the theory outlined above. Then made a final conclusion about the drainage pump capacity required to cope with floods in the region of East Surabaya with planning a return period of 2, 5, and 10 years.

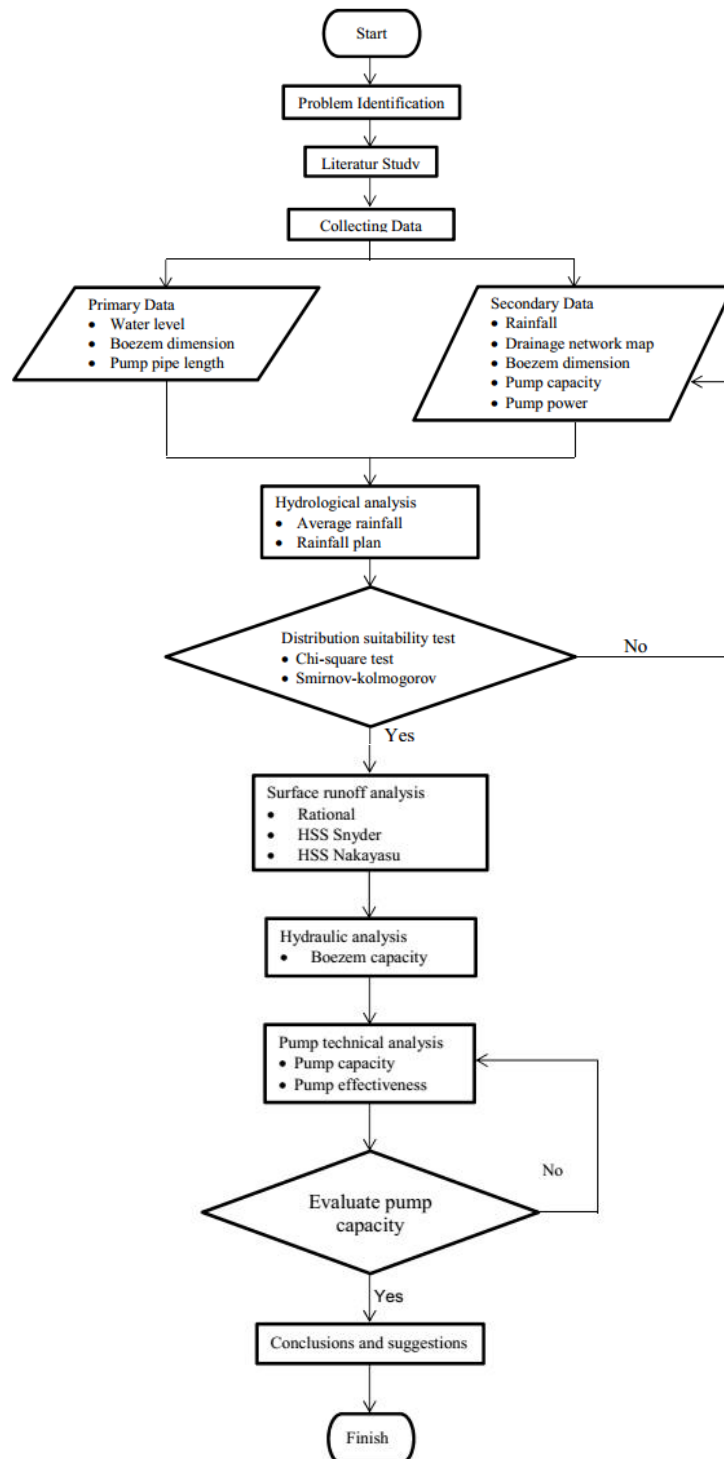


Figure 1. Research flow chart

3.2. Data Source

Table 1. Data source

No.	Data	Edition	Source	Typical
1	High water level	-	Survey	Primary data
2	Boezem dimention	-	Survey	Primary data
3	Pump pipe length	-	Survey	Primary data
4	Rainfall	2008-2018 (10 Years)	BMKG	Secondary data
5	Drainage network map	2013	DPUBMP	Secondary data
6	Boezem dimension	2016	DPUBMP	Secondary data
7	Pump capacity	2018	DPUBMP	Secondary data
8	Pump power	2018	DPUBMP	Secondary data

Source: Observations

4. Results and Discussion

There are 3 rain stations in the Kalidami watershed, namely: the Keputih rain station, the Gubeng rain station, and the Wonokromo rain station. In the calculation of the rainfall, not all areas of the rain station is used, only the territory contained in Kalidami DAS and affects the discharge occurred.

Table 2. Area

No.	Rain Station	Area (km ²)	Koefisien Thiessen (W)
1	Keputih	5.658	0.107
2	Gubeng	4.418	0.391
3	Wonokromo	1.209	0.501
	Total		11.285

Source: (Sari et al., 2017)

The formula used is the method of calculating the average algebra / arithmetic, as well as the calculation method Thiessen polygons, whereas Isohyets method is not used because the nearest rain station used contained only 3 stations of rain, while the method requires at least 4 stations Isohyets rain.

Table 3. Maximum rainfall data

No.	Year	Keputih	Gubeng	Wonokromo	Arithmetic	Thiessen
1	2009	120	86	104	103.33	104.98
2	2010	90	106	110	102	98.41
3	2011	72	81	98	83.67	78.31
4	2012	85	70	106	87	81.38
5	2013	80	99	87	88.67	88.19
6	2014	134	109	83	108.67	118.75
7	2015	84	61	63	69.33	72.75
8	2016	164	98	108	123.33	132.16
9	2017	124	116	114	118	119.80
10	2018	49	65	73	62.33	57.83
					$\Sigma = 946.33$	$\Sigma = 952.55$
					$\bar{X} = 94.63$	$\bar{X} = 95.25$

Source: Processed data by researchers (2021)

The statistical parameters were calculated for the Normal method and the Gumbel method consisting of the skewness coefficient or CS, and the kurtosis coefficient or CK.

$$S_x = \sqrt{\frac{5057.67}{(10-1)}} = 23.71$$

$$C_s = \frac{10 \times 7288.88}{(10-1)(10-2) 23.71^3} = 0.076$$

$$C_k = \frac{10^2 \times 4871726.91}{(10-1)(10-2)(10-3) 23.71^4} = 3.06$$

Then calculated the skewness coefficient or CS and the kurtosis coefficient or CK for distribution log Pearson III.

$$S_x = \sqrt{\frac{0.1134}{(10-1)}} = 0.1122$$

$$C_s = \frac{10 \times (-0.0036)}{(10-1)(10-2) 0.1122^3} = -0.3535$$

$$C_k = \frac{10^2 \times 0.0028}{(10-1)(10-2)(10-3) 0.1122^4} = 3.4641$$

The following are the results of the inclination coefficient and the peak coefficient from the Normal method, the Gumbel method, and the Log Pearson method, as well as the required requirements:

Table 4. Distribution requirements

No.	Type	Requirements	Calculation	Result
1	Gumbel	cs = 1.139	cs = 0.076	Does not meet
		ck < 5.402	ck = 3.061	Meet requirements
2	Normal	cs = 0	cs = 0.076	Does not meet
		ck = 3	ck = 3.061	Meet requirements
3	Log pearson III	cs = exempt	cs = -0.354	Meet requirements
		ck = exempt	ck = 3.464	Meet requirements

Source: Processed data by researchers (2021)

According to the conclusion above, the design rainfall data that will be used is the Log Pearson III method. Then, the above data will be tested with two different kinds of distribution fit test.

Table 5. Recapitulation of distribution suitability test

Distribution equation	Suitability Test							
	Chi Kuadrat Test				Smirnov-Kolmogorov Test			
	X ²	Nilai	Xh ²	Evaluation	Dmax	Nilai	D0	Evaluation
Log Pearson III	1	<	5.99	Accepted	0.0565	<	0.41	Accepted

Source: Processed data by researchers (2021)

It can be concluded that the Log Pearson III method can be used as a design rainfall calculation. Then the analysis of surface runoff that occurs can be calculated using three methods. According to Surabaya Drainage Masterplan concentrated rainfall that occurred in Surabaya on average for 5 hours. With this centralized average rainfall, the value of the hourly rain pattern can be seen with the following results:

Table 6. Hourly rain pattern

No.	Time T	Hourly rain pattern				Return Period		
		R _t	t.R _t	(t-1).R(t-1)	R't	2	5	10
1	1	0.58	0.58	0	0.58	25.73	31.61	34.90
2	2	0.37	0.74	0.58	0.15	6.69	8.22	9.07
3	3	0.28	0.84	0.74	0.11	4.69	5.76	6.36
4	4	0.23	0.93	0.84	0.08	3.74	4.59	5.07
5	5	0.2	1	0.93	0.07	3.15	3.87	4.28

Source: Processed data by researchers (2021)

Based on the three methods of surface runoff analysis above, it can be seen the highest flood discharge of each method as follows:

Table 7. Recapitulation of maximum flood discharge

No.	Method	Maximum flood discharge		
		2	5	10
1	Rasional	30.0192	36.8710954	40.7120272
2	HSS Snyder	22.8682	28.08788272	31.0138506
3	HSS Nakayasu	29.7161	36.49888531	40.3010433

Source: Processed data by researchers (2021)

The highest flood discharge results are using the rational method, but because the rational method does not have a time calculation such as HSS Snyder and HSS Nakayasu, the HSS Nakayasu method will be used. Which can be seen in the chart below flood discharges occurring ratio based on the period over.

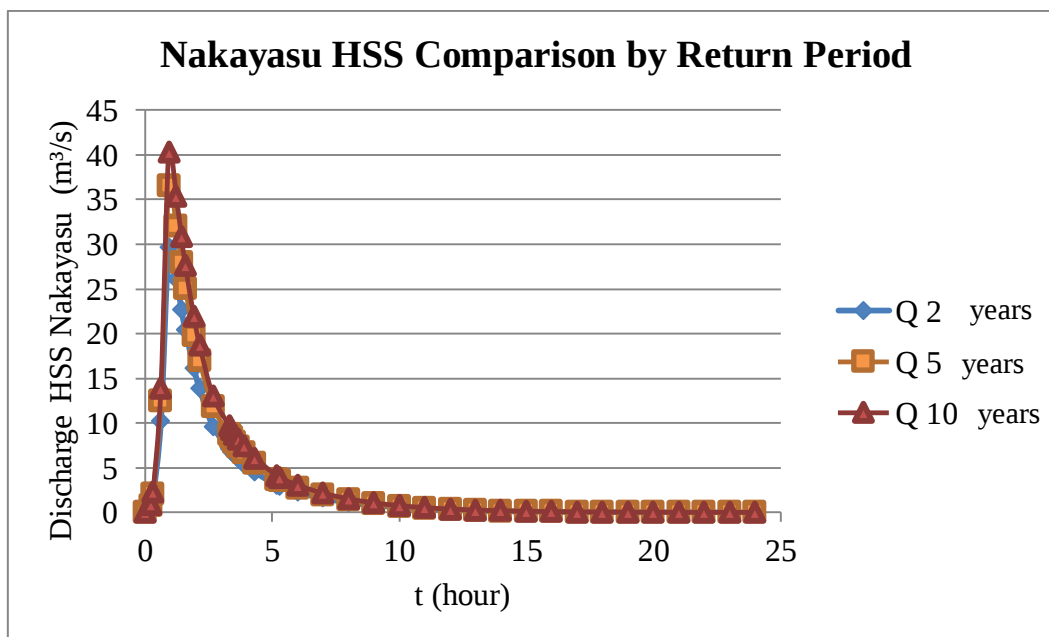


Figure 2. The comparison of the HSS Nakayasu flood discharge based on the return period

So if the pump house Boezem Kalidami has 7 pumps with each pump capacity is 3 m³/s, the total capacity of efficient amounted to 15.33 m³/s.

If recalculate flood routing by entering the pump efficiency as a factor in the calculation, the results will be as follows:

Table 8. Flood routing with a 3 m³/s pump with a return period of 10 years

No.	t	Δt	Q	V _{in}	n	Q _{pump}	V _{out}	V _{runover}	Annotation	H
1	0	0	0	0	0	0	0	0	-	-
2	0.23	835.37	0.91	761.32	0	0	0	-48679	Not runover	-
3	0.31	278.46	2.29	637.74	0	0	0	-48041	Not runover	-
4	0.62	1113.83	13.84	15412.43	0	0	0	-32629	Not runover	-
5	0.93	1113.83	40.30	44888.63	6	13.15	14641.2	-2381	Not runover	-
6	1.42	1779.04	30.84	54869.79	7	15.34	27282.7	25206	Run over	1.02
7	1.58	564.09	27.67	15610.48	7	15.34	8650.62	32165.86	Run over	1.30
8	2.14	2023.61	18.76	37959.04	7	15.34	31033.3	39091.55	Run over	1.58
9	2.67	1898.58	13.02	24726.89	7	15.34	29116	34702.49	Run over	1.40
10	3.32	2346.27	9.64	22624.46	7	15.34	35981.6	21345.37	Run over	0.86
11	3.41	330.46	9.24	3054.46	7	15.34	5067.83	19332	Run over	0.78
12	3.53	438.81	8.74	3834.20	7	15.34	6729.41	16437	Run over	0.66
13	4.32	2823.46	6.09	17182.70	6	13.14	37113.9	-3494.40	Not runover	-
14	5.18	3110.90	4.09	12709.08	5	10.95	34076.9	-24862	Not runover	-
15	5.28	348.07	3.91	1359.98	5	10.95	3812.8	-27315	Not runover	-
16	6	2595.23	3.04	7902.12	2	4.38	11371.3	-30784	Not runover	-
17	7	3600	2.15	7756.21	0	0	0	-23028	Not runover	-
18	8	3600	1.52	5488.18	0	0	0	-17540	Not runover	-
19	9	3600	1.08	3883.36	0	0	0	-13657	Not runover	-
20	10	3600	0.76	2747.81	0	0	0	-10909	Not runover	-
21	11	3600	0.54	1944.31	0	0	0	-8964.38	Not runover	-
22	12	3600	0.38	1375.76	0	0	0	-7588.61	Not runover	-
23	13	3600	0.27	973.47	0	0	0	-6615.14	Not runover	-
24	14	3600	0.19	688.81	0	0	0	-5926.33	Not runover	-
25	15	3600	0.14	487.39	0	0	0	-5438.93	Not runover	-
26	16	3600	0.10	344.87	0	0	0	-5094.06	Not runover	-
27	17	3600	0.07	244.03	0	0	0	-4850.03	Not runover	-
28	18	3600	0.05	172.67	0	0	0	-4677.36	Not runover	-
29	19	3600	0.03	122.18	0	0	0	-4555.18	Not runover	-
30	20	3600	0.02	86.45	0	0	0	-4468.73	Not runover	-
31	21	3600	0.02	61.17	0	0	0	-4407.56	Not runover	-
32	22	3600	0.01	43.28	0	0	0	-4364.27	Not runover	-
33	23	3600	0.01	30.63	0	0	0	-4333.64	Not runover	-
34	24	3600	0.01	21.67	0	0	0	-4311.97	Not runover	-

Source: Processed data by researchers (2021)

If it is planned to add up to 10 pumps with additional capacity of each pump up to 5 m³/s, but with a similar efficiency of 73.03%, the total efficient capacity of the planned pumps is 36.51 m³/s. By calculating the previous flood routing but replaced with a pump capacity of the pump capacity of the plan will result in the calculation as follows:

Table 9. Flood routing with a 5 m³/s pump with a return period of 10 years

No.	t	Δt	Q	V _{in}	n	Q _{pump}	V _{out}	V _{runover}	Annotation	H
1	0	0	0	0	0	0	0	0	-	-
2	0.23	835	0.91	761.32	0	0	0	-3550.65	Not run over	-
3	0.31	278	2.29	637.74	0	0	0	-2912.92	Not run over	-
4	0.62	1114	13.84	15412.43	4	14.61	16267.96	-3768.45	Not run over	-
5	0.93	1114	40.30	44888.63	10	36.51	40669.91	450.27	Run over	0.02
6	1.42	1779	30.84	54869.79	9	32.86	58462.99	-3142.94	Not run over	-
7	1.58	564	27.67	15610.48	7	25.56	14417.70	-1950.16	Not run over	-
8	2.14	2024	18.76	37959.04	6	21.91	44333.36	-8324.48	Not run over	-
9	2.67	1899	13.02	24726.89	5	18.26	34661.85	-18259.44	Not run over	-
10	3.32	2346	9.64	22624.46	4	14.61	34268.16	-29903.14	Not run over	-
11	3.41	330	9.24	3054.46	4	14.61	4826.50	-31675.19	Not run over	-
12	3.53	439	8.74	3834.20	4	14.61	6408.96	-34249.95	Not run over	-
13	4.32	2823	6.09	17182.70	4	14.61	41237.66	-58304.91	Not run over	-
14	5.18	3111	4.09	12709.08	0	0	0	-45595.83	Not run over	-
15	5.28	348	3.91	1359.98	0	0	0	-44235.85	Not run over	-
16	6	2595	3.04	7902.12	0	0	0	-36333.73	Not run over	-
17	7	3600	2.15	7756.21	0	0	0	-28577.52	Not run over	-
18	8	3600	1.52	5488.18	0	0	0	-23089.33	Not run over	-
19	9	3600	1.08	3883.36	0	0	0	-19205.98	Not run over	-
20	10	3600	0.76	2747.81	0	0	0	-16458.17	Not run over	-
21	11	3600	0.54	1944.31	0	0	0	-14513.86	Not run over	-
22	12	3600	0.38	1375.76	0	0	0	-13138.09	Not run over	-
23	13	3600	0.27	973.47	0	0	0	-12164.62	Not run over	-
24	14	3600	0.19	688.81	0	0	0	-11475.81	Not run over	-
25	15	3600	0.14	487.39	0	0	0	-10988.41	Not run over	-
26	16	3600	0.10	344.87	0	0	0	-10643.54	Not run over	-
27	17	3600	0.07	244.03	0	0	0	-10399.51	Not run over	-
28	18	3600	0.05	172.67	0	0	0	-10226.84	Not run over	-
29	19	3600	0.03	122.18	0	0	0	-10104.66	Not run over	-
30	20	3600	0.02	86.45	0	0	0	-10018.21	Not run over	-
31	21	3600	0.02	61.17	0	0	0	-9957.04	Not run over	-
32	22	3600	0.01	43.28	0	0	0	-9913.75	Not run over	-
33	23	3600	0.01	30.63	0	0	0	-9883.13	Not run over	-
34	24	3600	0.01	21.67	0	0	0	-9861.45	Not run over	-

Source: Processed data by researchers (2021)

With the plan to increase pump capacity and the number of pumps, there is a very significant difference in overflow, there is no overflow at all during the return period of 2 years and 5 years, and there is very little overflow, which is only 2 cm high during the 10 year return period.

5. Conclusion And Suggestions

5.1. Conclusion

1. Based on Nakayasu HSS method, the maximum discharge runoff that occurs during the period of 2, 5, and 10 years respectively is 29.72 m³ / s, 36.5 m³ / s, and 40.3 m³ / s.

2. 2 The volume of Boezem Kalidami reservoir is 49,440 m³ and with the planned runoff discharge, Boezem Kalidami can only accommodate runoff discharge up to the first 1.42 hours and there will be a runoff of 1.58 meters from Boezem Kalidami's lips at 2.14 hours.
3. 3 With a pipe length of up to 75 meters, the head loss that occurs in the pipe is large enough so that the efficiency obtained by the pump is only 73.03% with a total of 7 pumps so the total efficient capacity is only 15.34 m³ / s.

5.2. Suggestions

Planning for additional pump capacity and increasing the number of pumps in the Boezem Kalidami pump house is required. For the 10-year planning period, the pump capacity of 5 m³ / sec with the addition of up to 10 pieces of the pump is very inadequate.

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Analysis of Flood Control Plan in Cibitung Kertagraha Housing, Bekasi District

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Abstract

The change in the function of land to housing can cause a decrease in the level of the water absorption zone that occurs in the area and can cause inundation or even flooding. Housing can be categorized as good, that is, it must have drainage facilities that can drain rainwater quickly and not cause stagnation of water even though the rainfall is very high. Therefore, the right solution to tackle standing water, drainage problems, and flooding in Kertagraha housing is to create a retention pond because in the kertagraha housing there is no final storage system that is suitable for dealing with flooding. The location of this research is located in Sukarukun Village, Sukatani District, Cibitung, Bekasi Regency with the category of housing area. In this study, a hydrological analysis was carried out with rainfall data from the Rain Post Station located in Sukatani and the TRMM Rain Post located in Cikarang within a 10-year return period starting from 2010-2019, and the planned flood discharge data were obtained. Furthermore, hydraulic analysis is carried out to determine the flood discharge capacity in the existing drainage channels and to plan the volume of the storage pool. After that, the retention pond design planning is carried out. In the calculation analysis, it is found that the planned rain discharge value in the next 10 years is 7.393 m³ / second using the Haspers method. The total capacity of the storage pool is 12,385 m³, with the dimensions of the retention pond, namely P = 70m, L = 20m, T = 10meter. With a concentration time of 1675 seconds. Based on the analysis carried out and there is sufficient land, this retention pond is the best solution to overcome the flood problem in Kertagraha housing.

Keywords:

Floods, Hydrology, Haspers Methods, Hydraulics, Retention Pools.

1. Introduction

Flood disaster is a natural condition in which water cannot be stored in the drainage channel or water flow is blocked in the main channel, so that it overflows the surrounding area (flood plain). According to Suripin, "Sustainable Urban Drainage System".

Flood control is an effort made to minimize the risk of flooding that can occur. Mitigation that can be done is by means of structural and non structural methods. Structural mitigation includes technical physical development such as dams, retention ponds, check dams, Groundsill, Retarding Basin, Polder Construction, Infiltration Well, River Network System, River Repair, Embankment Protection, Sudetan, and Estuary Repair, while non-structural such as Watershed management, land use management, erosion control, flood area development, flood area management, emergency handling, flood forecasting, flood warning and control of coastal areas (Robert J. Kodoatie & Roestam Sjarief, 2010)

Kertagraha housing itself is located in the Cibitung area of Bekasi Regency, with topographical conditions in the lowlands surrounded by villages and rice fields, so this housing is very at risk of flooding when the rainfall is high. Floods often occur in the southern area in the kertagraha housing area because the area is the lowest point of land surface conditions. Outside the housing area, there is the nearest river, namely the embankment river with a width of ± 8 meters and an average depth of 6 meters. Therefore, the authors will analyze and plan flood control using a storage pool which is calculated from the maximum flood discharge obtained in the kertagraha housing area from the average over the last 10 years period.

Increasing population growth and drainage management have an impact on changing the function of land use as happened in residential areas, especially in the Kertagraha housing area. Therefore, the authors get problems such as: Stagnation of water in housing occurs when the rainfall is very high and stable, especially in the area of the lowest point of the housing area, water overflows from the existing drainage system, as a result the puddles that occur are not controlled, are the existence of a proper final disposal system in the residential area, the southern area of the housing section, the condition of the land contour is very low so it is not possible to make several housing units in the housing so the discharge accommodated by the channel will gather in the lowest point.

Of the many problems that exist above, if action is not taken immediately it will make it difficult for the population and will aggravate and expand the flood-prone areas in the housing area. Countermeasures that must be done to minimize the floods that come every rainy season are building infrastructure in the form of construction of storage ponds or retention ponds which function to divert excess water discharge that cannot yet flow into rivers.

The aims and objectives of the preparation of the final project are as follows: Analyzing the rainfall to get the maximum flood discharge in the Kertagraha Housing area, Planning a storage pool to deal with flooding that occurs in the Kertagraha Housing area and Planning an outflow system to the volume of the retention pond.

This research will serve as a reference for the government and housing developers to control the potential for flooding in the Cibitung area, Bekasi district and other areas, then provide additional knowledge to readers regarding the calculation of flood discharge, retention pond volume, and discharge discharge system from retention ponds.

2. Research Methods

The method used by the writer in this thesis research is quantitative method and descriptive method. The data from this study were collected and then processed and analyzed. Furthermore, to analyze and find the maximum flood discharge in the kertagraha housing itself the author uses data collection techniques using the Rational Method and the Haspers Method.

The data needed to find the maximum flood discharge is rainfall data, the rainfall data that the author gets comes from the nearest rain station, namely the Sukatani rainfall station and the TRWM rainfall station, Central Cikarang. then Contour data, Contour data is needed to calculate the water flow rate from upstream to downstream. The author obtained contour data from the developer and also surveyed several problematic places during the rain, and reviewed the area to be used as a flood control area. And the last one, namely Watershed Data (DAS), Mapping of watershed boundaries (DAS) is one of the main parameters used as a boundary for determining the catchment area in kertagraha housing which the authors conducted research.

This research was conducted with various systematic work steps in order to obtain optimal results. The research work step is a series of procedures and steps in conducting structured research that is systematic and directed so that the objectives of the research can be achieved properly.

Flowchart view is a "diagram that provides an overview of the flow from one scene to another" (Munir 2012, p. 102). The steps used by the author in this study are seen in the research flowchart as follows:



Figure 1. literature review

In principle, a literature review or literature review is carried out to find out some important things related to the topic or research issue that we raise. The literature review that the author uses in the preparation of this thesis comes from books, journals, articles and related lecturer guidance which aims as a reference in the preparation and makes it easier to analyze the calculations contained in this study. In data processing, the authors

collect the necessary data by visiting the rainfall station, reviewing the location of the kertagraha housing area, and obtaining data from the developer which aims to assist in analyzing flood control in the residential area. The following is the sequence of calculations that the authors use in this study:

2.1. Hydrological Analysis

Hydrological analysis is needed to determine the hydrological characteristics of the watershed areas in kertagraha housing. Hydrological analysis is used to determine the planned flood discharge in a flood control plan. The data for determining the planned flood discharge in this final project is rainfall data, where rainfall is one of several data that can be used to estimate the amount of planned flood discharge.

1. Regional Rain Analysis

According to Suyono Sosrodarsono, Ir (1977) rainfall and discharge data are very important data in planning rainwater reservoirs. There are three methods used in calculating the watershed average rainfall (DAS), namely the arithmetic average (algebra) method, the Thiessen polygon method and the Isohyet method.

2. Concentration Time

Concentration time (t_c) is the time required for water points to flow from the farthest hydraulic point in the flow area to an inlet, so that $t_d = t_c$, meaning that at that time the entire flow area contributes to the flow at the point. the.

$$t_c = t_0 + t_d$$

Where :

t_c = concentration time

t_0 = in-let time

t_1 = conduit time

L = Channel Length

V = Kec. Channel average

3. Frequency Analysis

Frequency analysis is a prediction in the sense of obtaining a probability for the occurrence of a hydrological event in the form of a planned discharge / raindrop which serves as the basis for calculating hydrological planning to anticipate any possibilities that will occur.

In frequency analysis, the results obtained depend on the quality and length of the data. The shorter the data available, the more storage that occurs. In statistical science, there are several types of frequency distribution and four types of distribution that are widely used in the field of hydrology, namely:

- Normal Distribution
- Normal Log Distribution
- Gumbel distribution
- Pearson Type II Log Distribution

4. Fit Test

Distribution fit test analysis is carried out to test the suitability of the frequency distribution of the data sample against the probability distribution function which is expected to describe or represent the frequency distribution. The method that the authors use in the fit test is the Chi-Square and Smirnov-Kolmogorov test.

5. Rainfall Intensity Analysis

Rainfall in the short term is expressed in intensity per hour which is called the intensity of rainfall. Rain of high intensity generally occurs for a short time. The relationship between rainfall intensity and rainfall time has been formulated, which generally depends on local parameters.

$$I = \frac{R_{24}}{24} \left(\frac{24}{t} \right)^m$$

Where :

I = Rainfall intensity (mm / hour)

t = Length of rainfall (hours)

R_{24} = Maximum rainfall in 24 hours (mm)

m = according to Van Breen's figure is taken $m = 2/3$

(CD. Soemarto, 1993, Engineering Hydrology)

6. Maximum Flood discharge calculation

In the process of calculating the maximum flood discharge that the author uses in this study, there are 2 methods, namely the rational method:

$$Q = 0.278 \cdot CIA$$

Where :

Q : Discharge (m^3 / sec)

0.278 : Constant, used if the unit area uses km^2

C : Flow coefficient
 I : Rainfall intensity during concentration time (mm / hour)
 A : Area of flow (km²)

and the haspers method:

$$Q_{\max} = \alpha \times \beta \times I \times A$$

where $Q_{\max}$ is the maximum flowrate (m³ / s), α is the flow coefficient, β is the reduction coefficient, I is the maximum rainfall (mm / s / km²), A is the area of the drainage area (km²).

2.2. Hydraulics Analysis

Hydraulic analysis aims to determine the ability of the cross section to accommodate the planned discharge. As happened in Kertagraha housing, one of the causes of flooding is due to the inability of the cross section to accommodate the flood discharge that occurred and it is not suitable for the final storage system.

1. Drainage

In general, drainage is defined as a series of water structures whose function is to reduce and or remove excess water from an area or land, so that the land can be optimally functioned. The water level in the channel (h) and the channel width (b) are the parameters for determining the wet area (A). The wet area (A) is analyzed based on the rain discharge (Q) which is also the channel discharge and the water flow velocity in the channel (V):

$$Q = A \cdot V$$

$$A = Q / V$$

V is the velocity of water flow in the drainage channel, which is obtained from Table 2.1 or analyzed by the Manning formula or the Chezy formula. To calculate the speed of water flow in a channel, it is determined based on:

Table 1. Velotic of Water Flow	
Channel I Slope (%)	Velocity V (m / s)
<1	0.40
1 - <2	0.60
2 - <4	0.90
4 - <6	1.20
6 - <10	1.50
10 - <15	2.40

(Source: Abdul Halim., 2002)

2. Retention Pool

A retention pool is a tub or pool that can accommodate or absorb the temporary water contained in it. In this type of pond, the water that enters the inlet must be able to accommodate the water according to the planned capacity so that it can reduce peak flow during overflow, so that the pool functions as a place to reduce flood discharge due to the additional time to concentrate water for flow on the surface. The capacity of the retention pond that can accommodate the volume of water at the time of the peak flood discharge is calculated using the general equation below:

$$V = \int_0^t (Q_{\text{in}} - Q_{\text{out}}) dt$$

Where :

V : The volume of the pool
 t : The initial time the water enters the inlet
 t_0 : When the water comes out of the outflow
 Q_{in} : Inflow discharge

3. Result and Discussion

The research location of this final project is located in the Sukarukun village, Sukatani district, Bekasi Regency, West Java. This residential area has a land area of 91,406 m².



Figure 2. Source: Google Earth

In planning a good drainage system, it is necessary to pay attention to the contour conditions or topographic map of the area to be studied, because it is useful for knowing the flow of water from upstream to downstream, here is a land contour map in the Kertagraha housing area of Bekasi district. The results of the discussion contain the following descriptions:

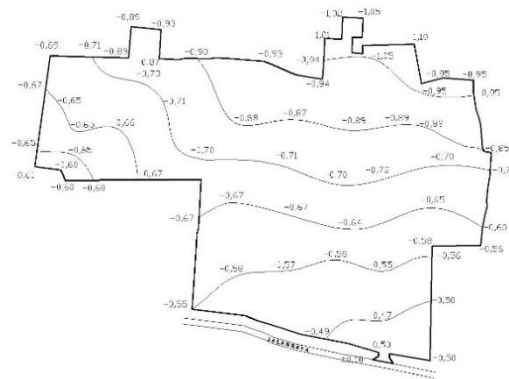


Figure 3. Source: Developer.

Topographic maps are useful for providing information about whereabouts, locations, and distances, such as the location of residents, travel routes and communications. Topographic maps were obtained from the Kertagraha housing developer on November 24, 2020. The topographic map contains information such as ground level and , existing river, spot level and land boundary. The elevation from the zero point of the residential building to the road surface is +50,000 centimeters.

3.1. Calculation Analysis

3.1.1. Hydrological Analysis

Table 2. Rainfall Data

Year	Rain Thickness (mm)		Algebraic Mean	
	Sukatani data	TRMM Cikarang data	P	N
Yrs.	Ch. Max.	Ch. Max.		
2010	87.00	96.80	183.80	91.90
2011	51.00	89.60	140.60	70.30
2012	101.00	94.40	195.40	97.70
2013	141.00	161.00	302.00	151.00
2014	167.00	115.50	282.50	141.25
2015	95.00	124.60	219.60	109.80
2016	87.00	111.60	198.60	99.30
2017	140.00	167.09	307.09	153.55
2018	94.00	0.00	94.00	47.00
2019	130.00	140.40	270.40	135.20

Source: Rainfall Data of Sukatani Post & TRMM Cikarang Post.

a. Frequency Analysis

Table 3. Statistical Parameters

Year	Xi	Xi-Xr	(xi-Xr) ²	(xi-Xr) ³	(xi-Xr) ⁴
2010	91,90	-17,80	316,82	-5639,28	100376,31
2011	70,30	-39,40	1552,32	-61160,66	2409699,25
2012	97,70	-12,00	143,99	-1727,78	20732,54
2013	151,00	41,30	1705,73	70447,56	2909519,27
2014	141,25	31,55	995,43	31406,44	990888,95
2015	109,80	0,10	0,01	0,00	0,00
2016	99,30	-10,40	108,15	-1124,70	11696,92
2017	153,55	43,85	1922,43	84289,81	3695728,92
2018	47,00	-62,70	3931,23	-246485,99	15454548,1
2019	135,20	25,50	650,28	16582,35	422858,23
Σ	1.097	0,00	11.326	113.412	26.016.048

Source: Calculation Results

Table 4. Rainfall with Gumbel Method Return Period

No	Rt Year	$yt = -\ln(\ln(Rt/-1))$	Yn	Sn	$K = Yt - Yn/Sn$	Xr	SD	Rn (mm)
1	2	10	0,4952	0,9496	-0,14	109,70	35,48	104,89
2	5	10	0,4952	0,9496	1,06	109,70	35,48	147,23
3	10	10	0,4952	0,9496	1,85	109,70	35,48	175,27
4	25	10	0,4952	0,9496	2,85	109,70	35,48	210,69
5	50	10	0,4952	0,9596	3,59	109,70	35,48	236,97
6	100	10	0,4952	0,9596	4,32	109,70	35,48	263,05

Source: Calculation Results

Table 5. Analysis of the Frequency of Rain with the Normal Distribution Method

No	Rt year	$yt = -\ln(\ln(Rt/-1))$	Xr	SD	KT	Rn (mm)
1	2	10	109,70	35,48	0,0000	109,70
2	5	10	109,70	35,48	0,8400	139,50
3	10	10	109,70	35,48	1,2800	155,11
4	25	10	109,70	35,48	1,6400	167,88
5	50	10	109,70	35,48	2,0500	182,42
6	100	10	109,70	35,48	2,3300	192,36

Source: Calculation Results

Table 6. Analysis of Rain Frequency, Normal Log Distribution Method

No	Rt year	Yr	Sy	Log Rn	Rn (mm)
1	2	2,0156	0,1626	2,0156	103,6571
2	5	2,0156	0,1626	2,1522	141,9688
3	10	2,0156	0,1626	2,2237	167,3949
4	25	2,0156	0,1626	2,2823	191,5500
5	50	2,0156	0,1626	2,3490	223,3331
6	100	2,0156	0,1626	2,3945	248,0186

Source: Calculation Results

Table 7. Frequency Distribution of the Log Person III Method

No	Year	Rainfall X	CH0, Log X	(log x-log X')	(log x-log X') ²	(log x-log X') ³	Ln X	(log x-log X') ⁴
1	2009	91,90	1,96	-0,0523	0,0027	-0,0001	4,5207	0,00001
2	2010	70,30	1,85	-0,1686	0,0284	-0,0048	4,2528	0,00081
3	2011	97,70	1,99	-0,0257	0,0007	0,0000	4,5819	0,00000
4	2012	151,00	2,18	0,1634	0,0267	0,0044	5,0173	0,00071
5	2013	141,25	2,15	0,1344	0,0181	0,0024	4,9505	0,00033
6	2014	109,80	2,04	0,0250	0,0006	0,0000	4,6987	0,00000
7	2015	99,30	2,00	-0,0187	0,0003	0,0000	4,5981	0,00000
8	2016	153,55	2,19	0,1706	0,0291	0,0050	5,0340	0,00085
9	2017	47,00	1,67	-0,3435	0,1180	-0,0405	3,8501	0,01392
10	2018	135,20	2,13	0,1154	0,0133	0,0015	4,90676	0,00018
Σ		1,097	20,16	0,000	0,2380	0,0322	46,4109	0,0168

Source: Calculation Results

Below is a table recapitulation of the results of the calculation of the frequency of rain analysis whether it matches the predetermined requirements or not, specifically for the log person III distribution analysis, there are no restrictions in the requirements.

Table 8. Analysis to Determine

No	Distribution	Requirement	Count Results	Information
1	Gumbel	$C_s \leq 1,1396$	C_s	-0,35 Accepted
		$C_k \leq 5,4003$	C_k	3,26 Accepted
2	Normal	$C_s = 0$	C_s	-0,35 Rejected
		$C_k = 3$	C_k	3,26 Rejected
		$C_s = C_v^3 + 3C_v$	C_s	0,24 Rejected
3	Log Normal	$C_s = 0,365$	C_s	0,24 Rejected
		$C_k = C_v^8 + 6C_v^6 + 15C_v^4 + 16C_v^2 + 3$	C_k	3,10 Rejected
		$CK = 3,238$		
4	Log Person III	Tidak Ada Batasan	C_s	-1,040 Accepted
			C_k	4,768 Accepted

Source: Calculation Results

Analysis to determine the flood discharge plan that will be used in the planning of this storage pool, the results of the calculation of the rainfall plan for the T year period can be seen from the terms of the distribution type of the table above. The conclusion from the table above that can be used is the type of Gumbel distribution.

b. Fit Test Chi-Square Test

 Table 9. Recapitulation of X^2 and X^2_{cr}

Probability Distribution	X^2	DK	X^2_{cr}	Information
Gumbel	3,00	3,800	7,815	Accepted
Normal	1,00	3,800	7,815	Accepted
Log Normal	6,00	3,800	7,815	Accepted
Log Person III	4,00	3,800	7,815	Accepted

Source: Calculation Results

Based on the results of the calculations in the table above, it can be concluded that the distribution test of the chi square method of all distribution methods is acceptable, then the Smirnov Kolmogorof test is then carried out.

c. Kolmogrov's Smirnov test

The following is a table of the results of the Smirnov Kolmogorof harmony test using the Gumbel method.

Table 10. The Smirnov-Kolmogorov test.

Period (Year)	Xt	m	P(x)=m/(n+1)	P(x<)	f(t)	P'(x)=m/(n-1)	D
2	104,9	1	0,143	0,857	-1,44	0,200	0,057
5	147,2	2	0,286	0,714	-0,72	0,400	0,114
10	175,3	3	0,429	0,571	-0,25	0,600	0,171
25	210,7	4	0,571	0,429	0,36	0,800	0,229
50	237,0	5	0,714	0,286	0,80	1,000	0,286
100	263,1	6	0,857	0,143	1,25	1,200	0,343

Source: Calculation Results

d. Rain CuraH Intensity

The following is an example of calculating rainfall intensity using the Mononobe method with a 10 year return period.

Table 11. Rainfall for the return period using the gumbel method.

Re-period T (Thn)	Xt
2	104,89
5	147,23
10	175,27
25	210,69
50	236,97
100	263,05

$$I = \frac{175,27}{24} \times \left(\frac{24}{\frac{5 \text{ menit}}{60 \text{ menit}}} \right)^{2/3} = 318.5 \text{ mm / hour}$$

From the above calculations, it is obtained I = 318.5 mm / hour. Below is a table of the results of calculating the intensity of rain using the Dr Mononobe method:

Table 12. 10 Year Return Period Rain Table.

t(minute)	t(hour)	R24/24	24/t	(24/t) ^{2/3}	1(mm/hour)
0	0,000	7,303			
5	0,083	7,303	288	43,611	318,5
10	0,167	7,303	144	27,473	200,6
15	0,250	7,303	96	20,966	153,1
20	0,333	7,303	72	17,307	126,4
45	0,750	7,303	32	10,079	73,6
60	1,000	7,303	24	8,320	60,8
120	2,000	7,303	12	5,241	38,3
180	3,000	7,303	8	4,000	29,2
360	6,000	7,303	4	2,250	18,4
720	12,000	7,303	2	1,587	11,6

Source: Calculation Results

Table 13. Hourly Rain Table.

t(hour)	r2	r5	r10	r25	r50	r100
	104,89	147,23	175,27	210,69	236,97	263,05
1	36,36	51,04	60,76	73,04	82,15	91,20
2	22,91	32,16	38,28	46,01	51,75	57,45
3	17,48	24,54	29,21	35,12	39,49	43,84
4	14,43	20,26	24,11	28,99	32,60	36,19
5	12,44	17,46	20,78	24,98	28,10	31,19
6	11,01	15,46	18,40	22,12	24,88	27,62
7	9,94	13,95	16,60	19,96	22,45	24,92
8	9,09	12,76	15,19	18,26	20,54	22,80
9	8,40	11,80	14,04	16,88	18,99	21,08
10	7,83	11,00	13,09	15,74	17,70	19,65
11	7,35	10,32	12,28	14,77	16,61	18,44
12	6,94	9,74	11,59	13,94	15,67	17,40
13	6,58	9,23	10,99	13,21	14,86	16,49
14	6,26	8,79	10,46	12,57	14,14	15,70
15	5,98	8,39	9,99	12,01	13,51	14,99
16	5,73	8,04	9,57	11,50	12,94	14,36
17	5,50	7,72	9,19	11,05	12,43	13,79
18	5,29	7,43	8,85	10,63	11,96	13,28
19	5,11	7,17	8,53	10,26	11,54	12,81
20	4,94	6,93	8,25	9,91	11,15	12,38
21	4,78	6,71	7,98	9,60	10,79	11,98
22	4,63	6,5	7,74	9,30	10,46	11,62
23	4,5	6,31	7,51	9,03	10,16	11,28
24	4,37	6,13	7,3	8,78	9,87	10,96

Source: Calculation Results

The rain intensity of the planning area is presented in the following graph:

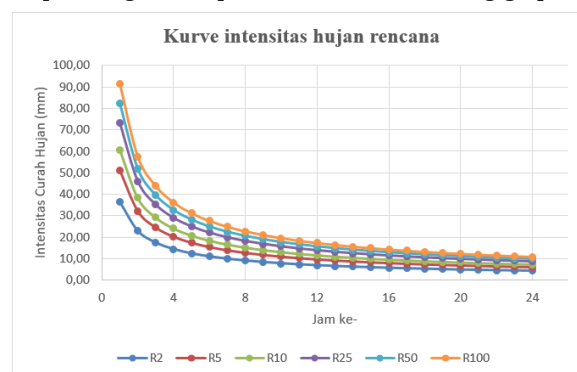


Figure 2. Graph of planned rainfall intensity.

Maximum Flood discharge calculation

Calculation Analysis:

The area of the residential area watershed = 9,140 hectares

Primary Channel Length (L) = 615 meters

The height difference from upstream to downstream (H) = 1 meter

1. Rain Intensity:

$$\text{Look for the slope } i = H / (0.9 \times L) \\ = 1\text{m} / (0.9 \times 615\text{m}) = 0.00181 \text{ meters}$$

Seek speed

$$V = 72 \times S^6$$

$$V = 72 \times [0.00181]^6 = 0.263 \text{ m / hour}$$

2. Finding Concentration Time:

$$t_c = 0.0133Lxi^{(-0.6)}$$

$$t_c = 0.0133 \cdot 0.615 \cdot [0.00181]^{(-0.6)} = 0.3779 \text{ hours or } 0.3779 \times 60 = 22,676 \text{ minutes}$$

Finds Rain intensity for a 10 year return period.

$$R_{24} = 263.05\text{mm}$$

$$I = R_{24} / 24 \times (24 / t_c)^{(2/3)}$$

$$= (263.05\text{mm}) / 24 \times (24 / (0.3779))^{(2/3)}$$

$$= 179.57 \text{ mm}$$

3. Rational Method

$$\text{Flow coefficient } C = C_t + C_s + C_v$$

the conditions of the research location were obtained,

$$C = C_t + C_s + C_v$$

$$C = 0.03 + 0.26 + 0.28$$

$$= 0.57$$

From the above calculations, the peak discharge using the Rational method is as follows:

$$Q = 0.278 \cdot C \cdot I \cdot A \quad \text{or} \quad Q = (C \cdot I \cdot A) / (3.60)$$

$$Q = 0.278 \times 0.57 \times 179.57 \times 0.091$$

$$= 2,5989\text{m}^3 / \text{sec}$$

4. Haspers Method

The data obtained are:

- Watershed area = 0.0914 km²
- River length (L) = 0.615 km
- Upstream Elevation = 5 meters
- Downstream Elevation = 4 meters
- Difference in height (h) = 1 meter

Finding the slope (I)

$$i = h / L = 1/615 = 0.00163$$

Find the area coefficient of rain

$$\frac{1}{\beta} = 1 + \frac{0,465 + (3,70 \times 10^{0,40 \cdot 0,733})}{0,465^2 + 15} \times \frac{91,406^{0,75}}{12} = 1,003$$

$$\beta = 1 / 1,003 = 0,997 \text{ km/jam}$$

For the calculation of the 10 year return period is obtained

$$R = 175.27 \text{ mm}$$

If $t < 2$ hours, the formula is used:

$$r = \frac{t \times R}{t + 1 - 0,0008(260 - R)(2 - t)^2} \\ r = \frac{0,465 \times 175,27}{0,465 + 1 - 0,0008(260 - 175,27)(2 - 0,465)^2} \\ r = 137,446$$

Next is to find q for a period of 10 years,

$$q = \frac{r}{3,6 \times t}$$

Where r = specified return period rainfall (mm)

$$q = \frac{137,446}{3,6 \times 0,465} = 82,048$$

So to determine the flood discharge the 10 year return period is

$$Q = 0.988 \times 0.997 \times 82.048 \times 0.09141$$

$$= 7.393 \text{ m}^3 / \text{sec}$$

From the results of the calculation of the two methods above, the flood discharge is obtained as follows:

Table 14. Recapitulation of Flood Discharge Used.

Method	Q 10 year (m ³ /det)
Rasional	2,599 m ³ /det
Haspers	7,393 m ³ /det

Source: Calculation Results

3.1.2. Hydraulics Analysis

a. Drainage Channels

Table 15. Kertagraha Housing Channel Data

Channel Type	Wide	High	Broad m ³	Long m	Total m ³
Primer	3 2,5	2	5,5	615	3382,5
Sekunder	0,6 0,6	0,9	0,54	1223,72	660,8
tersier	0,5 0,5	0,5	0,25	14594	3648,5

- Calculation of the volume of rain flow in the catchment area to design drainage
 $A_m = 91406 \text{ m}^2$ (water catchment area)
 $I = 263.05 \text{ mm/h}$ (obtained from the calculation of the frequency analysis method of the gumbel)
 $C = 1$ (flow coefficient for housing)
 Q_m (volume of rain flow)
 $= (1/3600000) \times C \times I \times A_m$
 $= (1/3600000) \times 1 \times 263.05 \times 91406$
 $= 6.679 \text{ m}^3/\text{s}$
- Find the drainage capacity using manning's formula. The roughness factor is obtained from the table Typical manning roughness coefficient, (n).

a. Calculate runoff flow

$$Q = WA \times V$$

$$= 4 \text{ m}^2 \times 2.207 \text{ m/sec}$$

$$= 8.829 \text{ m}^3/\text{sec}$$

$$Q_m (\text{volume of rain flow}) \leq Q (\text{flow in channel})$$

From the above calculations, it is obtained:

$$Q_m = 6,679 \text{ m}^3$$

$$Q = 8,829 \text{ m}^3/\text{sec}$$

Check $6,679 \text{ m}^3 \leq 8,829 \text{ m}^3/\text{s}$, then the existing channel is safe.

b. Retention Pool

Based on the flood hydrograph that enters the retention pond

$$Q_{mak} = \text{maximum flood discharge}$$

$$= 7.393 \text{ m}^3/\text{sec}$$

$$n = 2$$

$$t_c = \text{Concentration Time}$$

$$= 0.465 \text{ hours or } 1675 \text{ seconds}$$

The formula if using an outlet pump:

$$V_t = ((Q_{mak} - Q_p)^2 \cdot N \cdot T_c) / (2 \cdot Q_{mak})$$

The formula if not using an outlet pump:

$$V_t = (Q_{mak}^2 \cdot N \cdot T_c) / 2 \cdot Q_{mak}$$

Because in the research the author calculates the volume of the temporary flood retention pond, which can reduce the flood discharge so that it does not overflow in the residential area, then an intact pump is used to channel water to the city canal, therefore the formula used to find the storage volume is as follows.

$$V_t = (Q_{mak}^2 \cdot N \cdot T_c) / 2 \cdot Q_{mak}$$

$$V_t = ((7,393^2 \times 2 \times 1675) / (2 \cdot 7,393))$$

$$V_t = 12,385 \text{ m}^3$$

Simple calculation of infiltration pond

The planned volume of the flood retention pond uses a formula

$$V_t = 0.855 \cdot C \cdot A \cdot R$$

Where :

A = Area of land = 91.406 m²
C = Runoff coefficient = 0.988 (obtained from the calculation of the haspers method)
R = 10 year period rain intensity = 175.27 mm
R = 175.27 / 1000 = 0.17527 m
Vt = 0.855. C. A .R
Vt = 0.855. 0.988. 91,406 m². 0.17527 m
Vt = 13,538 m³

Table 16. Recapitulation Calculation of the volume of flood retention ponds

Method	
Hidrograf	Simple
12.385 m3	13.538 m3
Source: Calculation Results	



Figure 4. Planned flood retention ponds.

Planned Retention Pool Area

=width 20 mx length 70 m
= 1400 m²

Checking,

A =Pool area retention plan
1250 m² = 1400m²

From the above calculations, the dimensions of the planned flood retention pond are:

Long = 70 meters
Wide = 20 meters
High = 10 meters

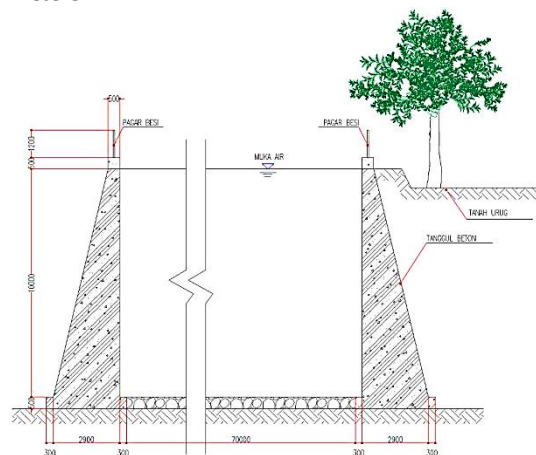


Figure 5. Size of the Flood

The size of the flood retention pond is 1400m² with a width of 20meter, a length of 70meter, and a depth of 10m which is planned to be able to accommodate the flood discharge with a 10-year return period of 12,385 m³. obtained from the maximum planned flood discharge using the haspers method of 7.393 m³ / second with a concentration time of 1675 seconds.

With an outlet system leading to the city channel using a pipe system and a flood gate.
as follows :



Figure 6. Pipa System



Figure 7. a Floot Gate

4. Conclusion

Based on the results of the research that has been done, it can be concluded:

1. The planned flood discharge in the kertagraha housing area reaches $7.393 \text{ m}^3 / \text{second}$ which is calculated using the haspers method and the planned flood discharge is $2.599 \text{ m}^3 / \text{second}$ using the rational method. With 175.27 mm of rain in a 10 year return period.
2. Furthermore, the size of the retention pond is obtained to accommodate the flood discharge of the Kertagraha housing area with a width of 20 meters, a length of 70 meters and a depth of 10 meters. The total volume of retention ponds in the Kertagraha residential area is 14000 m^3 with an area of 1400 m^2 which will be made in a rectangular shape, while the design flood discharge produced by the hydrograph method is 12385 m^3 with an area of 1238.5 m^2 , so the difference is more than 1615 m^3 of storage pool. The pond is planned to accommodate the final drainage from the Kertagraha housing area and then channeled to the city channel.

5. Suggestion

From the results of the research that has been done there are several things that can be suggested, namely as follows:

1. We recommend that for further research it is necessary to analyze the water level of the embankment river to determine the maximum flood period and prevent the occurrence of river water levels beyond the height limit of the Kertagraha housing embankment.
2. The author suggests that further research can calculate the structure of the existing retention ponds and new ponds in the event of housing development and to plan a better outflow system with more detailed tools and calculations.
3. For the developer or developer, if there is a development in the Kertagraha housing development, it is better to recalculate the planned flood discharge that will occur, because the excess of the previous storage pool was only 1615 m^3 . If there is limited land, you can use a pump system for outflow to the city channel if at any time the Flood Retention pool is unable to accommodate the flood discharge from the Kertagraha housing area and runoff from the embankment river.

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Analysis of the Causes of Waste with the Lean Construction Method on the 1700 Units Apartment Algeria Project

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Abstract

The construction industry is currently experiencing various problems such as time and cost overruns. One of the causes is waste. In the construction work of the 1700 apartment unit project in Algeria, it was found that waste was found in materials, tools, and time. One of the ways to control waste is lean construction. The purpose of this study is to determine the causes that have a high influence on the presence of waste in the 1700 unit Algerian apartment project and to know the strategies to manage it through the lean construction approach. This research method was conducted with a 4-stage questionnaire. The results obtained in this study are the causes that have a high effect on the presence of waste in the 1700 apartment unit construction project in Algeria: a. Last Planner System (poor planning and scheduling), b. First Run Studies (bad weather in winter), c. 5S Process (Visual Work Place) (a place where the material is easily disturbed and unsafe, and d. Fail-safe for Quality and Safety (repair work). Strategies that can be applied: a. Last Planner System: making an appropriate master schedule and evaluation daily, b. First Run Studies: evaluating the anticipation of bad weather, and claiming lost time, c. 5S Process: grouping materials and moving materials, d. Fail-safe for Quality and Safety: conducting routine daily meetings and using appropriate repair methods .

Keywords:

Apartment, Lean Construction, Waste

1. Introduction

The construction industry is currently experiencing various problems such as time and cost overruns, poor safety and health, bad environmental influences, managerial problems, inefficiency in the construction process. Building construction is often classified under the order of the lowest in production management efficiency.

One of the causes of inefficiency in the construction process is waste of waste. Waste in the construction process is a loss that results in losses in terms of cost, quality, and time. This form of waste can be generated from materials, tools, human resources, time, and so on. . Based on data from the Lean Construction Institute (LCI), waste in the construction industry is 57% (oleh Ir. H. Muh. nur Sahid, M.M., 2017).

During the construction of the 1700 apartment unit construction project in Algeria, it was found that there was waste in materials, tools, and time which could cause costs and project schedule not to be achieved. Waste cannot be avoided but can be controlled, one of which is with lean construction. For this reason, construction companies need to carry out good construction management in order to find out what are the causes of waste in construction projects so that they can be managed properly with a lean construction approach.



Figure 1. Project of 1700 units apartment Algeria

The aim of this research is:

- a. Knowing the causes that have a high effect on the existence of waste in the 1700 units apartment Algeria project.
- b. Knowing the strategies that can be applied to manage high-impact waste through the lean construction approach in the 1700 units apartment Algeria project.

2. Literatur Review

2.1 Waste

Waste is all kinds of loss resulting from an activity that generates costs, either directly or indirectly, but does not add to the benefits/value of a product from the client's point of view. (Ahmad Chasan Mudzakir, 2017). In general, waste is not just wasted materials, but also other resources such as time, energy (manpower), and tools that do not provide added value (sapitri, 2019).

2.2 Waste Identification

The waste referred to the seven types of waste that Ohno identified as part of the Toyota Production System, known as lean manufacturing. The definition for each waste is as follows (Lubis, 2016) :

a. Overproduction

Overproduction is the most dangerous waste, which will lead to production problems where too much of this waste is produced or obtaining goods before they are really needs.

b. Defect

Defect can occur due to various things, namely; man, machine, method, material, etc. This waste causes more costs for collateral and rework to repair the defective product.

c. Excessive Transportation

This waste occurs as a result of inefficient worksite layouts where the materials needed are transferred from one process to another. This will result in the risk of being damaged, lost, delayed, etc.

d. Waiting

Waiting refers to the waiting time between activities. Workers must wait for the material to be sent or wait for the machine to be processed.

e. Unnecessary Inventory

Unnecessary inventory occurs due to excess storage and delay of product or material information which causes increased costs and decreased service to customers.

f. Unnecessary Motion

It can be defined as a symptom related to the use of the time that does not add value to the product or process. This type of waste is common in workforce activities in factories or projects, occurs due to the unreliable conditions of the work environment and equipment, which can disrupt production lead times and information flow.

g. Inappropriate Processing

This waste refers to unnecessary operations (to do more than the customer wants). This may also lead to extra transportation due to poor communication.

2.3 Waste In Construction Projects

Waste generated during the construction process affects project productivity and also negatively affects the environment, or in other words, it has a bad impact on the surrounding environment. (Asih Triandini, 2019).

Waste in the construction sector is often equated with nonvalue-added costs, which can be interpreted as the loss or loss of various resources, namely material, time, and capita, which are caused by activities that require direct or indirect costs but do not add value to the final product for the construction service user.

The problem that is often faced in construction projects is that no matter how well the planning has been done, at the implementation stage there are always changes that result in delays in completion. (Julisa, 2019). Waste is a major problem in a construction project because this has an impact on the environment around the project (Cintya Puput Zulaida, 2019).

2.4 Lean Construction

The term "lean construction" was first coined by the International group for lean construction in 1983. Then Glenn Ballard and Greg Howell founded the Lean Construction Institute (LCI) in August 1997. Lean construction is a way to design a production system to minimize waste, both materials and time, human power with the aim of producing maximum value. This system is to identify the root causes of waste, eliminate the causes and prevent the waste (Jamil Sarhan, 2017).

The philosophy of Lean Manufacturing is taken from the Toyota culture, namely the Toyota Production System (TPS) where TPS became the first model of worldwide lean management developed by Japanese

companies after the second world war. The philosophy of lean construction is adapted from the philosophy of lean manufacturing with the characteristics and limitations of the construction industry.

Unlike lean manufacturing, lean construction focuses on the production process of the project. Lean construction has links to project progress in all dimensions of construction and the environment, including design, implementation of activities, maintenance, safety, and recycling. The concept of this approach tries to regulate and improve the construction process by obtaining maximum value with minimum costs related to customer needs (Lubis, 2016).

2.5 Lean Construction Principles and Models

There are several main principles in lean construction, namely: (Mohamed Saad Bajjou, 2019).

- a. Focus on the customer : Customer relations, customer involvement, flexible resources, value optimization / value identification.
- b. Employee involvement : Employee involvement, top management involvement / contractor involvement, training, Health Safety Environment (HSE).
- c. Supply : Supply Chain Management (SCM), on time, supplier involvement, pull system.
- d. Standardization : Job optimization, job definition.
- e. Quality : Total Quality Management (TQM), error checking, reaction to error / problem source analysis, fail-safe for quality.
- f. Waste elimination : Reducing process cycle time, waste awareness, value stream mapping, product system optimization.
- g. Planning and scheduling : Last planning system, Percent Plan Complete (PPC) chart, planning collaboration.
- h. Continuous improvement : Matrices (productivity, quality, safety), organizational learning, first run studies / PDCA, huddle meetings.
- i. Transparency : Visual management, workplace organization.

2.6 Lean Construction Tools

In the book Lean Construction Management - The Toyota Way, Salem and his friends discuss the transferability of lean manufacturing techniques to the world of construction. Assessment tools are developed to evaluate the impact of lean construction tools on construction project performance. Salem only focuses on the feasibility of lean production tools in the construction industry, these tools include :

a. Last Planner System

Last Planner System (LPS) is a method in the form of a workflow and maps various activities in construction projects. In the LPS there is a sequence of implementation, namely; master schedule, Reverse Phase Schedule (RPS), six week lookahead, Weekly Work Plan (WWP), Percent Plan Complete (PPC). (Ahmad Chasan Mudzakir, 2017).

b. Increased Visualization

Increased Visualization is a means of communicating effectively to employees through the installation of various signs, signs, and labels around construction sites. (Ahmad Chasan Mudzakir, 2017).

c. Daily Huddle Meetings

Two-way communication is the key to the daily team meeting in order to make employees participate. This concept is similar to employee involvement in lean manufacture, which empowers workers by observing reactions when facing problems, and opens communication intensively through the meeting tool box. (Ahmad Chasan Mudzakir, 2017).

d. First Run Studies

These activities usually use media such as videos, photos, or graphics to show a construction project process or illustration. A PDCA cycle (plan, do, check, action) is suggested as a basis for enhancing learning. (Ahmad Chasan Mudzakir, 2017).

e. 5S Process (Visual Work Place)

5S Process is "a location for everything and everything is found at that location". 5S process has five stages of improvement that can help minimize waste (Kobayashi, 1995; Hirano, 1996), namely; Seiri (sort), Seiton (straighten), Seiso (shine), Seiketsu (standardize), and Shitsuke (sustain). (Ahmad Chasan Mudzakir, 2017).

f. Fail-safe for Quality and Safety

Fail-safe for quality relies on ideas being aware of the potential for flaws. It is the same as virtual inspection (poka-yoke) on lean manufacturing. (Ahmad Chasan Mudzakir, 2017).

2.7 Benefits of Lean Construction

Based on research from Aftab Hameed Memon, Muhammad Akram Akhund, Abdul Nasir Laghari, Hafiz Usama Imad, and Shadab Noor Bhangwar in 2018, there are several benefits of lean construction, including;

reduce project duration, reduce waste, streamline workflow, visual control, improve safety, improve project quality, customer satisfaction, increase flexibility, good scheduling, reduce breakdowns, standardize work, simplify work, reduce costs, good estimation, and profit / more profit.

3. Methodology

The method used in this study used a questionnaire instrument. The questionnaire consists of 4 stages and is processed with the help of SPSS and Importance Index (IMPI). The 4-stage questionnaire includes:

- Questionnaire of validation phase 1
- Questionnaire of pilot survey
- Questionnaire of respondents
- Questionnaire of final expert validation

3.1 Questionnaire of Validation Phase 1

This questionnaire is a questionnaire with expert validation. Show whether the variables are relevant to the indicators in this study. Initial expert validation was carried out by giving a questionnaire to the expert containing the variables from the results of the literature study. These variables must be validated by an expert before they are put into the respondent's questionnaire so that the variables issued in the respondent's questionnaire are in accordance with the expected research objectives. Experts in this stage also help to add or subtract variables to be used in research.

3.2 Questionnaire of Pilot Survey

The pilot survey questionnaire is a questionnaire that aims to make adjustments to the delivery or language used in the questionnaire so that the research objectives are achieved.

3.3 Questionnaire of Respondents

Respondent's questionnaire is a questionnaire given to respondents after validation phase 1 and a pilot survey to determine the causes of construction waste which aims to collect information from respondents about this research.

From a specified number of populations, samples were taken to conduct research using random sampling techniques because the population was homogeneous and because any element selected as the sample could represent the population. The calculation of the number of samples taken based on the Slovin formula is as follows:

$$n = \frac{N}{N x (d)^2 + 1}$$

$$n = \frac{45}{45 x (0.1)^2 + 1}$$

$$n = 31.0344$$

$$n = 31 \text{ person (rounded)}$$

Note :

n = sample

N = population = 45

d = 0.1 if precision 90%

At this stage of the questionnaire, validity and reliability tests were carried out using SPSS software. The Pearson moment validity test uses the principle of correlating each questionnaire item score with the total score of respondents' answers. The instrument test is said to be valid if the pearson correlation (r count) output on SPSS is greater than the r table and vice versa. This reliability test aims to determine the level of consistency or reliability of the research instrument itself if measurements are carried out using the questionnaire repeatedly. To determine the reliability level of an instrument, look at the alpha of the test results and compare it with Cronbach's alpha with a minimum of 0.6.

After the data has been tested and produces reliable results, then the variables are calculated the Frequency Index (FI), Severity Index (SI), and Importance Index (IMPI) to determine the variables that have a high influence in this study. Frequency Index (FI) is the percentage of the probability score or frequency of events calculated based on the respondent's answer. FI can be calculated by the following formula:

$$FI (\%) = \frac{\sum_{i=1}^5 a_i n_i}{5 N} x 100$$

Note :

FI = Frequency Index

ai = The weight given by the respondent with a score of i; ai = 1,2,3,4, and 5

n_i = The number of respondents who answered the score of i
 N = The total number of respondents

Severity Index (SI) is the percentage score of the severity or impact of an event in terms of time, cost, and quality which is calculated based on the respondent's answer. SI can be calculated in the formula below :

$$SI (\%) = \frac{\sum_{i=1}^5 a_i n_i}{5 N} \times 100$$

Note :

SI = Severity Index

a_i = The weight given by the respondent with a score of i ; $a_i = 1, 2, 3, 4$, and 5

n_i = The number of respondents who answered with a score of i

N = The total number of respondents

IMPI is used to show importance index from the multiplication of frequency and severity. IMPI can be calculated by the formula :

$$IMPI (\%) = \frac{FI (\%) \times SI (\%)}{100}$$

Note :

FI = Frequency Index

SI = Severity Index

IMPI = Importance Index

In the IMPI results, high influencing variables can be classified according to the following score ranges :

Number	Scale	Information
1	Index 0% - 20%	Low
2	Index 21% - 40%	Moderate
3	Index 41% - 60%	Significant
4	Index 61% - 100%	High

3.4 Questionnaire of Final Expert Validation

The final expert validation questionnaire is the result of the validation of the respondent's questionnaire that has been approved by the experts. At this stage, previously the IMPI score was taken which could be categorized as having a high influence (significant and high). Filling the questionnaire by experts aims to validate the end to find out the results of the respondents' questionnaire so that it fits the purpose of this study and to provide a way to control the causes of waste based on the experience of experts

4. Result and Discussion

4.1 Questionnaire of Validation Phase 1

The following is expert education data, amounting to 3 people in this study:

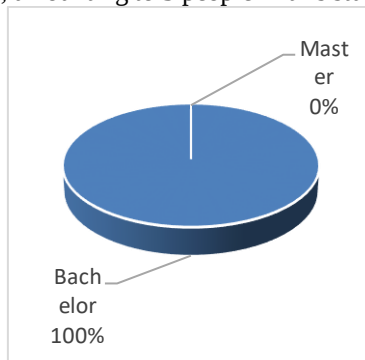


Figure 2. Percentage of expert education

Whereas for the expert work experience is as follows:

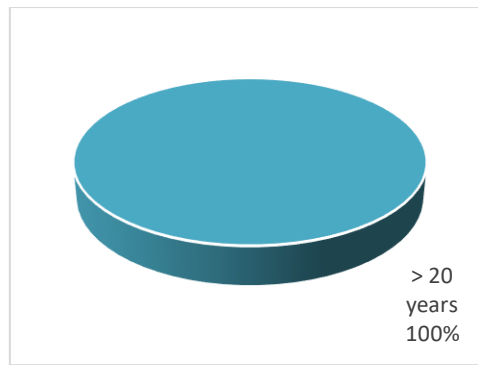


Figure 3. Percentage of expert experience

The results of the stage 1 expert validation questionnaire can be seen in table 2 :

Table 2.The results of the stage 1 expert questionnaire

The Cause of Waste	Code	Expert Approval			Conclusion
		1	2	3	
Last Planner System					
Time waiting for material to come	X1.1	Yes	No	Yes	Yes
Time waiting for tools to come	X1.2	Yes	Yes	Yes	Yes
Poor planning and scheduling	X1.3	Yes	Yes	Yes	Yes
Lack of measuring tools for achieving weekly targets	X1.4	Yes	Yes	Yes	Yes
Increased Visualization					
Lack of safety signs	X2.1	Yes	Yes	Yes	Yes
Daily Huddle Meetings					
Job instruction error	X3.1	Yes	Yes	Yes	Yes
Poor coordination	X3.2	Yes	Yes	Yes	Yes
Unemployed workforce	X3.3	Yes	Yes	Yes	Yes
Slow / ineffective worker	X3.4	Yes	Yes	Yes	Yes
Solidless teamwork	X3.5	Yes	Yes	Yes	Yes
Time waiting for instructions	X3.6	Yes	Yes	Yes	Yes
First Run Studies					
Work accident	X4.1	Yes	Yes	Yes	Yes
Lack of adjustment of work methods to the conditions and constraints found	X4.2	Yes	Yes	Yes	Yes
Bad weather in winter	X4.3	Yes	Yes	Yes	Yes
There was a complaint from the public	X4.4	Yes	Yes	Yes	Yes
5S Process (Visual Work Place)					
Loss of material on site	X5.1	Yes	Yes	Yes	Yes
Losing tools on site	X5.2	Yes	Yes	Yes	Yes
The material storage area is easily disturbed and unsafe	X5.3	Yes	Yes	Yes	Yes
The absence of the implementation of the 5S (Sort, Straighten, Shine, Standardize, Sustain)	X5.4	Yes	Yes	Yes	Yes
Material damage on site	X5.5	Yes	Yes	Yes	Yes
Fail-safe for Quality and Safety					
Late surveillance	X6.1	Yes	Yes	Yes	Yes
Rework	X6.2	Yes	Yes	Yes	Yes
Repair	X6.3	Yes	Yes	Yes	Yes

Of all these variables, there are conclusions of 23 variables that are approved by the expert, so that these 23 variables will be continued at the pilot survey questionnaire stage.

4.2 Questionnaire of Pilot Survey

The following is the educational data for the pilot survey respondent, totaling 5 people in this study:

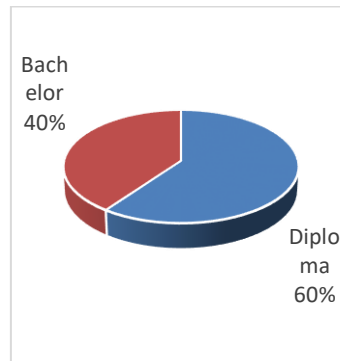


Figure 4. Percentage of education pilot survey respondent

Meanwhile, the experiences of the survey pilot respondents are as follows:

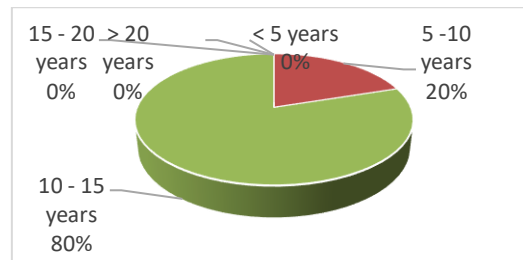


Figure 5. Percentage of work experience pilot survey respondent

The results on the survey pilot questionnaire can be seen in the following table :

Table 3. Results of the pilot survey questionnaire

Variable	Code	Easy to Understand Statement					Conclusion
		1	2	3	4	5	
Last Planner System							
Time waiting for material to come	X1.1	Yes	Yes	Yes	Yes	Yes	Yes
Time waiting for tools to come	X1.2	Yes	Yes	Yes	Yes	Yes	Yes
Poor planning and scheduling	X1.3	Yes	Yes	Yes	Yes	Yes	Yes
Lack of measuring tools for achieving weekly targets	X1.4	Yes	Yes	Yes	Yes	Yes	Yes
Increased Visualization							
Lack of safety signs	X2.1	Yes	Yes	Yes	Yes	Yes	Yes
Daily Huddle Meetings							
Job instruction error	X3.1	Yes	Yes	Yes	Yes	Yes	Yes
Poor coordination	X3.2	Yes	Yes	Yes	Yes	Yes	Yes
Unemployed workforce	X3.3	Yes	Yes	Yes	Yes	Yes	Yes
Slow / ineffective worker	X3.4	Yes	Yes	Yes	Yes	Yes	Yes
Solidless teamwork	X3.5	Yes	Yes	Yes	Yes	Yes	Yes
Time waiting for instructions	X3.6	Yes	Yes	Yes	Yes	Yes	Yes
First Run Studies							
Work accident	X4.1	Yes	Yes	Yes	Yes	Yes	Yes
Lack of adjustment of work methods to the conditions and constraints found	X4.2	Yes	Yes	Yes	Yes	Yes	Yes
Bad weather in winter	X4.3	Yes	Yes	Yes	Yes	Yes	Yes
There was a complaint from the public	X4.4	Yes	Yes	Yes	Yes	Yes	Yes
5S Process (Visual Work Place)							
Loss of material on site	X5.1	Yes	Yes	Yes	Yes	Yes	Yes
Losing tools on site	X5.2	Yes	Yes	Yes	Yes	Yes	Yes
The material storage area is easily disturbed and unsafe	X5.3	Yes	Yes	Yes	Yes	Yes	Yes
The absence of the implementation of the 5S (Sort, Straighten, Shine, Standardize, Sustain)	X5.4	Yes	Yes	Yes	Yes	Yes	Yes
Material damage on site	X5.5	Yes	Yes	Yes	Yes	Yes	Yes
Fail-safe for Quality and Safety							
Late surveillance	X6.1	Yes	Yes	Yes	Yes	Yes	Yes
Rework	X6.2	Yes	Yes	Yes	Yes	Yes	Yes
Repair	X6.3	Yes	Yes	Yes	Yes	Yes	Yes

From all variables, there are conclusions that 23 variables have passed the pilot survey stage, so that 23 variables will be continued at the responsive questionnaire stage.

4.3 Questionnaire of Respondents

The following is the education data of respondents, which amounted to 31 people in this study :

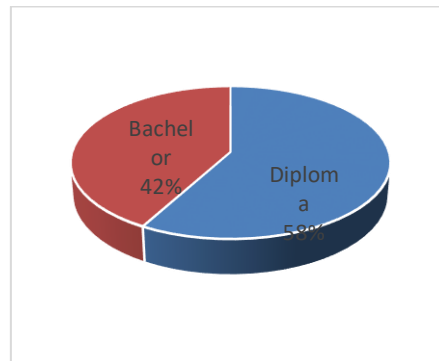


Figure 6. Percentage of respondent education

Meanwhile, the respondents' experiences are as follows :

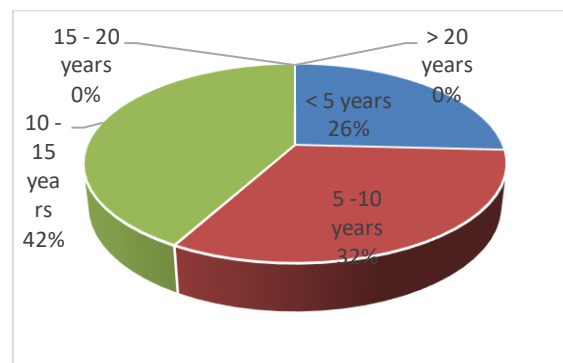


Figure 7. Percentage of respondent's work experience

The results on the respondent's questionnaire can be seen in the following table :

Table 4. Results of the respondent's questionnaire

Variable	Code	Frequency					Severity				
		1	2	3	4	5	1	2	3	4	5
Last Planner System											
Time waiting for material to come	X1.1	0	6	18	7	0	0	12	13	6	0
Time waiting for tools to come	X1.2	0	9	12	10	0	0	9	16	6	0
Poor planning and scheduling	X1.3	0	5	14	11	1	0	6	10	13	2
Lack of measuring tools for achieving weekly targets	X1.4	0	8	16	6	1	0	12	14	5	0
Increased Visualization											
Lack of safety signs	X2.1	4	11	10	6	0	2	11	14	4	0
Daily Huddle Meetings											
Job instruction error	X3.1	2	10	12	7	0	1	8	16	6	0
Poor coordination	X3.2	1	10	11	7	2	2	11	14	3	1
Unemployed workforce	X3.3	1	6	15	9	0	2	11	11	7	0
Slow / ineffective worker	X3.4	1	4	18	8	0	1	8	13	7	2
Solidless teamwork	X3.5	2	6	15	8	0	1	8	17	4	1
Time waiting for instructions	X3.6	1	9	14	7	0	1	11	16	3	0
First Run Studies											
Work accident	X4.1	2	10	16	3	0	2	11	14	4	0
Lack of adjustment of work methods to the conditions and constraints found	X4.2	1	11	9	10	0	2	6	17	6	0
Bad weather in winter	X4.3	1	2	12	12	4	1	3	13	12	2
There was a complaint from the public	X4.4	1	12	12	5	1	1	11	12	6	1
5S Process (Visual Work Place)											
Loss of material on site	X5.1	1	9	15	5	1	1	12	11	5	2
Losing tools on site	X5.2	1	11	13	5	1	1	16	12	0	2
The material storage area is easily disturbed and unsafe	X5.3	1	5	14	8	3	1	6	11	9	4
The absence of the implementation of the 5S (Sort, Straighten, Shine, Standardize, Sustain)	X5.4	3	12	13	3	0	2	9	16	4	0
Material damage on site	X5.5	1	6	17	7	0	1	9	13	8	0
Fail-safe for Quality and Safety											
Late surveillance	X6.1	1	10	12	8	0	1	10	14	6	0
Rework	X6.2	1	7	14	7	2	1	4	15	10	1
Repair	X6.3	1	5	15	4	6	1	5	9	12	4

Several tests were conducted on the results of the respondent's questionnaire, namely by testing the validity and reliability testing with the help of SPSS software. The results of the validity test are as follows :

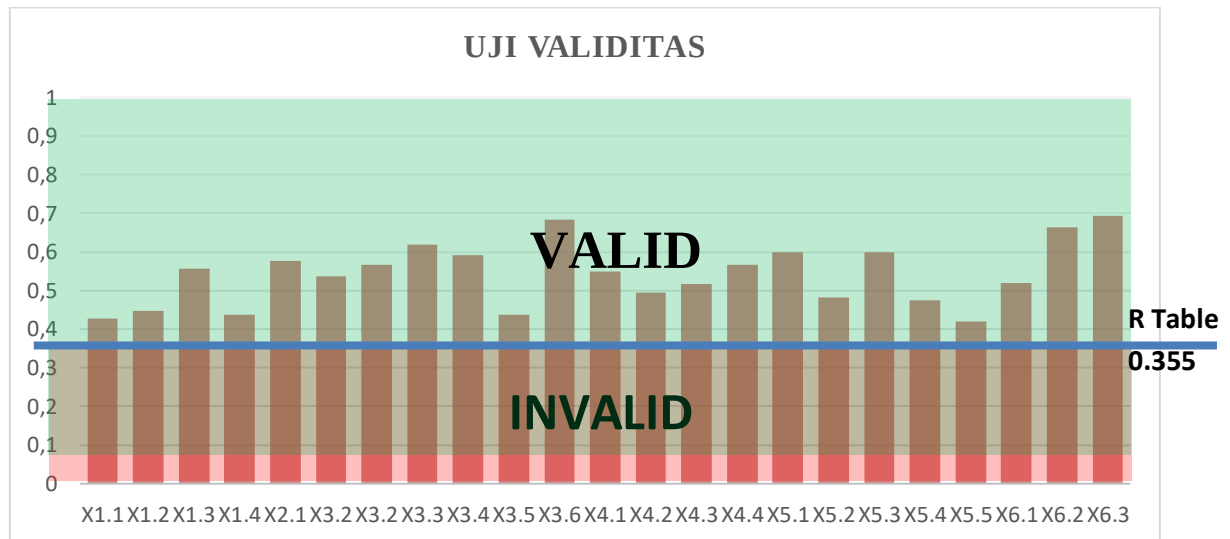


Figure 8. The results of the validity test

After the validity test is carried out, it is known that the score of r count for all variables is declared valid so that it can be continued with the next test stage. The next test is the reliability test, which is to determine the reliability level of an instrument which can be seen in alpha and compared with the cronbach alpha score. The results of the reliability test in this study are as follows:

Table 5. Reliability test results

Cronbach Alpha	N of Items
0,892	23

From the table above, it is obtained that the Cronbach alpha score is 0.892 which can be seen in the range 0.80 to 1, it can be concluded that the instrument data used is very reliable.

After being declared valid and reliable, the calculation of FI, SI and IMPI is then carried out to determine the level of a variable. The following is the FI score based on the results of the respondent's questionnaire :

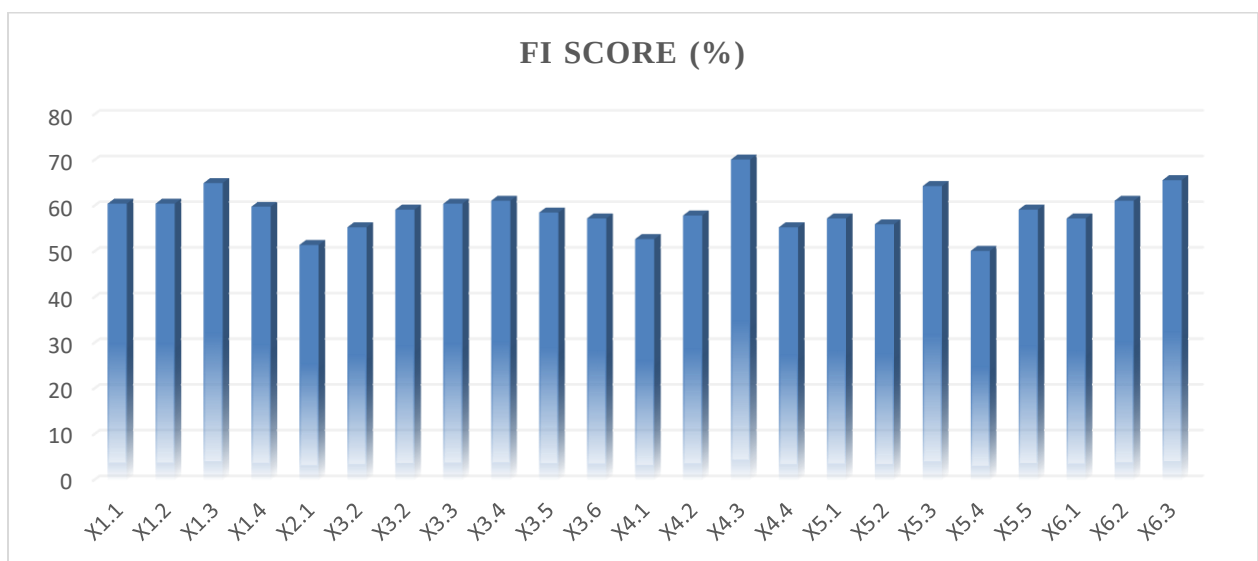


Figure 9. Bar chart of score Frequency Index (FI) %

After calculating the FI, proceed with calculating the SI. The following is the SI score based on the respondent's questionnaire :

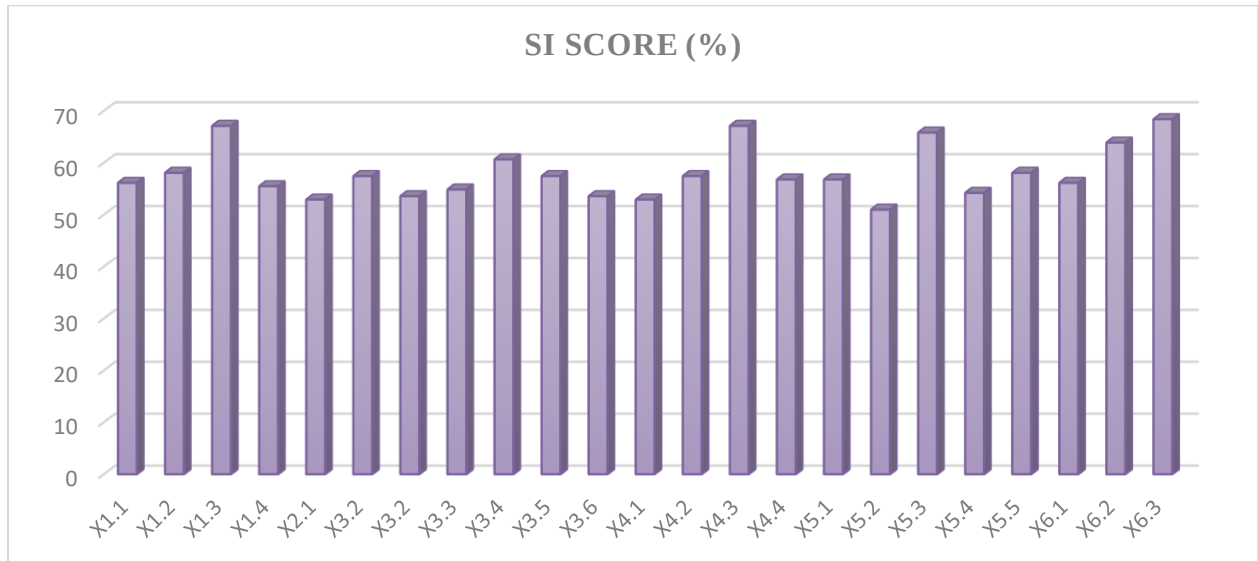


Figure 10. Bar chart of score Severity Index (SI) %

Furthermore, the IMPI can be calculated with the following results :

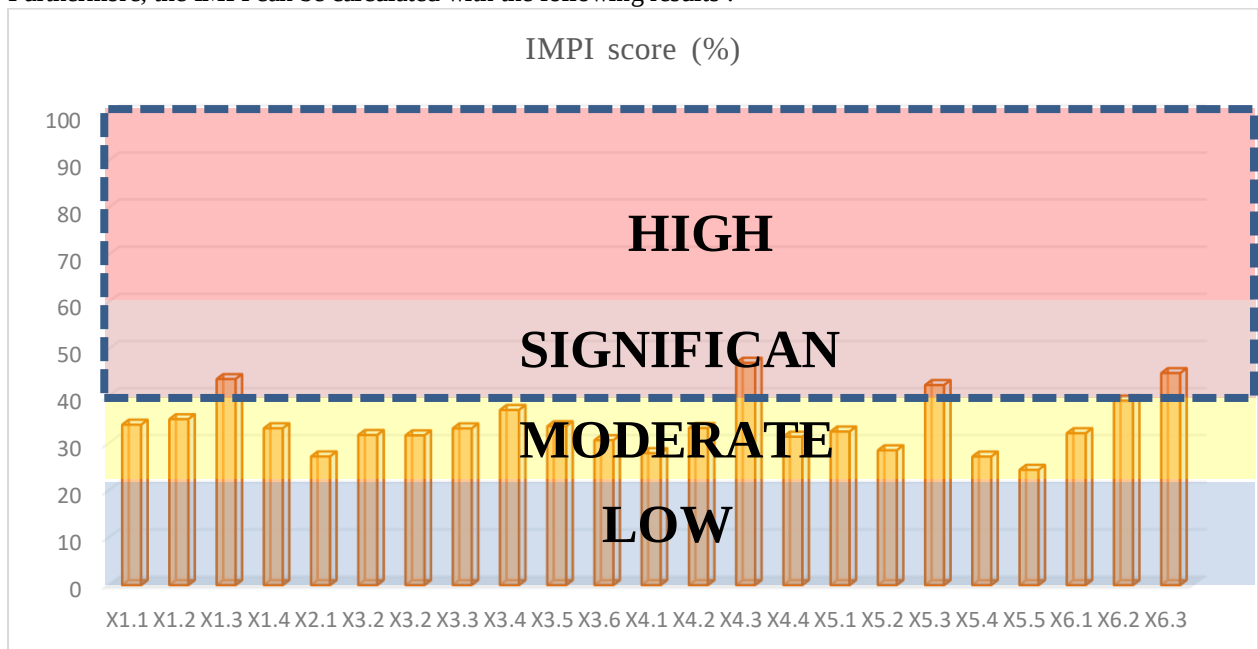


Figure 11. Bar chart of score Importance Index (IMPI) %

From the IMPI results, there are 4 variables which are categorized as "significant". Variables that have a significant category are found in the last planner system tools, first run studies, 5S process (visual work place), and fail-safe for quality and safety. Some of these variables have the code X1.3 - Poor planning and scheduling (IMPI 43.72%), X4.3 - Bad weather in winter (IMPI 47.18%), X5.3 - The material storage area is easily disturbed and unsafe (42.46%), and X6.3 – Repair (IMPI 45.00%).

4.4 Questionnaire of Final Expert Validation

Following are the results of the final expert validation agreement :

Table 6. Results of final approval of the final expert validation questionnaire

Variables Affecting Project Performance Due to Waste	Code	Expert 1		Expert 2		Expert 3	
		Yes	No	Yes	No	Yes	No
Last Planner System							
Poor planning and scheduling	X1.3	✓		✓		✓	
First Run Studies							
Bad weather in winter	X4.3	✓		✓		✓	
5S Process (Visual Work Place)							
The material storage area is easily disturbed and unsafe	X5.3	✓		✓		✓	
Fail-safe for Quality and Safety							
Repair	X6.3	✓		✓		✓	

All variables were approved by the expert, as for the results of preventive and corrective actions from the final expert validation questionnaire:

Table 7. Results of preventive and corrective action final expert validation questionnaire

Variables Affecting Project Performance Due to Waste	Code	Expert	Preventive	Corrective
Last Planner System				
Poor planning and scheduling	X1.3	1	Daily evaluation and monitoring is held.	Make changes to methods based on daily evaluation and monitoring.
		2	Create a master schedule with the most appropriate critical path.	Perform schedule evaluation, especially on critical paths that have gone out of time.
		3	Scheduling that is integrated directly with materials, tools, and time.	Carry out daily schedule control through daily reports
First Run Studies				
Bad weather in winter	X4.3	1	Carrying out new innovations in order to reduce the risk of increased waste.	The work method was created to increase the hot temperature to speed up the drying of the concrete so that the formwork unloading cycle can be achieved and the strength of the concrete is achieved.
		2	Conducting continuous evaluation of the anticipation of bad weather.	Do over time (claim) to make up for lost time due to cold weather.
		3	Conducting studies on other similar projects in anticipation of the impact of waste in winter.	A large warehouse is made, if there are already rooms in the building it can be used for the warehouse, it will be better, prepare covers and tool boxes in the field.
5S Process (Visual Work Place)				
The material storage area is easily disturbed and unsafe	X5.3	1	Made closed which is safe from weather disturbances.	Making data collection and grouping of material types and material stock containers, which are weather resistant and not weather resistant
		2	Improve the quality and quantity of security officers (security). Choosing and sorting storage places or warehouses according to the type of material or equipment when	Perform patrols and shift changes 24 hours by security officers (security).
		3		Regularly moving disturbed and unsafe materials, especially those with large waste, such as iron.

			you first arrive at the site.	
			Fail-safe for Quality and Safety	
		1	The implementation plan is carried out carefully, and is applied with a master schedule	The repair method is carried out in the event of irregularities and evaluated so that there are no re-deviations.
		2	Hold weekly meetings and monitor daily implementation according to the master schedule.	Create a more efficient method based on evaluation and close weekly.
		3	Creating a master schedule includes materials, tools, labor and time.	Doing repairs with the consideration of minimizing waste, especially material and time.
Repair	X6.3			

5. Conclusion

- a. The causes that have a high influence on the existence of waste on the 1700 units apartment Algeria construction project :
 1. Last Planner System : Poor planning and scheduling
 2. First Run Studies : Bad weather in winter
 3. 5S Process (visual work place) : The material storage area is easily disturbed and unsafe
 4. Fail-safe for Quality and Safety : Repair
- b. Strategies that can be applied to manage high-impact causes of waste through the lean construction approach on the 1700 units apartment Algeria project:
 - 1) Poor planning and scheduling
 - Preventive : Making the right master schedule integrated with tools and people as well as daily monitoring.
 - Corrective : Perform daily routine evaluation and monitoring and control on the critical path.
 - 2) Bad weather in winter
 - Preventive : Conduct bad weather anticipation evaluations and studies of other projects.
 - Corrective : File weather lost time claims, set up an all-weather warehouse, and apply special winter methods.
 - 3) The material storage area is easily disturbed and unsafe
 - Preventive : Grouping the use of good and closed storage and evaluation of security officers.
 - Corrective : The removal of the wrong material parallel based on the location list of material types, increased security guards.
 - 4) Repair
 - Preventive : Routinely conduct daily and weekly meetings referring to the master schedule.
 - Corrective : Perform the repair method with good consideration and re-evaluate it.

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Biography

Novika Candra Fertilia, born in Belitang on November 12, 1989. She earned her Engineer title in Civil Engineering in Lampung University in 2012 with the title of her thesis is Project Planning Using Primavera Project Planner. She earned her Master of Civil Engineering with concentration in Construction Management from University of Indonesia in 2016 with the title of her thesis is Development of Planning Process on EPC Project Based on PMBOK to Improve Time Performance at PT. KE. Now she is a Lecturer in Faculty of Engineering at Mercu Buana University with several courses such as Construction Management, Survey and Spatial Information, Physics, and Mechanical of Material.

Dian Andaka, born in Jakarta on June 19, 1995. He earned his Diploma 3 in Civil Engineering degree with concentration in Building Construction Engineering from Jakarta State Polytechnic in 2016 with the title of Final Project is Formwork Implementation Methods in the Medical Education and Research Centre Project, Faculty of Medical, University of Indonesia . Now, he is continuing his studies to earn a Bachelor's degree in Civil Engineering at Mercu Buana University.

Legal Aspects of Electronic Signatures in E- Commerce Transactions

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Abstract

Technological advances have brought about significant changes from the use of the Internet in human life. However, there are still many parties who do not understand how the position of electronic signatures that meet the requirements and standards, especially in financial technology transactions where the electronic signature function was essential. This study discusses the position of electronic signatures in financial technology transactions as well as legal remedies that can be taken if there was an electronic signature dispute. The type of research used in this paper was normative. The approach to the problem used in the writing of this research was the statute approach and the conceptual approach. The legal materials used in the writing of this study consist of primary legal materials, secondary legal materials, and tertiary legal materials. The analysis used in the writing of this research is descriptive qualitative. The conclusion in this study is that in accordance with applicable laws and regulations, electronic signatures must meet aspects of authenticity, integrity, and non-repudiation. With regard to fraud that causes losses to users of financial technology transactions, financial technology operators are liable for an error with a reversal of the burden of proof. Legal recognition in applicable laws and regulations confirms that electronic signatures can be used as evidence in court examinations. Legal remedies that can be taken if there is a dispute are through Litigation or Non-Litigation. The majority of business players prefer Non-Litigation legal remedies, namely alternative dispute resolution to resolve any problems that arise in business activities because the settlement system is more effective, fair, does not take up time, and is relatively cheaper.

Keywords

electronic signature, e-commerce, legal aspects.

1. Introduction

The current technological development is so fast and encourages the development of electronic trading activities (e-commerce) in Indonesia. In trading transactions conducted via the internet or cyberspace, the signature used is also a signature in the form of electronic data (electronic signature). (Harahap, 2004)

Electronic signature (digital signature or electronic signature) is not a digitized image of handwritten or not a signature or image, but is by making a message digest in advance, in the form of a mathematical summary document that will be sent via cyber space. Referring to the ITE Law Article 1 point 12, an electronic signature is a signature consisting of electronic information that is embedded, associated or related to other electronic information that is used as a means of verification and authentication. Many people are unfamiliar with the term electronic signature and think that an electronic signature is the result of a printed document that has been signed and is in soft copy. In fact, the actual electronic signature is not obtained through this method.

In order to face the era of e-commerce that is growing rapidly around the world, especially financial technology activities, business actors and all parties related to financial technology activities need to understand how the electronic signature requirements and their function in financial technology actually are. If the use of an electronic signature meets the required standards, its function can be optimized in anticipating legal risks in financial technology transactions. Especially in the financial technology of loans, financing, and provision of capital whose transaction characteristics are customer to customer (C2C), electronic signatures need to be used as an implementation of the precautionary principle.

1.1. Problems

5. What was the position of the electronic signature in financial technology transactions?
6. What legal remedies can be taken if there was an electronic signature dispute?

2. Research Methodology

This research is written with the type of normative legal research, namely by explaining a problem using various legal provisions related to the problem. This legal research is based on the author's logical thinking followed by a review of applicable laws and regulations relevant to the formulation of the problem. This research,

namely the position of electronic signatures in financial technology transactions and legal remedies that can be taken if there is an electronic signature dispute. Apart from the use of statutory regulations, there is also literature that is relevant to the formulation of the problem. Literatures containing the opinions of jurists and developing doctrines in the science of law will be examined in depth to get the conclusions of this research. The approach to the problem used in this study is the conceptual approach and statute approach.

3. Result and Discussion

3.1. Position of Electronic Signature in Financial Technology Transactions

The position of electronic signatures in electronic transactions in the prevailing laws and regulations confirms that electronic signatures can be used as evidence in court examinations. The use of information technology based on electronic means in electronic transactions is believed to have a positive impact on business people, especially in terms of speed and ease of conducting transactions in global interactions without limitation of place and time. In this regard, the need for confidentiality of information and safeguarding the authenticity of information has increased so that the Government of the Republic of Indonesia issued Law Number 11 of 2008 concerning Electronic Information and Technology (hereinafter referred to as Law 11/2008) (Forder, 2008).

One of the things that need to be considered in electronic transactions is the implementation of a digital signature which aims to legalize documents / results in an electronic transaction. Related to this, Law 11/2008 regulates the authentication of rights and obligations in an electronic document that is digital signature.

3.1.1. Digital Signature

Based on Article 1 paragraph (12) of Law Number 11 Year 2008, an electronic signature is a signature consisting of electronic information that is embedded, associated or related to other Electronic Information which is used as a verification and authentication tool. Further provisions on electronic signatures are regulated by Government Regulation Number 82 of 2012 concerning Electronic Systems and Transactions (hereinafter referred to as PP Number 82 of 2012). Article 52 paragraph (2) of Government Regulation Number 82 of 2012 states that the Electronic Signature in Electronic Transactions is the approval of the Signer for Electronic Information and / or Electronic Documents signed with the Electronic Signature.

Based on Article 54 paragraph (1) Government Regulation Number 82 of 2012 Electronic Signatures are divided into 2 (two), namely:

1. Certified Electronic Signature, which is made using the services of an electronic certification operator, and proven by an Electronic Certificate; and
2. Electronic Signature is not certified, which is made without using the services of an electronic certification provider.

3.1.2. Electronic Signature Creation

Referring to Article 55 paragraph (3) of Government Regulation Number 82 of 2012, making electronic signatures must meet the following conditions:

1. The entire manufacturing process is guaranteed its security and confidentiality;
2. Electronic Signature Creation data using cryptographic codes must not be easily known from the Electronic Signature verification data through certain calculations, within a certain period of time, and with a reasonable means;
3. Electronic Signature Creation data is stored in an electronic media which is under the control of the Signer;
4. Data related to the Signer must be stored in a place or data storage facility, which uses a trusted system that can detect changes and meet the following requirements:
5. Only authorized persons can enter new data, change, exchange, or replace data;
6. Signer identity information can be checked for authenticity; and
7. Other technical changes that violate security requirements can be detected or discovered.

Every person involved in an Electronic Signature is obliged to provide security for the Electronic Signature that is used. Electronic Signature Safeguarding includes at least (Article 12 paragraph (1) Law Number 11 Year 2008).

3.1.3. The system cannot be accessed by unauthorized people

Signers must apply the precautionary principle to avoid unauthorized use of data related to Electronic Signature creation. The Signer must without delay, use the recommended method or other appropriate means and should immediately notify someone whom the Signer deems to trust the Electronic Signature or to a party supporting the Electronic Signature service if:

1. The Signer is aware that the Electronic Signature creation data has been compromised; or

2. Circumstances that are known to the Signer could create significant risks, possibly as a result of the breakdown of the Electronic Signature creation data;
3. In the event that an Electronic Certificate is used to support an Electronic Signature, the Signer must ensure the truth and integrity of all information related to the Electronic Certificate.

Before the Electronic Signature is used, the Electronic Signature Operator is obliged to ensure the initial identification of the Signer by means of (Article 58 paragraph (1) Government Regulation Number 82 of 2012)

1. Signer conveys identity to the Electronic Signature Operator;
2. Signers register with Providers or Supporters of Electronic Signature Services.

3.1.4. Electronic Signing Mechanism

Electronic Information to be signed must be known and understood by the Signer. (Article 56 paragraph (2) Government Regulation Number 82 Year 2012) Signer Approval of Electronic Information to be signed with Electronic Signature must use affirmation mechanisms and / or other mechanisms that show the intent and purpose of the Signer to be bound in an Electronic Transaction (Article 56 paragraph (2) Government Regulation Number 82 of 2012). Electronic Signatures to prove the identity of the Signers electronically are required to apply a combination of at least 2 (two) authentication factors (Article 58 paragraph (2) Government Regulation Number 82 of 2012).

3.1.5. The Power of Digital Signature Law

Referring to Article 5 paragraph (1) of Law Number 11 Year 2008, Electronic information and / or Electronic Documents and / or their printouts are valid legal evidence, this is an extension of valid evidence in accordance with the applicable procedural law in Indonesia

Based on Article 11 paragraph (1) of Law Number 11 Year 2008 jo. Article 53 paragraph (2) Government Regulation Number 82 Year 2012, Digital Signature has legal force and legal consequences as long as it meets the following requirements:

1. The electronic signature creation data is related only to the signer.
2. The electronic signature creation data during the electronic signing process is only in the power of the signing.
3. Any changes to the electronic signature that occur after the signing time can be known.
4. Any changes to electronic information related to the electronic signature after the signing time can be known.
5. There are certain methods used to identify who the signatories are.
6. There are certain ways to show that the signer has given consent to the related electronic information.

Based on the things that have been stated above, the Implementation of Electronic Transactions, especially electronic signatures in Insurance Companies against Losses, is one of the supporting factors for business transactions realized with a Digital Policy. The application of a Digital Policy in electronic transactions can be applied as long as the issuance of a digital policy has gone through a series of processes in accordance with the company's internal policies which have been standardized into the system and its security is guaranteed. (Susanti Adi Nugroho, 2018).

3.2. Legal Remedies That Can Be Found If There Are Electronic Signature Disputes

In general, e-commerce means conducting trade using electronic means. Furthermore, Electronic commerce can be defined as commercial activities carried out through the exchange of information created, stored, or communicated through electronic, optical, or analog media, including EDI (Electronic Data Interchange), E-mail, and so on. Furthermore, based on the UNCITRAL Model Law on Electronic Commerce with Guide to Enactment 1996 it is stated that: (Hill, 1996)

The term "commercial" should be given a wide interpretation so as to cover matters arising from all relationship of a commercial nature whether contractual or not. Relationships of a commercial nature include, but are not limited to the following transactions: any trade transaction for the supply or exchange of goods and services; distribution agreement; commercial representation or agency; factoring; leasing; construction of works; consulting; engineering; licensing; investment; financing; banking; insurance; exploitation agreement or concession; joint venture and other forms of industrial or business cooperation; carriage of goods or passengers by air, sea, rail or road.

Meanwhile, basically the Indonesian legal system currently accommodates the equivalent of the term e-commerce. The law that regulates the meaning of the term e-commerce is Law Number 11 of 2008 concerning Electronic Information and Transactions (UU ITE). The ITE Law uses the term electronic transaction. The definition of Electronic Transaction is regulated in Article 1 point 2 which regulates as follows: "Electronic Transaction is a legal act conducted by using a computer, and / or other electronic media."

In practice, many people define electronic commerce differently. However, basically electronic commerce has basic characteristics, namely:

1. The availability of offers via the internet;
2. Transactions between 2 parties;
3. There is an exchange of goods, services or information
4. Using media that comes from the use of Information Technology. The internet is the main medium in this process or mechanism.

In Article 45 paragraph (2) of the Consumer Protection Law it is stated that:

"Settlement of consumer disputes can be pursued through the court or outside the court based on the voluntary choice of the disputing parties."

So in an effort to resolve consumer disputes according to the UUPK, there are two options for dispute resolution, namely:

- 1) Settlement outside the court, through an institution in charge of resolving disputes between consumers and business actors:
 - a. Amicable dispute resolution by the parties themselves
 - b. Settlement of disputes through an authorized institution, in this case the Consumer Dispute Resolution Agency by using the mechanism of conciliation, mediation, or arbitration.
- 2) Settlement of disputes through courts located within the general court.

Settlement of consumer disputes as referred to in Article 45 paragraph (2) of the Consumer Protection Law, does not preclude the possibility of peaceful settlement by the disputing parties, namely business actors and consumers, without going through a court or Consumer Dispute Resolution Agency, and as long as it does not conflict with UUPK. In fact, in the elucidation of the article it is stated that at each stage efforts are made to use a peaceful settlement by both parties to the dispute. From the explanation of Article 45 paragraph (2) of the Consumer Protection Law, it can be seen that the Consumer Protection Law requires that a peaceful settlement be a legal remedy that the disputing parties seek first, before the parties choose to settle their dispute through a consumer dispute settlement agency or judiciary. (manuhutu febian leonardo, 2014)

In carrying out efforts to resolve consumer disputes outside the court, the Government forms a new agency, namely the Consumer Dispute Resolution Agency, for the settlement of consumer disputes outside the court. With the existence of the Consumer Dispute Resolution Agency, consumer dispute resolution can be done quickly, easily and cheaply, fast because the Consumer Protection Law stipulates that within a grace period of 21 working days the Consumer Dispute Resolution Agency is obliged to issue a decision. (Susanti Adi Nugroho, 2011). Easy because administrative procedures and decision-making processes are very simple. Cheap lies in affordable court fees. This is of course very useful in resolving e-commerce transaction disputes between businesses and consumers. Therefore, in the case of implementing e-commerce transactions between business actors and consumers, if a dispute occurs, it will be more appropriate to resolve it through out of court settlement, namely through the Consumer Dispute Resolution Agency (BPSK).

In the context of e-commerce dispute resolution, the role of BPSK is very important to immediately provide protection for traffickers. This is of course done in accordance with BPSK's duties, namely through the handling and settlement of consumer disputes by means of conciliation, mediation, or arbitration. Therefore, in order to carry out this task effectively in e-commerce dispute resolution, BPSK must also be able to adjust to the characteristics of the current electronic transaction and system administration. The operation of electronic systems and transactions is currently regulated in the ITE Law and PP PSTE. This means that BPSK should adjust to these provisions.

The difference between the operation of an electronic system for public services and the operation of an electronic system for non-publics can be found in several provisions in PP PSTE. In particular, administrators of electronic systems for public services are obliged to locate data centers and disaster recovery centers in the territory of Indonesia, must obtain an electronic system feasibility certification from the minister, and must be registered with the ministry that administers government affairs in the field of communication and information technology. In addition, the operation of electronic systems for public services is also required to use software registered with the ministry that administers government affairs in the field of communication and information technology, ensuring the safety and reliability of operations as appropriate, and in accordance with statutory provisions. If it is concluded, the implementation of an electronic system for public services demands to implement good and accountable governance. Basically, the same standard also applies to administrators of electronic systems for non-public services. However, the regulation is not rigidly regulated by opening up the possibility for non-public service providers to develop good and accountable governance.

4. Conclusion

1. The position of electronic signatures in electronic transactions in the prevailing laws and regulations confirms that electronic signatures can be used as evidence in court examinations. Electronic signatures

must meet the requirements according to legal provisions in Indonesia to be valid and meet the security aspects of electronic documents as stated in the ITE Law and PP PSTE. These aspects are authenticity, integrity, and non-repudiation. Legal recognition of electronic signatures in Indonesia through the provisions in the ITE Law, PP PSTE, POJK, and SEOJK shows that electronic signatures can replace the conventional signature function to show the agreement and competence of the parties according to the law, so that it can be used as evidence in the judge.

2. BPSK as the Operator of Electronic Transactions in the Scope of Public Services Based on the provisions of the Public Service Law and the ITE Law, BPSK can be categorized as a public service provider. Therefore, BPSK should adjust to the provisions regarding electronic system administrators within the scope of public services which are currently regulated under Government Regulation Number 82 of 2012 concerning Electronic System and Transaction Operation. If BPSK wants to provide protection for consumer dispute resolution in Indonesia, BPSK should have followed these provisions in order to carry out online dispute resolution (Online Dispute Resolution). Furthermore, as an electronic system operator within the scope of public services, BPSK needs to adjust to several provisions regarding the eligibility of electronic system administrators which include registration, hardware, software, experts, governance, security, and certification of electronic system eligibility.

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