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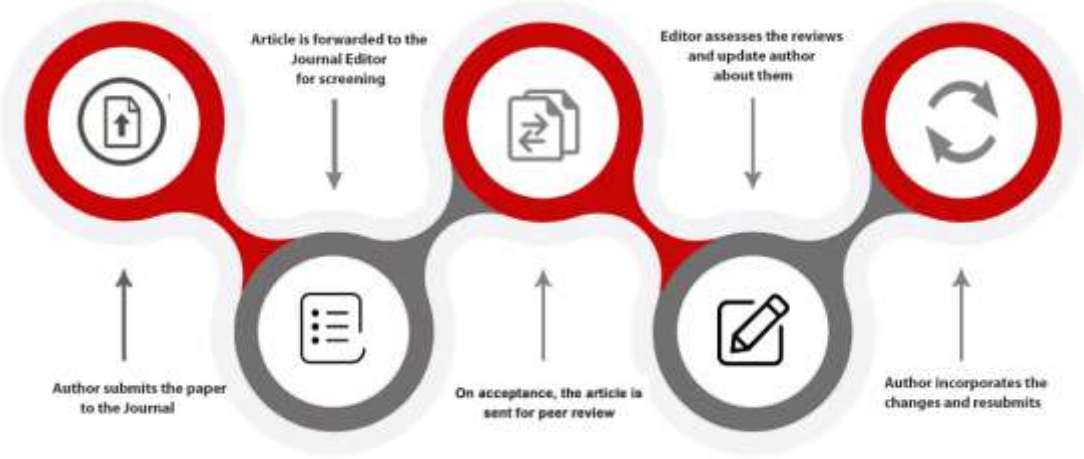

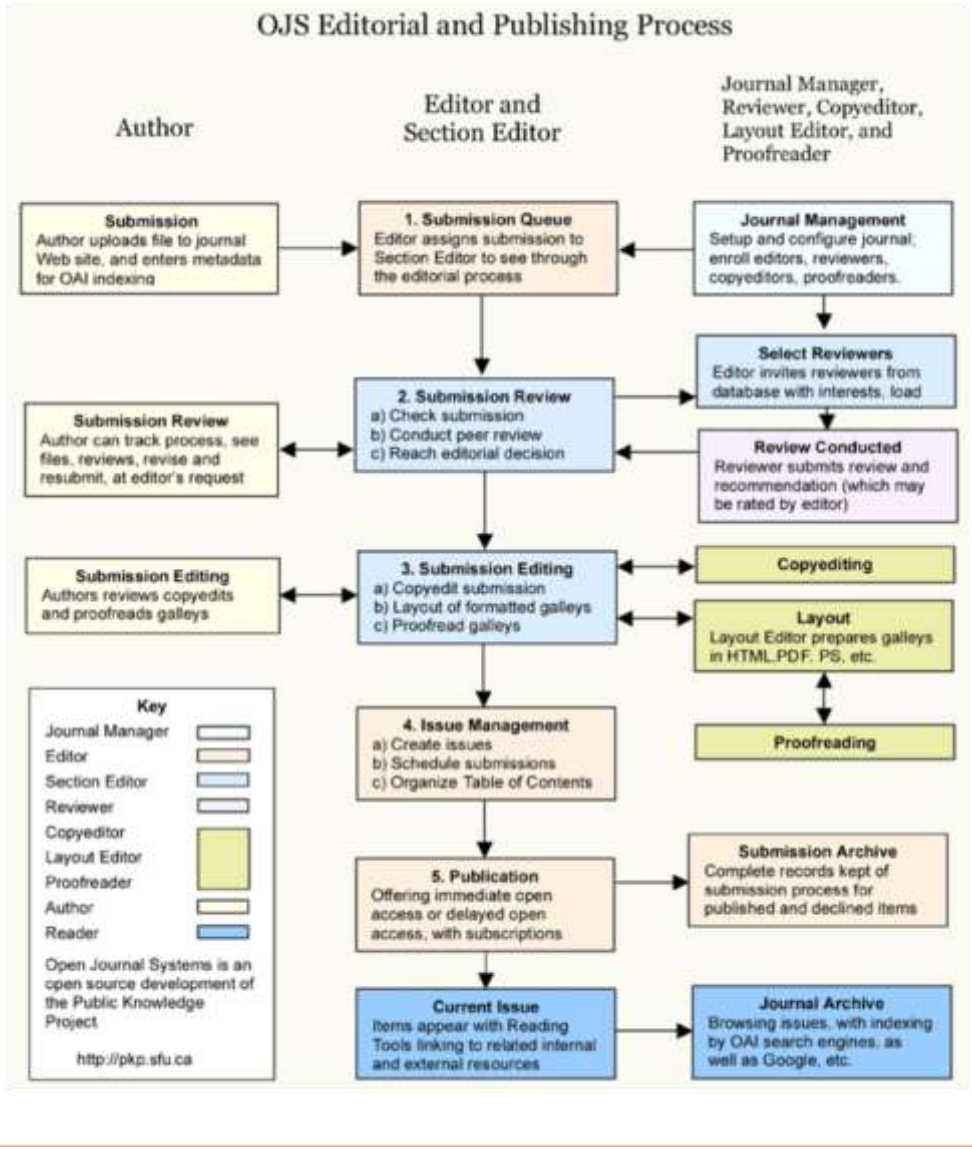

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Effect of Utilization of Bamboo Fiber and Gypsum Substitution as Cement Against Strong Concrete Press

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Abstract

Bamboo Fiber is one of the materials that can be alternative as an added material to increase strong concretepress. The gypsum waste comes from the disposal of household flatfon dismantling, which becomes one of the added materials in the manufacture of cement. The use of both materials as concrete mixture subtitution is expected to reduce environmental pollution and exploitation of natural resources. This research aims to find out the influence of the use of SB as fiber and LG as cement subtitution semen on concrete mixture against strong concrete press. The study used a mixture of SB of 1%, 1.5%, 2%, and 3%of cement weight, as well as LG as much as 3%,and5% of cement weight. Strong press testing was conducted on the 14th and 28th days. The result of this study is that the higher percentage of SB and LG workability is decreasing. Strong press testing shows that all variations have a strong press yield of 1%B3%G above the normal concrete press strength and the rest under normal concrete. The highest press strong value is derived from the variation of 1%B3G with a mixture of 1%SB + 3% LG which is 20.81 MPa.

Keywords
Alternative, Bamboo Fiber, Compressive Strength, Concrete, Strong Press, Waste Gypsum.

1. Introduction

Concrete is a mixture of cement, aggregate, and water. Fiber concrete (*fibre reincorced concrete) is* a modification of conventional concrete by adding fiber adukannya. Fiber concrete is defined as concrete made of a mixture of cement, fine aggregate, coarse aggregate and a small amount of fiber / fibre (ACI Committee 544, 1982). Fiber materials that can be used for the improvement of concrete properties in fiber concrete include steel, plastic, glass, carbon and fiber from natural materials such as ijuk, hemp and fiber from other plants(ACI Committee 544, 1982). Cement is a hydraulic adhesive produced by smoothing the clinker consisting of the main material of calcium silicate and gypsum stone additives where the compounds can react with water and form new substances adhesive on the rocks.

Concrete mixture material other than cement is sand and stone. Sand and rock can be obtained in several places, one of which is in the river. Continuous sand and rock mining activities will cause some environmental damage ranging from ambles and damage to water breaker structures, one side of the plengseng, to a decrease in groundwater level as a result of the decline of the river floor. The use of industrial waste is a good alternative as a mixing of concrete constituent materials.

Concrete has several advantages, among others: strong ness is relatively high, easy to form as desired, maintenance is cheap and can be combined with other materials. On the other hand, concrete has a bitter nature (brittle), so practically the ability to withstand tensile voltage is relatively small (Al mufid, 2018)

Previous research has been conducted on the use of sugar cane and glass powder on concrete, but previous research has been done partially. In this study, researchers will combine or mix the two subtitution materials. That is, sugar cane sand is subtitus with cement and glass powder is subtitus with sand in one concrete mixture. But the mixing is done in various variations. With the conduct of this research is expected to know the effect of sugar cane ash that is subtitus with cement and glass powder subtitus with sand against strong press concrete.

With the development of very significant development of concrete, an alternative is needed in the concrete mixture in its application. Therefore, the need for materials that can be updated and waste wasted is added in concrete, such as fly ash, coconut shell, plastic seeds, chicken bones, sugar cane cane, and others. With these innovations can be alterative materials in the use of non-renewable natural resources such as, the use of plastic seeds as a substitute material for gravel that continues to be mined so that if continuous use can be exhausted, the increasing use of cement in concrete can cause cement raw materials to become thinning and depleted, so that gypsum and flyash waste can be a replacement solution for cement. The use of additives that

are currently used to strengthen concrete is also expensive and has a content that can pollute the environment so that using fibers such as bamboo fibers and ijuk fibers can be one of the alternatives.

This prompted research into concrete mixtures in addition to these materials with bamboo fibers and gypsum waste as substitutions to cement. The use of bamboo fibers is expected to increase the strength of the concrete press and make the concrete into one type of concrete that is environmentally friendly and can reach targets above normal concrete, in order to reduce the amount of additive and concrete use making the concrete have a strong high press, and with the use of gypsum can impact the needs of cement that can be reduced and can reduce gypsum waste that is currently less normalized as well as possible because it can potentially pollute the soil and air can also cause pollution to Environment. and it is expected that with the addition of these materials is expected to reach the target of concrete strength of 20 MPa for columns.

2. Materials And Methods

2.1. Materials

In this study the constituent materials on the concrete mixture are as follows:

a. The bamboo fibers used in this study are bamboo chopsticks that are broken and sededted into fibers.
b. The gypsum waste in this study is gypsum board waste that has been disposed of.
c. The cement used in this study is PPC Cement (*Pozollan Portland Cement)* type1 gresik brand.
d. The water used in this study came from the UMB Civil Engineering Laboratotium.
e. The sand used in this study is sand derived fromLampung.
f. The gravel used in this study is gravel derived from bogor.

2.2. Method

In this study, using experimental methods by variable mixing bamboo fibers as well as cement subtitution by using gypsum waste against concrete mixtures which is to obtain data and results from this study. According to Zulnaidi, (2007) revealing that the experimental method is a research procedure carried out to reveal the causal relationship of two or more variables, with manipulation or treatment of the influence of other variables. According to Bambang Prasetyo Lina Mifthaul Jannah Esterberg, (2002) experimental research is usually done somewhere called labolatorium.

The research variables in this study consist of two kinds. The first variable is an independent variable with X1 and X2 the second variable is a dependent variable given notation Y. Free variables (X1) and (X2) determine changes to bound variables (Y), but regardless of the effect of bo

und variables. While a bound variable (Y) is a variable that is affected by a free variable (X). In this study it was determined that variables are free. (X1) is a concrete that is added bamboo fibers, and on a free variable (X2) in the form of gypsum waste as a cement subtitution and variable bound (Y) strong press concrete.

The percentage of bamboo fiber addition as much as 0% ; 1%; 1,5%; 2% and 3% and by subtitus gypsum waste with cement of 0% ; 3% ; and 5% of the cement weight into the concrete. Concrete is printed with a cylindrical mold measuring 15x30 cm as much as 4 pieces on each test concrete quality. And will be tested strongly press at the age of 14, and 28 days. The number of strong press test objects – 2 pieces with a cylinder size of 15x30 cm, is intended to make savings in terms of concrete volume or test objects that automatically lead to the saving of raw materials, time and cost. In this study, the first step by preparing materials such as sand, gravel, cement, water and also additional materials of bamboo fiber and Gypsum waste. Then then do the testing of materials in the laboratory, then the mix design process using microsoft excel software. And done with the process of trial mix, if the result of slump test is as planned continued the process of making samples of test objects printed using cylindrical mold size 15x30 cm. Then concrete is dismantled from mold after 24 hours and immediately carried out immersion / curring concrete until the day that has been determined. As a result the concrete lives in a strong test press

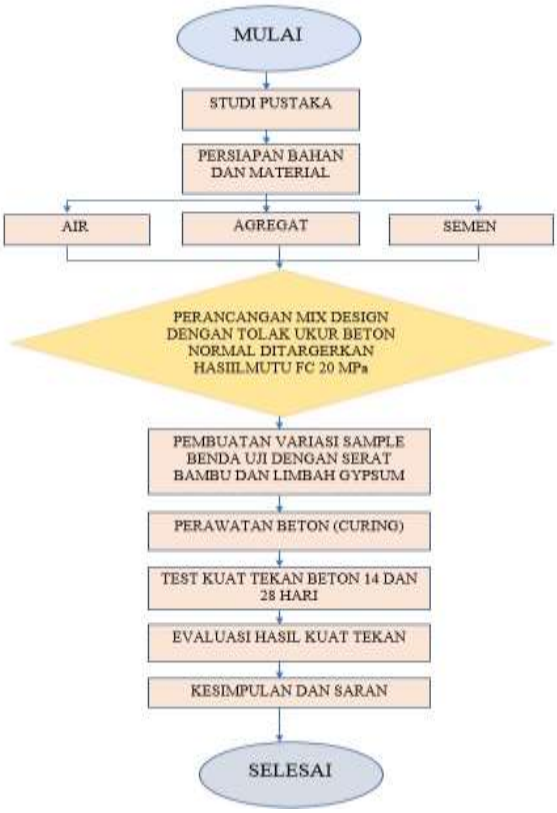

Figure 1. of The Research Flowchart
Source: Research Data

Table 1. Material requirements for 1 concrete m^3 with FC-20 MPa quality

Materials	Needs($\boldsymbol{kg/m^3}$)
Cement	427,083
Water	205
Sand	491,53
Gravel	1264,38

The research was conducted as many as 8 variations of the mixture plus normal concrete as control concrete. Each variation per day is 3 samples. So, a total of all variations plus normal concrete as many as 50 samples. Here is the number of material needs for each cylinder 15x30 cm:

Table 2. Material needs for 1 cylinder 15x30 cm

Bumbu		Gypsum		Semen	Air	Pasir	Kerikil
1%	27,20	3%	81,6	2638,4	1304	3126	8040
	27,20	5%	136	2584	1304	3126	8040
1,5%	40,80	3%	81,6	2638,4	1304	3126	8040
	40,80	5%	136	2584	1304	3126	8040
2%	54,40	3%	81,6	2638,4	1304	3126	8040
	54,40	5%	136	2584	1304	3126	8040
3%	81,60	3%	81,6	2638,4	1304	3126	8040
	81,60	5%	136	2584	1304	3126	8040

2.3. Research Place and Time

Venue: Laboratotium Structure and Materials

Building Civil Engineering Study Program, Faculty of Engineering, Mercu Buana University Bekasi Campus D.

When : September 2019 to January 2020

3. Results And Discussions

Gypsum Waste Gradation Testing
Figure 2. Waste Gypsum Mash
Source : Research Data

Gypsum granular gradation testing aims to determine the smooth gradation of granules in gypsum. The size of the gypsum granules should be equal to the size of the cement granules. Please note that cement granules escape from the no. 100 sieve. Here are the results of gypsum waste gradation testing:

Table 3. Gypsum gradation testing

Saringan	Berat Tahanan (Gram)	Jumalah Berat Tertahan (gram)	Jumlah Beban	
			Tertahan	Lewat
4	0	0		100
8	0	0	0	100
10	0	0	0	100
12	0	0	0	100
20	100	100	5	95
40	200	300	15	80
80	160	460	23	77
100	1200	1660	83	17
200	300	1960	98	2
Pan	40	2000	100	0

Source: Research Data

3.1 Slump Testing (Workability)

Testing *of slump* (*workability)*is necessary to know the level of fresh concrete kelecakan. The higher the *slump* value, the more diluted the concrete and easier to work with, and vice versa. In this study, researchers planned a *slump value* of 6-18 cm.

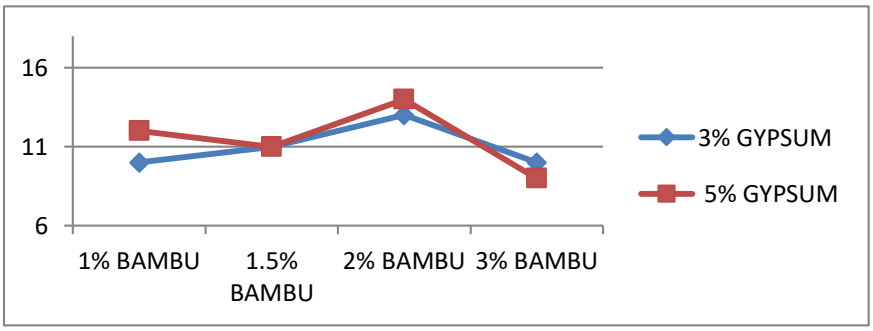

Figure 4. Value of Slump Test Results
Source: Research Data

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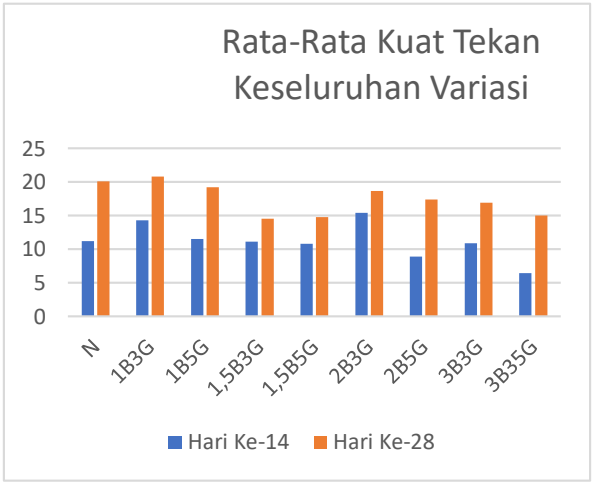
From the data of the above test results, it can be seen that in this study the more amount of bamboo fiber and gypsum waste mixed then the lower the slump value. This can be seen from the graph of the result of the slump that is decreasing.

3.2 Strong Concrete Press Testing

Strong concrete press testing is carried out using a press test tool with 6 *concrete samples* per variation.



3 *samples* on the 14th day, 3 *other samples* on the 28th day. Here are the results of the powerful test press:

Figure 5 Results of Strong Concrete Press
Source: Research Data

From the histogram above, it can be noted that the highest press strong result on all variations on day 14 is a 1B3G variation with a mixture of 1% bamboo fiber + 3% gypsum with a strong press of 14.33 MPa. While on the 28th day strongest concrete press is at variation 1B3G which is 20.81 MPa. Meanwhile, concrete with a mixture of bamboo fibers and gypsum has decreased significantly with the value listed on the chart.

4. Conclusion

1. Based on the results of the study The larger the mixture of bamboo fibers and gypsum on the concrete mixture makes a decrease in the strong value of the concrete press due to the increasing absorption of water that occurs resulting in bitternessOn the 28th day strong press obtained from all variations of concrete mixture that has been subtitused with sugar cane sand ash and glass powder gets value below normal concrete.
2. Based on the results of the study the highest press strong value of concrete mixed with substitution material is in the mixture or variation of 1B3G (1% + 3%) with an average yield of 20.81Mpa.
3. Based on the result of concrete disalition mixed with substitution material the highest slump value is found in variations of 2B5G (2 % + 5%) 14 cm, and the lowest slump value is found in the 3B5G variation (3 % + 5 %) namely 9 cm, where the result is still in accordance with the calculation of the design mix which is between 60 - 180 mm.
4. Based on the results of concrete research with bamboo fiber as fiber and substitution material in the form of gypsum as cement substitution material with substitution variation 1B3G (1% + 3%) with an average yield of 20.81Mp for 28 days can be used on the construction of the structure because it has strong press results that correspond to the initial planning and for other variations more efficiently.

4.1 Advice

The advice that can be silenced from this research, namely:

1. At the time of research there needs to be more attention to the testing of materials materials, testing additional materials, calculation of mix design, curring control, and strong test press, in order to get maximum results.
2. At the time of the manufacture of the test material after stirring and at the time of pounding should be carried out according to the procedure so that the printed concrete does not have a large pore cavity so that the resulting concrete does not suffer from damage, in the event of damage to the concrete will affect the result of the strong value of the concrete press.
3. At the time of Curring do not be tightened with other samples because it can lower the strong value of press on concrete that is in the curring process.

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An Experimental Study on The Effect of Disinfectant Sodium Hypochlorite (Naclo) Liquid on Density and Compressive Strength Concrete

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Abstract

The increasing use of disinfectants based on Sodium Hypochlorite (NaClO) for the need of preventive spraying for the COVID-19 pandemic, raises concerns about a decrease in strength in concrete structures. Therefore, the authors researched whether spraying disinfectants based on Sodium Hypochlorite (NaClO) would penetrate the density of the concrete, as well as ascertain whether the concrete structure might experience a massive decrease in compressive strength after spraying. The purpose of this study was to determine the effect of spraying and penetration of Sodium Hypochlorite (NaClO) disinfectant on the compressive strength of concrete. The method used in this research is experimental by doing a trial mix which being worked on at the Becakayu Toll Road Concrete Batching Plant Laboratory - PT. Waskita Beton Precast, Tbk. From the results of the research, the quality of K-500 concrete samples decreased in density by 0.74% in the NaClO-S treatment at the age of 7 days, 0.92% in the NaClO-R treatment at the age of 7 days, 1.09% in the NaClO-S treatment at the age of 14 days, 1.28% in the NaClO-R treatment at the age of 14 days, 1.61% in the NaClO-S treatment at the age of 28 days, 1.55% in the NaClO-R treatment at the age of 28 days. A Comparison of the compressive strength of NaClO-R treatment with Air-R treatment on K-500 quality concrete samples at the age of 7, 14, and 28 days sequentially was 13%, 27%, and 15% higher in the Air-S treatment. The biggest difference in the compressive strength value occurred in the k-500 quality concrete sample at the age of 14 days, namely 352.61 Kg / Cm2 for NaClo-S treatment versus 482.73 Kg / Cm2 for Water-S treatment.

Keywords
Compressive Strength, Density, Sodium Hypochlorite (NaClO)

1. Introduction

The choice of the use of concrete in the development of infrastructure development is one of the things that are in great demand in today's modern era. Some of the advantages that make concrete attractive to construction actors are that it has large compressive strength, is durable, is resistant to fire, the raw material for making concrete is easy to obtain and does not experience decay. Mulyono (2003) Research on concrete continues to develop every day, in order to improve the quality and function of concrete for the better and to keep pace with the increasing demand for high-quality concrete in the world of infrastructure.

Environmental factors are a very crucial issue for all types of industries without exception. The outbreak of the COVID 19 pandemic in the world has forced governments around the world to take preventive steps to fight the fast spread of COVID 19. Massive spraying of disinfectants is one of the main options being carried out. The increasing use of disinfectants based on sodium hypochlorite (NaClO) for the need for prevention of the COVID-19 pandemic, raises concerns about a decrease in strength in concrete structures. Therefore, a study is required on whether the spraying of a disinfectant based on sodium hypochlorite (NaClO) will penetrate the density of concrete, as well as to ascertain whether the concrete structure will experience a massive decrease in compressive strength after spraying (Fepy Supriani and Mukhlis Islam, 2017).

Fepy Supriani and Mukhlis Islam (2017) conducted a study on the effect of treatment methods in concrete treatment on the compressive strength and durability of concrete. The aim is to determine the effect of concrete treatment on the compressive strength of concrete. Concrete plan 20 MPa, with a slump of 60-100 mm. The specimen is cubic with side 15 cm. The compressive strength test was carried out at 28 days and 56 days. The treatment of concrete treatment consists of 9 variations, namely, untreated, soaking, and watering. The results of the optimum compressive strength in general for 28 days were produced by concrete with freshwater immersion treatment that was 31.3 MPa. Treated concrete placed outdoors without treatment has the second-highest compressive strength value, which is 28.6 MPa. The compressive strength value of concrete treated with

watering and covered with gunny sacks for 28 days is still below the compressive strength of untreated concrete. From this research, it can be concluded that with increasing age the treated concrete has better strength (Fepy Supriani and Mukhlis Islam, 2017).

From the many previous studies, it can be concluded that the effect of immersion in concrete in different materials affects the value of the compressive strength of concrete. The concentration of sodium hypochlorite disinfectant (NaClO) results in low pH (M. K. Dr. Padoli, 2014)the effect of low pH has the potential to damage the concrete blanket and cause a decrease in the compressive strength and density of the concrete, as explained by previous studies (J. Pandiangan, M. Olivia, 2014).

This research will be a new experimental study, due to the absence of previous research on the effects of immersion and exposure to the disinfectant concentration of sodium hypochlorite (NaClO). This research will further study the physical properties of concrete after immersion and exposure to a disinfectant based on sodium hypochlorite (NaClO) that has a low pH.(M. K. Dr. Padoli, 2014). The physical properties of the concrete to be studied are the density and compressive strength of the concrete, using type 1 OPC cement and Type F Admixture.

2. Method

The method used in this study is experimental, namely the method of research conducted by experimenting to obtain data that connects the variables under investigation. The independent variable in this study is sodium hypochlorite (NaClO) that is assumed to affect the density and compressive strength when sprayed and penetrated on a fixed variable, namely concrete, with the K-175, K-300, and K-500 concrete quality variants. The research processes and procedures will refer to SNI (Indonesian National Standard), ASTM (American Society for Testing and Materials), and previous journals by related research.

In the initial process, material preparation is carried out, which is then carried out by aggregate testing to determine the quality of the aggregate used. The aggregate test carried out includes a colloid content test, sieve analysis test, specific gravity, absorption, clay lump test, organic impurities. for fine aggregates), density, abrasion test for coarse aggregates (abrasion test) then a mix design is carried out, after the composition of the mixture is obtained then a concrete mix trial is carried out with the initial slump flow test. If the test results match the specifications, fresh concrete is poured into the sample molds. The test samples printed in this study were printed using a cylindrical print, with dimensions of Ø10.85 cm and a height of 20 cm.(Badan Standarisasi Nasional, 1993)

In making the sample Mix design uses cement OPC type 1 (Semen Gresik), fine aggregate sand ex. Jambi, fine aggregate sand ex. Leles, coarse aggregate screening size 5 - 10 mm ex. Rumpin, clean water (PAM Aetra), additive type F (Consol P200 New) and use of 5.25% sodium hypochlorite (NaClO) concentrate in "Bayclin" products as a disinfectant and penetration solution.[5]

Table 1. Trial Mix Design

Material	Unit	TM K175 K175 (Kg/m³)	TM K300 K300 (Kg/m³)	TM K500 K500 (Kg/m³)
OPC Type I	Kg/m³	270	350	440
Soft Agregat Ex. Jambi	Kg/m³	480	429	495
Soft Agregat Ex. Leles	Kg/m³	476	426	491
Screening 5/10 Ex. Rumpin	Kg/m³	879	913	828
Clean Water Aetra	Ltr/m³	175	175	130
Admixture Type F	Ltr/m³	-	-	4,11
W/C Ratio		0,648	0,5	0,295

The dosage for sodium hypochlorite (NaClO) is 0.1% (Environmental Health Criteria 216 Disinfectants and Disinfectants By-Products - WHO, 2000) with a calculation of 0.1% x 1000ml / 5.25% = 19 ml. The dissolving dose per liter is 19 ml (Craun et al., 2004).

Table 2. Research Design

CONCRETE QUALITY	K-175 (Non-Structure)	K-300 (Structure)	K-500 (High-Quality)
DAYS	7, 14, 28	7, 14, 28	7, 14, 28
SOAK IN WATER	9	9	9
SOAK IN NaClO (0.1%)	9	9	9
WATER SPRAY	9	9	9
NaClO SPRAY (0.1%)	9	9	9
TOTAL SAMPLE	36	36	36
		108	

The method used in this study includes eight main activities, namely:

a. Examination of the physical and mechanical properties of the concrete mixture (Badan Standarisasi Nasional, 2008; SNI 1970, 2008);
b. Making concrete mixture using the SK SNI-03-2834-2000 method (Pusjatan-Balitbang PU, 1993);
c. Slump (workability) testing (SNI 1972:2008, 2008);
d. Spraying the sample using sodium hypochlorite (NaClO) disinfectant (Craun et al., 2004);
e. Penetration of the sample using sodium hypochlorite (NaClO) disinfectant (Craun et al., 2004);
f. Density testing/inspection after spraying and penetration of sodium hypochlorite on concrete samples (Tujuan, 1990);
g. Testing / checking the compressive strength of concrete at the age of 7, 14 and 28 days after spraying and penetration of sodium hypochlorite on concrete samples (Tujuan, 1990);
h. Data analysis and discussion of research results.

3. Results and Analysis

The results of the discussion contain the following descriptions:

3.1. The Results of Testing for Change in Density of Concrete

The test results are grouped on each sample quality, the length of age of the sample, and the treatment of the sample. Sample treatment has the following code:

1) NaClO-S, is a treatment by spraying samples with Sodium Hypochlorite
2) NaClO-R, is a treatment by soaking samples on Sodium Hypochlorite
3) Water-S, is a treatment by spraying samples with water
4) Water-R, is a treatment by soaking samples on water

Table 3. Density Change In Concrete Quality K-175

No	Sample Code	Days	Initial Density (kg/m3)	Final Density (kg/m)	(%)
1.	TRIALMIX NaClO-S	7	2154,97	2065,97	-4,13%
2.	TRIALMIX NaClO-R	7	2144,53	2146,83	0,11%
3.	TRIALMIX Water-S	7	2166,17	2086,9	-3,66%
4.	TRIALMIX Water-R	7	2163,2	2151,3	-0,55%
5.	TRIALMIX NaClO-S	14	2146,23	2027,57	-5,53%
6.	TRIALMIX NaClO-R	14	2162,53	2194,83	1,49%
7.	TRIALMIX Water-S	14	2155,5	2048,27	-4,97%
8.	TRIALMIX Water-R	14	2158,8	2189	1,40%
9.	TRIALMIX NaClO-S	28	2145,93	2016,3	-6,04%
10.	TRIALMIX NaClO-R	28	2167,83	2198,3	1,41%
11.	TRIALMIX Water-S	28	2145,9	2025,3	-5,62%
12.	TRIALMIX Water-R	28	2174,9	2198,3	1,08%

Based on table 3 the average density change in the concrete quality of K-175 has decreased by 4.13% in the NaClO-S treatment at the age of 7 days, 3.66% in the Water-S treatment at the age of 7 days, 0.55% at Water-R treatment at 7 days, 5.53% in NaClO-S treatment at 14 days, 4.97% in Water-S treatment at 14 days, 6.04% in NaClO-S treatment at 28 days, 5.62% on Water-S treatment at 28 days.

However, there was an increase of 0.11% in the NaClO-R treatment at the age of 7 days, 1.49% in the NaClO-R treatment at the age of 14 days, 1.40% in the Water-R treatment at the age of 14 days, 1.41% in the NaClO-R treatment at the age of 28 days, 1.08% in the Water-R treatment at the age of 28 days.

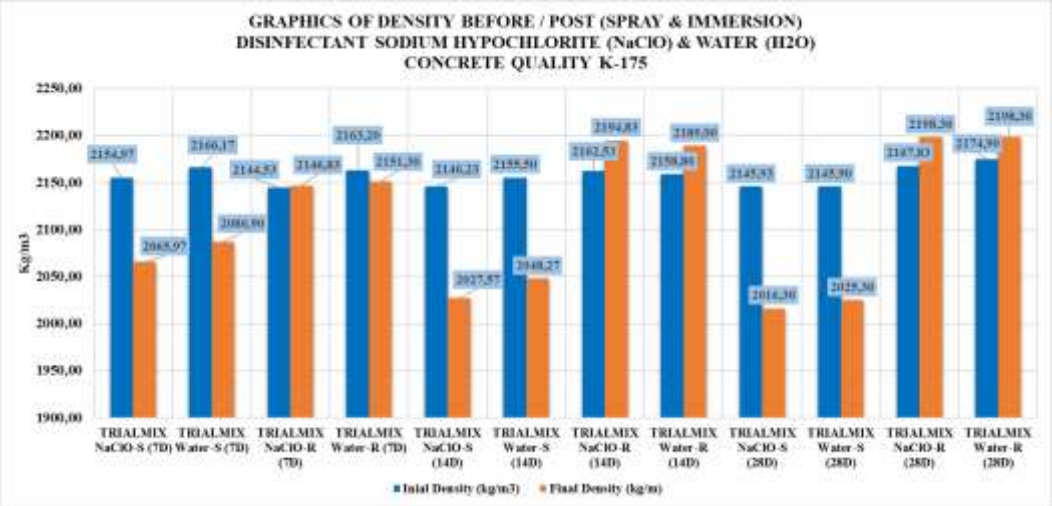

Figure 1. Density Change Graph Concrete Quality K-175
Source: Research Data, 2020

Table 4. Density Change in Concrete Quality K-300

No	Sample Code	Days	Initial Density (kg/m3)	Final Density (kg/m)	(%)
1.	TRIALMIX NaClO-S	7	2272,03	2212,67	-2,61%
2.	TRIALMIX NaClO-R	7	2231,60	2263,87	1,45%
3.	TRIALMIX Water-S	7	2326,13	2269,60	-2,43%
4.	TRIALMIX Water-R	7	2272,37	2281,57	0,40%
5.	TRIALMIX NaClO-S	14	2261,43	2212,27	-2,17%
6.	TRIALMIX NaClO-R	14	2298,40	2325,10	1,16%
7.	TRIALMIX Water-S	14	2270,63	2219,77	-2,24%
8.	TRIALMIX Water-R	14	2262,53	2293,77	1,38%
9.	TRIALMIX NaClO-S	28	2299,03	2225,30	-3,21%
10.	TRIALMIX NaClO-R	28	2244,03	2264,97	0,93%
11.	TRIALMIX Water-S	28	2266,47	2203,67	-2,77%
12.	TRIALMIX Water-R	28	2277,13	2297,40	0,89%

Based on table 4, the average density of concrete samples of K-300 Quality has decreased by 2.61% in the NaClO-S treatment at the age of 7 days, 2.43% in the Water-S treatment at the age of 7 days, 2.17% in the treatment NaClO-S at 14 days, 2.24% in Water-S treatment at 14 days, 3.21% in NaClO-S treatment at 28 days, 2.77% in Water-S treatment at 28 days.

However, there was an increase of 1.45% in the NaClO-R treatment at the age of 7 days, 0.40% in the Water-R treatment at the age of 7 days, 1.16% in the NaClO-R treatment at the age of 14 days, 1.38% in the Water-R treatment at the age of 14 days, 0.93% in the NaClO-R treatment at the age of 28 days, 0.89% in the Water-R treatment at the age of 28 days.

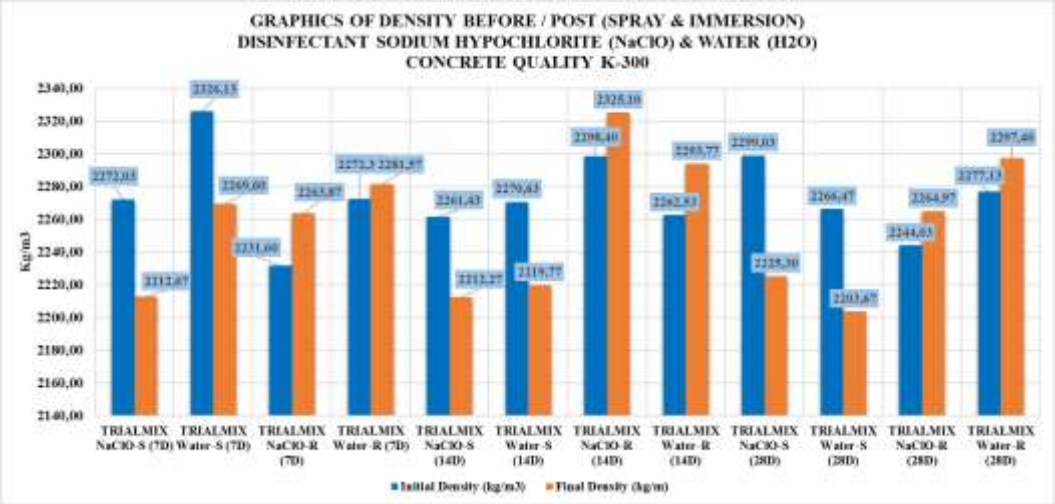

Figure 2. Density Change Graph Concrete Quality K-300
Source: Research Data, 2020

Table 5. Density Change in Concrete Quality K-500

No	Sample Code	Days	Initial Density (kg/m3)	Final Density (kg/m)	(%)
1.	TRIALMIX NaClO-S	7	2345,03	2327,70	-0,74%
2.	TRIALMIX NaClO-R	7	2357,03	2335,30	-0,92%
3.	TRIALMIX Water-S	7	2357,97	2380,27	0,95%
4.	TRIALMIX Water-R	7	2360,73	2384,60	1,01%
5.	TRIALMIX NaClO-S	14	2354,17	2328,60	-1,09%
6.	TRIALMIX NaClO-R	14	2370,40	2339,97	-1,28%
7.	TRIALMIX Water-S	14	2355,17	2387,90	1,39%
8.	TRIALMIX Water-R	14	2325,03	2358,60	1,44%
9.	TRIALMIX NaClO-S	28	2355,07	2317,23	-1,61%
10.	TRIALMIX NaClO-R	28	2390,20	2353,27	-1,55%
11.	TRIALMIX Water-S	28	2325,83	2376,70	2,19%
12.	TRIALMIX Water-R	28	2323,07	2362,27	1,69%

Based on table 5, the average density of concrete samples of K-500 Quality has decreased by 0.74% in the NaClO-S treatment at the age of 7 days, 0.92% in the NaClO-R treatment at the age of 7 days, 1.09% in the treatment NaClO-S at the age of 14 days, 1.28% in the NaClO-R treatment at the age of 14 days, 1.61% in the NaClO-S treatment at the age of 28 days, 1.55% in the NaClO-R treatment at the age of 28 days.

However, there was an increase of 0.95% in the Water-S treatment at the age of 7 days, 1.01% in the Water-R treatment at the age of 7 days, 1.39% in the Water-S treatment at the age of 14 days, 1.44% for the Water-R treatment at the age of 14 days, 2.19% for the Water-S treatment at the age of 28 days, 1.69% for the Water-R treatment at the age of 28 days.

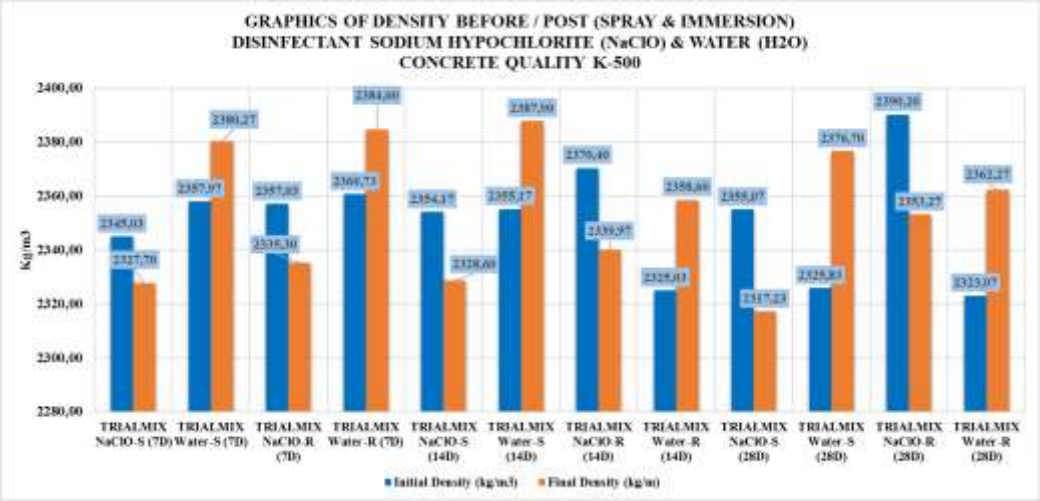

Figure 3. Density Change Graph Concrete Quality K-500
Source: Research Data, 2020

3.2. Compressive Strength Results

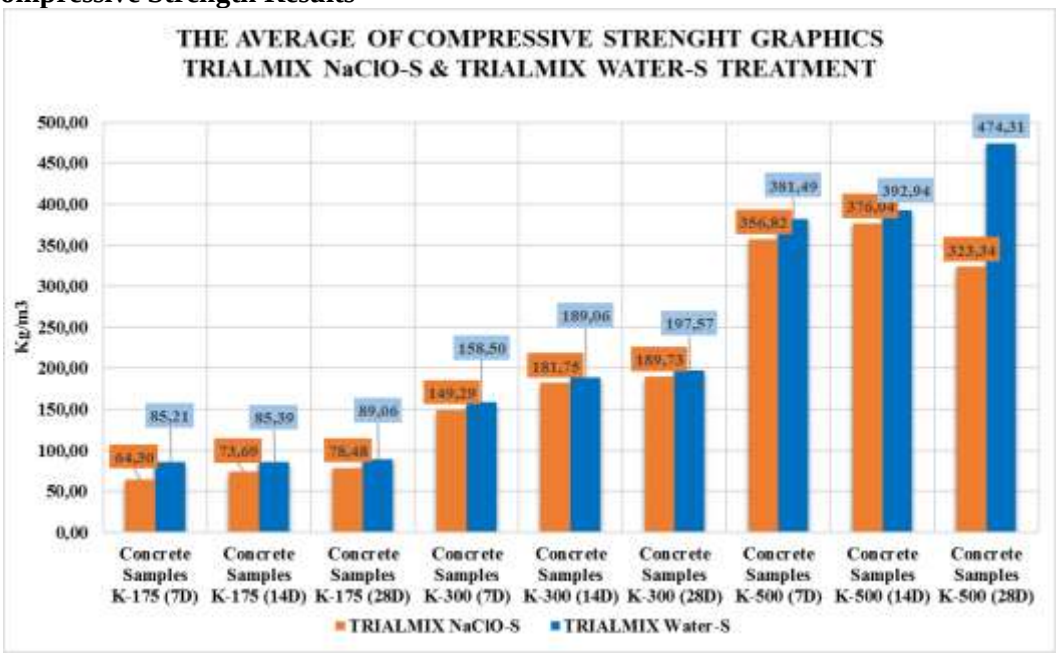

Figure 4. The Average of Compressive Strenght Graphics Trialmix Naclo-S & Trialmix Water-S Treatment
Source: Research Data, 2020

Based on the graph of the average compressive strength of the concrete with TRIALMIX NaClo-S & TRIALMIX Water-S treatment, it can be seen that the comparison of the compressive strength of the NaClO-S treatment with the Water-S treatment on concrete samples with quality K-175 at the age of 7, 14 and 28 days respectively were 25%, 14%, and 12% higher in the Water-S treatment. Comparison of the compressive strength of NaClO-S treatment with Water-S treatment on K-300 quality concrete samples at the age of 7, 14, and 28 days were 6%, 4%, and 4% higher in the Water-S treatment, respectively. As well as the comparison of the compressive strength of NaClO-S treatment with Water-S treatment on K-500 quality concrete samples at the age of 7, 14 and 28 days were 6%, 4%, and 32% higher in the Water-S treatment, respectively. The biggest difference in the compressive strength value occurred in the k-500 quality concrete sample at the age of 28 days, namely 323.34 Kg / Cm2 for NaClo-S treatment compared to 474.31 Kg / Cm2 for the Water-S treatment.

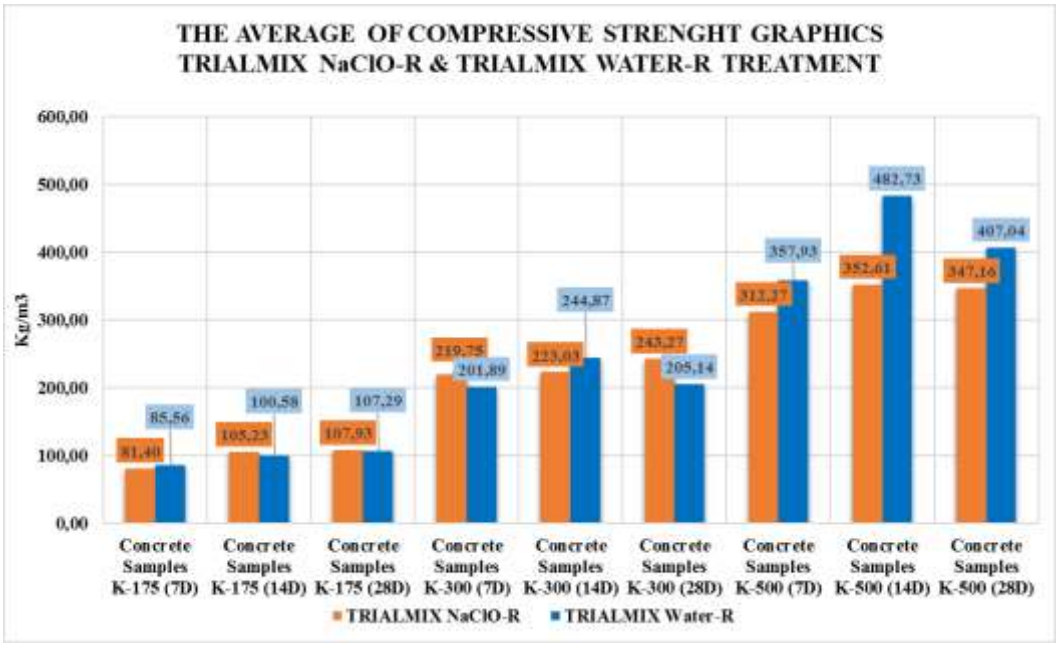

Figure 5. The Average of Compressive Strenght Graphics Trialmix Naclo-R & Trialmix Water-R Treatment
Source: Research Data, 2020

Based on the graph of the average compressive strength of the concrete with TRIALMIX NaClo-R & TRIALMIX Water-R treatment, it can be seen that the comparison of the compressive strength of the NaClO-R treatment with the Water-R treatment on concrete samples with K-175 quality at the age of 7 days is 5% higher. In the Water-R treatment, it was inversely proportional to the age of 14 and 28 days, namely 5%, 1% higher in the NaClO-R treatment. Comparison of the compressive strength of NaClO-R treatment with Water-R treatment on K-300 quality concrete samples at the age of 14 days was 9% higher in the Water-R treatment, inversely proportional to the age of 7 and 28 days respectively, namely 9%, 19 % higher in the NaClO-R treatment. As well as the comparison of the compressive strength of NaClO-R treatment with Water-R treatment on K-500 quality concrete samples at the age of 7, 14, and 28 days respectively were 13%, 27%, and 15% higher in the Water-S treatment. The biggest difference in the compressive strength value occurred in the k-500 quality concrete sample at the age of 14 days, namely 352.61 Kg / Cm2 for NaClo-S treatment versus 482.73 Kg / Cm2 for Water-S treatment.

4. Conclusions

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

1. The spraying treatment of Sodium Hypochlorite (NaClO) disinfectant caused a decrease in density in all concrete grades (K-175, K-300, K-500) and at all concrete ages (7, 14, 28 days). The soaking treatment of Sodium Hypochlorite (NaClO) disinfectant caused an increase in density in the concrete quality of K-175, K-300 and at all ages of concrete (7, 14, 28 days), inversely proportional to the quality of K-500 concrete which experienced a decrease in density at all ages concrete (7, 14, 28 days).
2. The spraying treatment of Sodium Hypochlorite (NaClO) disinfectant caused a low average compressive strength value of all concrete qualities (K-175, K-300, K-500) compared to normal curing concrete at all ages of concrete (7, 14, 28 days), whereas for the soaking treatment of Sodium Hypochlorite (NaClO) disinfectant in concrete quality (K-175, K-300) there is no difference in the average compressive strength value that is too significant compared to normal curing concrete at all ages of concrete (7, 14, 28 days.), inversely proportional to the soaking treatment of Sodium Hypochlorite (NaClO) disinfectant which causes a lower average compressive strength value in the quality of K-500 concrete compared to normal curing concrete at all ages of concrete (7, 14, 28 days)

5. Acknowledgment

This research was supported by Agung Sumarno and colleagues of the Becakayu Toll Road Concrete Batching Plant Laboratory - PT. Waskita Beton Precast, Tbk. We would like to thank our colleagues from the Department of Civil Engineering, Faculty of Engineering, University of Mercu Buana who have provided insights and expertise that really helped this research, until this research was completed.

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The Effect of Variations of Cese Waste Waste Levels on Marshall Parameters in Ac-Wc Layer

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Abstract

In the asphalt pavement mixture, filler is needed to support the performance of the pavement construction in order to withstand traffic loads. Various types of fillers have been widely used, including rock ash, portland cement and others. However, the limitation of natural resources encourages the use of waste materials in the construction of road pavements, a potential for the production of bagasse. In this study, sugar cane waste was used as a filler in the asphalt pavement mixture. The research method used is an experimental method, where the experiment is carried out to obtain a data set and analysis of test results. The test was carried out in 2 stages, namely testing the test object with Portland cement filler which was carried out to obtain Marshall parameters and KAO values and testing of the test object with bagasse ash filler to produce Marshall parameters and optimum filler content values. The results showed that the use of bagasse ash waste with a proportion of 5% to the weight of the filler increased stability. Tests carried out on the AC-WC layer mixture obtained the KAO value of 5.7% and the optimum filler content of 5.5%. The stability value with 7% bagasse ash filler obtained 1237.1 kg by immersing the test object for 30 minutes and 1156.4 kg with 7% bagasse ash filler by soaking the test object for 24 hours at 60 ° C, meeting the minimum requirements of 800 kg.

Keywords
Bagasse Ash, Environmentally Friendly Materials, Bagasse Ash, Laston AC-WC Asphalt, Marshall.

1. Introduction

Roads as transportation system infrastructure that are routinely used to support human activities every day must have adequate quality. The increase in the number of public and private vehicles results in an ever-increasing use of roads which are proportional to the potential for road damage if they are not of adequate quality. One of the factors in the quality of road infrastructure is the pavement of the road.

According to Sukirman (2003), Asphalt is a material which at room temperature is solid to somewhat dense, and is thermoplastic. Asphalt will melt when heated to a certain temperature, and will freeze again when the temperature drops. The amount of asphalt in the pavement mixture ranges from 4 - 10% based on the weight of the mixture or 10 - 15% based on the volume of the mixture.

Asphalt Concrete (Laston) is a mixture of coarse aggregate, fine aggregate and filler with asphalt binder under high temperature conditions with a composition that is researched and regulated by technical specifications. Hot asphalt mixture is a flexible pavement mixture consisting of coarse aggregate, fine aggregate, filler and asphalt binder with a certain ratio and mixed in hot conditions (Hamzah, 2018).

Utilization of waste materials or industrial waste such as waste from burning coal (fly ash), bagasse and wood industry waste in Indonesia is generally still not optimally utilized. Therefore, processing is carried out so that it can be used into more useful materials. It is hoped that the use of bagasse and wood industrial waste can be used as a filler in the laston mixture. Bagasse ash is industrial waste from burning bagasse in sugar factories. Bagasse is produced from the process of pressing or grinding sugarcane stalks five times in the production process at the factory. Sugarcane waste that piles up every day creates problems for the factory. Sugarcane bagasse ash waste has a fruitful nature that requires a larger storage area. In addition, the less than optimal

utilization of bagasse waste makes bagasse ash just thrown away. To overcome this problem, the authors are interested in conducting research on the use of bagasse ash as a filler in the asphalt mixture (Samsuri, M, 2007).

2. Methodology

This research was conducted at the Civil Engineering Laboratory of the University of Mercu Buana Jatisampurna Bekasi both in testing aggregates, asphalt and Marshall. Standards for testing aggregate and asphalt characteristics are based on the standard SNI 8198:2015 (2015) method. The research steps were to prepare tools and materials in the form of aggregate, asphalt, filler (cement and bagasse ash). Furthermore, if it meets the specifications then designs the Laston mix design with a hot mix system with a variation of asphalt content of 5%; 5.5%; 6% and 6.5%. The design of the mixture for the specimen with asphalt content used 5%, 5.5%, 6% and 6.5%. Then soaking the test object for 30 minutes then marshall test, analysis of test results (VMA, VIM, VFA, Stability, Melt and MQ and determination of KAO. Then mix design with the hot mix system using KAO that has been obtained from previous research. Then soaking for 30 minutes with a temperature of 60 ° C and immersion for 24 hours with a temperature of 60 ° C after that the Marshall test and analysis of the test results to obtain the optimum filler content and IKS value. Analysis of the test results then conclusions and suggestions. Coarse aggregate (including rock and standard filler) used from Narogong. Asphalt used from Pertamina penetration is 60/70. The alternative filler used is bagasse ash from the burning of bagasse in Bogor. Types of aggregate inspection carried out include Density Testing and Coarse Aggregate Water Absorption, Density Testing and absorption of fine aggregate water, testing the adhesiveness of aggregate to asphalt, analysis of fine and coarse aggregate sieve , Aggregate wear with Los Angeles. Types of asphalt inspection include Penetration Testing, Asphalt Softening Point Testing, Flash Point Testing, Asphalt Ductility Testing, and Asphalt Specific Gravity Testing. Standard Marshall test with 2x75 collisions. This study is only based on the results of the Marshall test to determine the value of stability, flow, VMA, VIM, VFA and Marshall Quotient to obtain residual strength index (IKS).

Figure 1. Preparation for Making Test Objects

3. Result and Analysis

The results of research which include aggregate testing, asphalt testing with penetration of 60/70 and Marshall test results meet all the requirements stipulated by the SNI 8198:2015 (2015) specification.

Table 1. Recapitulation of Coarse Aggregate Test Results

No.	Information	Formula	The result	Unit
1	Surface dry specimen	BJ	5058	gr
2	Test object in water	BA	3066	gr
3	Oven dry specimen	BK	5000	gr
4	Bulk density	$\frac{BK}{BJ-BA}$	2.510	gr
5	SSD specific gravity	$\frac{BJ}{BJ-BA}$	2.53	gr
6	Artificial density	$\frac{BK}{BK-BA}$	2.588	gr
7	Absorption	$\frac{BJ-BK}{BK}\ x\ 100\%$	2.44	%

Source: Research Results, 2020

Table 2. Recapitulation of Fine Aggregate Test Results

No.	Information	Formula	The result	Unit
1	Surface dry specimen	Bj	380	gr
2	Pycnometer + water weight	B	639	gr
3	Pycnometer + water + specimen weight	Bt	872	gr
4	Oven dry specimen weight	Bk	372	gr
5	Bulk density	$\frac{Bk}{B+Bj-Bt}$	2.531	gr
6	SSD specific gravity	$\frac{Bj}{B+Bj-Bt}$	2.585	gr
7	Artificial density	$\frac{Bk}{B+Bk-Bt}$	2.676	gr
8	Absorption	$\frac{BJ-BK}{BK}\ x\ 100\%$	2.676	%

Source: Research Results, 2020

Table 3. Recapitulation of Portland Cement Filler Test Results

No.	Information	Formula	The result	Unit
1	Filler weight	Bt	64	gr
2	Reading scale to 1	V1	0.6	cc
3	2nd scale reading	V2	22.4	cc
4	density	$\frac{Bt}{V2-V1}$	2.936	gr/cc

Source: Research Results, 2020

Table 4. Recapitulation of Sugarcane Dregs Ash Filler Test Results

No.	Information	formula	Test result	Unit
1	Filler weight	Bt	64	gr
2	Reading scale to 1	V1	0.5	cc
3	2nd scale reading	V2	25.5	cc
4	density	$\frac{Bt}{V2 - V1}$	2.215	gr/cc

Source: Research Results, 2020

Table 5. Recapitulation of 60/70 pen Asphalt Testing Results

No	Type Of Testing	Method	Terms		The Result	Information
			Min	Mak		
1	Penetration , 25^{0}C; 100 Gr; 5 Detik;0,1 Mm	SNI 2456 – 2011	60	70	664	Fulfill
2	Soft Spot , ^{0}C	SNI 2434 – 2011	48^{0}C	-	53	Fulfill
3	Flash Point , ^{0}C	SNI 2433 – 2011	175^{0}C	-	205^{0}C	Fulfill
4	Ductility 25^{0}C; Cm	SNI 2432 – 2011	100 Cm	-	109,1	Fulfill
5	Density	SNI 2441 – 2011	1	-	1.047	Fulfill

Source: Research Results, 2020

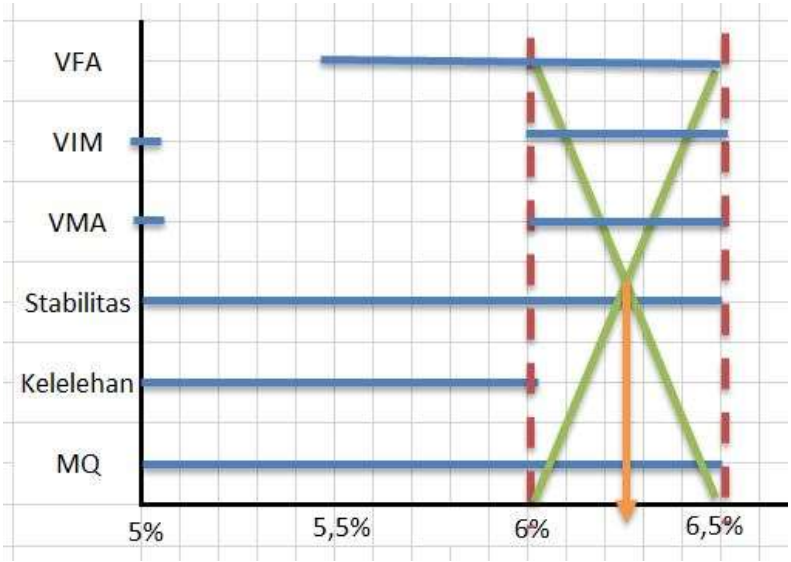

Figure 2. Optimum Asphalt Content with Portland Cement Filler
Source: Research Results, 2020

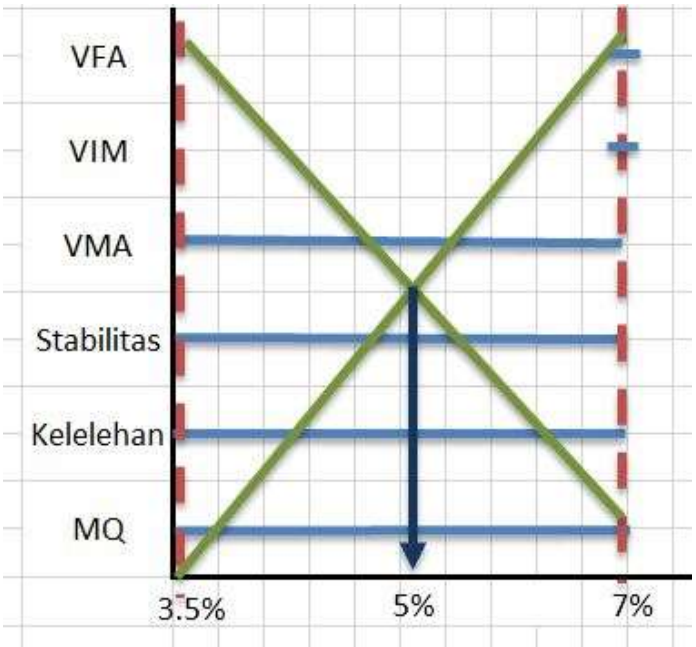

Figure 3. Optimum Asphalt Levels with Sugarcane Dust Filler
Source: Research Results, 2020

4. Conclusion

Based on the analysis and discussion of research conducted at the Laboratory of the University of Mercu Buana Jatisampurna regarding the effect of bagasse ash as a filler on the AC-WC mixture, the following conclusions were drawn:

1. The aggregate used is of a fairly good quality because each test meets the SNI requirements used.
2. Asphalt pen 60/70 used has a fairly good quality because each test meets the SNI requirements used.
3. Based on the results of the study, the value of the optimal asphalt content (KAO) obtained from the test object using Portland cement filler at asphalt content of 5%; 5.5; 6%; and 6.5% of the AC-WC asphalt mixture, namely 5.7%.

a. The use of bagasse ash filler with a content of 5% increased the stability value.
b. The stability value with asphalt content of 6.5% has decreased.
c. In bagasse ash filler, the value of stability by immersing the specimen for 30 minutes was higher than for 24 hours.

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Biography / Biographies

Muhammad Isradi, ST, MT, IPM served as Secretary of the Civil Engineering Study Program at Mercu Buana University. Mr. Isradi holds a Bachelor's degree in Civil Engineering from the University of Muhammadiyah Malang in 1992-1998, with the title of the thesis of One-Way Flat Plate Planning at the Ratu Plaza Madiun Building and a Masters in Civil Engineering in Brawijaya University of Malang in 1999-2001, with the title Model Analysis of Family Movement Awakening in Malang Sawojajar Housing Area. He has taught courses in Road Pavement Planning, Road Geometric Planning, Transportation Engineering, and Environmental Engineering.

Imam Sindu Baskoro is a student from Mercu Buana University, Kranggan with a Civil Engineering study Program. I am the second child of 2 siblings who graduated from SDN 11 Pagi Ciracas, the moved to As-

Salam Islamic boarding school Sukabumi, MAN 15 Kelapa Dua Wetan, until then I continued my education at Mercu Buana Kranggan University. There were several competitions that I participated in from elementary school to college, Arabic speeches and scout competitions. During junior high and high school I was quite active in the fields of Scouting, silat, Islamic spirituality, calligraphy, futsal and theater. When I entered Mercu Buana education I was active in the field of Assistant Lecturer in the Soil Mechanics course and had served for 1 year. In addition, I was a civil engineering laboratory assistant for 2 periods.

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Risk Analysis of Time Delay in The Sumbawa Shrimp Pond Farming Project

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Abstract

Sekar Laut Group is opening a new land of around 1,000 hectares for shrimp ponds in the Sumbawa area, West Nusa Tenggara. The land in Sumbawa is suitable for shrimp farming because the water is considered cleaner and has no pollution. during the construction process, there were various kinds of obstacles that resulted in work delays of around 23% of the agreed schedule. Therefore, research is conducted to determine the dominant risk that affects the project's time performance and provide risk mitigation so that the risks that occur can be minimized. This research uses quantitative research methods by distributing questionnaires to related parties and testing the validity and reliability using SPSS version 25 software. The data processing method uses risk value data analysis to determine which risks are classified as high risk. The number of risks identified in this research were 35 risks consisting of 33 risks based on literature studies and 2 new findings risks. based on 35 risks distributed to respondents, there are 2 risks that are categorized as high risk. 1 (one) risk comes from a literature study is the subcontractor's poor performance, and 1 (one) other risk comes from the risk of new findings from expert advice is the large amount of repair work due to the earthquake.

Keywords
Project Delays, Risk Management, Risk Value, Shrimp Pond Project.

1. Introduction

Sekar Laut Group opened about 1000 hectares of land for shrimp cultivation ponds in Sumbawa area, West Nusa Tenggara. The selection of land in Sumbawa is suitable for shrimp cultivation, because the water is considered lebih clean and not polluted (Jajeli, 2016). In 2018 Sekar Laut Group opened a new company, PT. Sentra Budidaya Biotek which manages the field of shrimp cultivation ponds recorded in the first stage of land management built an area of 365 hectares. During its work the project has experienced a delay of 23% of the total weight of 100%.

Figure 1. S Curve of the Sumbawa Shrimp Farming Project
Source: S-Curve Document for the Sumbawa Shrimp Pond Farming Project, 2020

The delay in completion is caused by risk factors both internal and external that arise from the early stages of project implementation. Therefore, risk management should be carried out throughout the project cycle from the initial stage to the end of the project (Pertiwi, 2017). There is currently no specific risk analysis applied to the Sumbawa Shrimp Pond project, which was carried out only to identify the cause of the delay. Risk analysis consists of three stages, namely, risk identification, risk analysis, prioritizing risk and mitigation. In risk management, ineffective handling can lead to loss of profits from projects and also a swelling of funds as a result of poor risk management. While the handlers are effective, it is expected that the negative effects of these risks can be minimized so that the project schedule and budget can run smoothly in accordance with the planning. Therefore, a study is needed to identify the risks that often arise in the construction of the project. This research seeks to conduct risk management on the implementation of shrimp cultivation project PT Sentra Budidaya Biotek so that it is expected that the project can be completed as scheduled and provide maximum profit for various parties.

1.1. Problem Identification

From the background that the authors have described, identify the problems that will be made the following research materials:

1. There is a delay of about 23% so that the schedule is not achieved.
2. There has not been a specific risk management, which has been done only to identify the cause of the delay.
3. The need for handling and allocation of risk is classified *as high risk.*

1.2. Problem Formulation

Based on the identification of the problem and in order for the discussion to be more targeted according to its purpose, the problem is formulated as follows:

1. What are the most dominant risk variables and affect project time performance in the construction of shrimp cultivation ponds?
2. How does proper handling and mitigation of the dominant risk variables affect project time performance in the construction of Sumbawa Shrimp Cultivation Pond?

1.3. Research Objectives

The purposes and objectives of this research are:

1. To know the most dominant risk that causes to affect the project time performance on the construction of Sumbawa Shrimp Cultivation Pond.
2. Formulate an appropriate handling strategy against the dominant risks that cause it to affect the time performance of the Sumbawa Shrimp Cultivation Pond project.

2. Method

Here's a flow chart of the research in the image below:

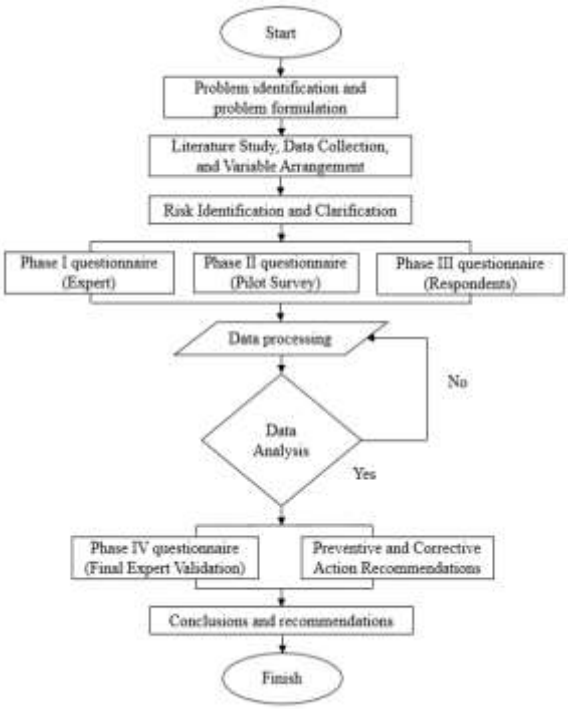


Figure 2. Research Method Flow Chart
Source: Processed Authors, 2020

2.1. Population

Population is a generalized region consisting of objects/subjects that have certain qualities and characteristics set by researchers to be studied and then drawn conclusions (Sugiyono, 2017). In this study, the population that became the object in the study was employees /staff and workers at the Shrimp Cultivation Pond Development Project in Sumbawa. The selection of population characteristics of this study was conducted with the consideration that employees/staff have a direct role in ongoing projects. The selection of population characteristics of this study was conducted with the consideration that employees/staff have a direct role in

ongoing projects. The population will be used as a questionnaire for respondents in this study as many as 30 respondents.

2.2. Research Variables

In determining variables, the authors reviewed the results of previous research journal literature studies by taking each of the most dominant variables and observing the conditions in the field, as well as conducting interviews with project staff in order to get a synchronization of relevant variables from the results of the literature study with the conditions of the Sumbawa Shrimp Pond development project. Furthermore, in order for variables to be easier to understand, the author asks for advice and input from experts on the preparation of variable categories. Research variables to be used as questionnaires, previously validated by experts. Whether the variables are relevant or inappropriate, and experts will add some additional variables if they are assessed the variables presented do not represent the problem that occurred. Here are the variables that experts agree on :

Table 1. Research Variables

Variable	Risk Affecting Project Time Performance
	Internal Factors
X1	The process of making work drawings by contractors
X2	Contractor's ability in financial
X3	Limited work equipment
X4	Supervision and job evaluation are not carried out
X5	Lack of supervision during project implementation
X6	Unclear work policies and procedures
X7	Incorrect construction methods lead to errors
X8	Lack of communication and coordination

Table 2. Research Variables

Variable	Risk Affecting Project Time Performance
	Internal Factors
X9	Lack of competence of experts
X10	Low level of management discipline
X11	Slow decision making

Table 3. Research Variables

	External Factors
X12	Late delivery of materials
X13	Late payment by the owner
X14	Low productivity of equipment and machines
X15	Difficult road access to the project site
X16	Delivery locations that are far from the warehouse
X17	Late approval shopdrawing
X18	Process of requesting and approving working drawings by owner
X19	Poor subcontractor performance
X20	Unstable weather conditions
X21	Lack of construction facilities
X22	There is a request for changes to work that has been completed
X23	Increase in material prices
X24	Change in material type during work execution
X25	The work area reaches the sea trough area, so quite a lot of material is shifting manually
X26	A job waiting for the low tide
X27	The occurrence of landslides
X28	An earthquake
X29	Damage to concrete structures
X30	The number of repair works due to the earthquake
X31	Conflict between human resources
X32	Poor soil conditions
X33	Design specifications are low
X34	Order limited quantities of ingredients
X35	The material does not yet exist in the local market

Source: Processed Authors, 2020

2.3. Data Analysis

In this research technical analysis of the data used leads to quantitative analysis. In analyzing the data for research purposes, researchers used a tool that is SPSS software. The data that has been obtained from the field through literature studies and processing of questionnaire variables based on previous research, is then analyzed using the following statistical techniques:

2.3.1 Validity Test

Dewi, (2018) suggests that the validity of factors is measured when items are arranged using more than one factor (between factors with each other there are similarities). Measuring the validity of these factors by correlated between the factor score (the summation of items in one factor) and the total factor score (the total of the total factors). Measure the validity of an item by correlated between the item score and the total score of the item. The validity of the item is indicated by the correlation or support of the total item (total score). When we use more than one factor, it means testing the validity of an item by correlated between the item score and the factor score, then continuing to correlate between the item and the total factor score (the summation of several factors). From the results of the correlation calculation will be able to be a correlation coefficient used to measure the validity rate of an item and determine whether an item is worth using or not. In determining whether or not an item is used, calculate the correlation between each statement and the total score by using the product moment correlation formula. This research conducted reliability test with statistical package for social sciences (SPSS 25.0 for Windows) software programtools.

2.3.2. Reliability Test

Reliability tests aim to determine the level of data reability generated by an instrument to ensure consistency of research instruments in the same concept. A commonly used reliability analysis is cronbach alpha (C-alpha) analysis. This research conducted reliability test with statistical package for social sciences (SPSS 25.0 for Windows) software programtools.

2.3.3. Probability Assesment

Probability Calculation uses the following equation formula:

$$(Probability) = \sum_{i=1}^{5} \left[a.\left(\frac{n}{N}\right)\right]$$

Where :
i : Response category index (1,2,3,4, and 5).
a : Weight associated with the Ith response value (1,2,3,4,and 5 sequentially).
n : Number of respondents per response value to i.
N : Total number of respondents.

2.3.4. Impact Assessment

Probability Calculation uses the following equation formula*:*

$$(Impact) = \sum_{i=1}^{5} \left[a.\left(\frac{n}{N}\right)\right]$$

Where :
i : Response category index (1,2,3,4, and 5).
a : Weight associated with the Ith response value (1,2,3,4,and 5 sequentially).
n : Number of respondents per response value to i.
N : Total number of respondents.

2.3.5. Risk Value Rating

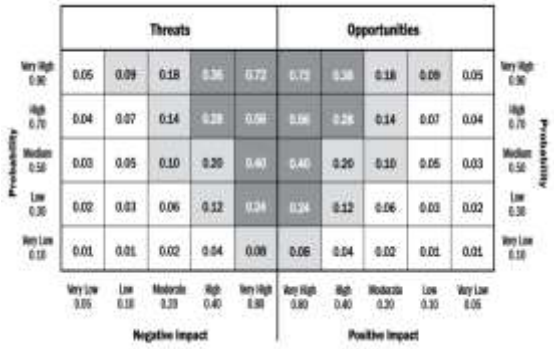
Test Analysis of the score in order to find the highest weight of each variable in the Analysis. In this study, the scoring was conducted using the PMBOK Analysis method 2017, by creating a weighting of the probability and weighting criteria of the impact criteria, with the average result of the impact value and the probability value obtained from the respondent. Furthermore, the average probability value is multiplied by the average impact value and taken the highest variables that will be used as the result as the dominant factor in the project delay.

To measure risk, use a formula:

$$Risk\ Value\ (\boldsymbol{R}) = P\ \mathrm{X}\ I$$

Where :
P : Probability
I : Impact

Table 4. Scoring Probability and Impacts Matrix



Source: PMBOK 2017

3. Results And Discussions

The data of the analysis results is obtained by the method shown above. The results are as follows:

Table 5. Risk Value Analysis Results and Risk Rating Categories

Variable	Probability (P)	Impact (D)	Risk (P x I)	Rank
X1	0.54	0.35	0.19	Low
X2	0.47	0.30	0.14	Moderate
X3	0.54	0.34	0.19	Moderate
X4	0.57	0.34	0.19	Moderate
X5	0.53	0.36	0.19	Moderate
X6	0.59	0.34	0.20	Moderate
X7	0.53	0.30	0.16	Moderate
X8	0.57	0.30	0.17	Moderate
X9	0.61	0.31	0.19	Moderate
X10	0.59	0.35	0.20	Moderate
X11	0.56	0.34	0.19	Moderate
X12	0.59	0.30	0.18	Moderate
X13	0.55	0.33	0.18	Moderate
X14	0.57	0.33	0.19	Moderate
X15	0.39	0.12	0.04	Low
X16	0.53	0.36	0.19	Moderate
X17	0.47	0.30	0.14	Moderate
X18	0.52	0.34	0.18	Moderate
X19	0.69	0.44	0.30	High
X20	0.47	0.30	0.14	Moderate
X21	0.59	0.27	0.16	Moderate
X22	0.55	0.37	0.20	Moderate
X23	0.37	0.13	0.05	Low
X24	0.59	0.31	0.18	Moderate
X25	0.59	0.33	0.20	Moderate
X26	0.61	0.29	0.17	Moderate
X27	0.56	0.31	0.18	Moderate
X28	0.57	0.34	0.19	Moderate
X29	0.54	0.31	0.17	Moderate
X30	0.75	0.50	0.38	High
X31	0.43	0.12	0.05	Low
X32	0.57	0.34	0.19	Moderate
X33	0.67	0.30	0.20	Moderate
X34	0.55	0.36	0.20	Moderate
X35	0.55	0.33	0.18	Moderate

Source: Processed Authors, 2020

Based on the results of risk value analysis, then get 2 variables with high risk category, as follows:

Table 3. High Risk Affecting Time Performance

Variable	Risk Affecting Project Time Performance
X19	Poor subcontractor performance
X30	The number of repair works due to the earthquake

Source: Processed Authors, 2020

It will then be sought preventive and corrective measures.

From 2 (two) causes of project delays, to 2 (two) experts have provided advice on preventive and corrective measures, namely:

3.1. Poor Performance of Subcontractors

3.1.1. Preventive Measures

Evaluation of subcontractors' working methods on a regular basis, and the holding of internal meetings both on the part of the main contractor and subcontractors related to planning problems and ineffective working methods, Selecting experienced and well-performing subcontractors and able to complete the work according to the project target, Inserting clauses tied to contract documents.

3.1.2. Corrective Action

Replacing the initial subcontractor with a new subcontractor who is expert in his field with a committed and qualified record and keriteria, taking over the work for himself by the main contractor, Looking for other subcontractors who are able to complete the rest of the work.

3.2. Number of Earthquake Repair Works

3.2.1. Preventive Measures

Planning must be adjusted to the guidelines of Design in accordance with the Indonesian National Standard (SNI) earthquake, Tighten supervision in the field on the work (in case of structural nature) to comply with the planning, Conduct risk analysis for disaster mitigation. Coordination with civil engineering engineers in the planning stage.

3.2.2. Corrective Action

Immediately evaluate the potential losses that occur such as, calculating the frequency of losses. After the evaluation is prepared the next step is to conduct a coordination meeting with all the sections to discuss appropriately to overcome the work that needs to be improved, To evaluate the structural work, after the evaluation of the engineering team looking for the concept of adding structure strengthenment to the damaged building with an efficient and strong concept, rescheduling with the acceleration of time, the addition of shift work, or the addition of workers to be able to be made a group that completes the repair work and the group that completes the main work.

4. Conclusion

Based on the results of analysis and discussion of the data collected from the respondents' answers in this study, conclusions can be drawn, among others:

1. The most dominant risks of identified risks are external factors in variables (X19 = Poor Subcontractor Performance with matrix probability and impacts value of 0.30), and (X30 = Number of Earthquake Repair Works with matrix probability and impacts value of 0.38).
2. Handling risks that affect project time performance can be done with the following precautions:

a. select experienced subcontractors and commit to the work to be carried out, conduct internal meetings with subcontractors to evaluate problems occurring in the field and evaluate less effective working methods,

b. tighten management to supervisorsin thegan, conduct disaster mitigation risk analysis, evaluate planning design before implementation with reference to SNI design.

4.1. Advice

Based on the results of the analysis of the research and all the limitations of the existing research, the authors suggest for further research on the same topics, including:

1. Risks associated with poor subcontractor performance issues, it is best to tender from several subcontractors first. Of the subcontractors selected, it is required to present a working method and understanding of the work to be carried out. So that subcontractors can be assessed expertly and experienced as well as the most able to complete the work with the best results on the target of the project.
2. In relation to the risks associated with the problem of many earthquake repair work, it is recommended that before carrying out the work needs to be done planning that is guided towards design in accordance with SNI standards so that the design results are more accurate and said to be feasible to be carried out.
3. For further research, the authors suggest that to get more accurate answers, it is necessary to increase the number of respondents from subcontractors. So respondents who were initially only the owner and maincontractors then became owners, maincontractors, and subcontractors.

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Sodium Hypoclorid and Benzalkonium Chloride Usage As A Disinfectant in Residential Area Towards The Durability of Non-Structure Building Materials

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Abstract

It is seen that the world is experiencing health recession due to the coronavirus spread massively which resulting in a COVID-19 pandemic. To prevent and break the chain of coronavirus infecting in Indonesia, The Government and society are actively taking various efforts. One of them is doing a disinfecting process in residential areas. The impact of disinfectants on the structure of building materials is unknown and has never been tested in previous studies. This study aims to test empirically the effect of several chemicals from disinfectant ingredients towards the durability of non-structure building materials which are often used as residential materials. The sample of this study consisted of four group types, that is mortar, brick, hebel stone, and concrete brick. Each type of test object has a total of 6 variations of treatment by spraying or immersing H2O, BZK, and NaCIO chemicals and then testing the compressive strength after the age of the test object reaches 7, 14, and 28 days. The results of the study visually showed that the four types of specimens did not undergo physical changes during the duration of the test. The results of the research data also show that the four types of specimens experience anomalous results in compressive strength. The greatest compressive strength values for 4 types of specimens are not all at the age of 28 days, but at the age of 14 days, the largest compressive strength value for mortar is 30.74 MPa in the 6th variation of chemical immersion of NaCIO at 14 days, on hebel brick the largest compressive strength value is 2.41 MPa in the 3rd variation of spraying with chemical BZK aged 14 days, for red brick the largest compressive strength value is 11.48 MPa in the 4th variation of immersion with chemical BZK aged 14 days, and on the concrete brick the largest compressive strength value is 2.20 MPa in the 3rd variation of spraying with chemical BZK aged 14 days.

Keywords
Benzalkonium Chloride, Compressive Strength, Covid Desinfectan, Residential Home Disinfecting, Sodium Hypochlorite

1. Preliminary

The world is currently experiencing a health recession due to the coronavirus which has spread massively and becomes a COVID-19 pandemic. A new type of coronavirus called SARS-CoV-2 is the cause of the disease. The case of COVID-19 was first detected by the Chinese government in Wuhan City, Hubei Province, China in December 2019. Indonesia experienced a pandemic when there were findings of two positive patients with the coronavirus and announced directly by President Joko Widodo at the Presidential Palace, Jakarta, Monday, March 02, 2020. After periodically monitoring and studying the SARS-CoV-2 coronavirus, which has a very high spread rate in the world, finally on March 11, 2020 it was reported on the official website of the World Health Organization (WHO) officially designated COVID-19 as a global pandemic.

Disinfectants are chemicals used to prevent infection or contamination by microorganisms or drugs to eradicate disease germs (Indonesia. Departemen Pendidikan Nasional.; Pusat Bahasa, 2008). The disinfectant process is carried out in the form of spraying chemical liquids into public places such as malls, offices, restaurants, roads, sidewalks, village access roads, residents' homes, even disinfectants were used to sterilize humans using a special Spray Chamber tool. The widespread practice of spraying disinfectants and alcohol across the sky, on roads, vehicles and personnel has no value; in addition, large amounts of alcohol and disinfectants are potentially harmful to humans and should be avoided (Yonghong and Torok, 2020).

Chemicals that can be used as disinfectant products of various types include chlorine, sodium hypochlorite, benzalkonium chloride, iodine, quartenemer ammonium alcohol, formaldehyde, potassium permanganate, and phenol. Previous studies regarding the effect of several chemicals on concrete have been done before. Concrete that is in an acidic environment will be more quickly exposed to corrosion which causes

concrete degradation. The higher the percentage of chloride in the concrete, the shorter the service life of the concrete (Hardianti, Kristiawan and Wibowo, 2017).

Sodium hypochlorite (NaCIO) and benzalkonium chloride (BZK, BKC, BAK, BAC) are mixtures contained in-floor cleaning products or clothes bleach that are easily available on the market. Both products contain chloride chemicals, as reviewed in previous studies concluded that these materials can reduce the compressive strength of concrete. A study is needed whether repeated exposure to BZK and NaCIO materials to non-structural building materials within a certain period can make physical changes and reduce the value of the compressive strength of each of these materials. Of course, it will be a dangerous thing for human safety in the house when scientific evidence is proven that BZK and NaCIO can reduce the value of compressive strength and change the physical form of building materials.

Of the many previous studies on the effect of chloride on the compressive strength of concrete, there has never been a study on the effect of exposure to chloride contained in disinfectants, namely sodium hypochlorite (NaCIO) and benzalkonium chloride (BZK, BKC, BAK, BAC) on physical changes. and the compressive strength of non-structural building materials. In this case, the study will discuss the use of sodium hypochlorite and benzalkonium chloride as a disinfectant against physical changes and the compressive strength of non-structural building materials.

2. Literature Review

2.1. Mortar

Cement mortar is a hydraulic cement similar to paired cement, but the specifications for cement mortar require lower air content and include the requirements for flexural adhesiveness (Badan Standarisasi Nasional, 2014). Mortar is one of the building materials used in the construction world both in small-scale residential houses to large-scale multi-story building projects. Mortar consists of a mixture of cement, water, sand. Mortar is a building material product as an "adhesive" for making non-structural buildings as well as a protective layer for walls.

2.2. Light Brick AAC

Light brick AAC lightweight bricks are cellular concrete where the air bubbles in the finished brick product are caused by a chemical reaction, AAC dough generally consists of lime, quartz sand, water, cement, a little gypsum, and aluminum paste as a developer (chemical filling of air into the product). After the dough is perfectly mixed, it will expand for 7-8 hours. The aluminum paste used in the dough, apart from functioning as a developer, plays a role in influencing the hardness of the concrete. The volume of this aluminum paste ranges from 5-8 percent of the dough that is made, depending on the desired density.

AAC light brick making material uses special sand, namely silica (> 95% SiO2), and must be ground to micro size. Just like in bread making in AAC, the expansion rate of the dough cannot be controlled precisely so that it will usually expand out of the mold. Therefore it must be cut to get the required dimensions. The relatively large number of air bubbles allows the production of AAC with a low density, which is around 700 - 800 kg / m^3 (Karijanto, Wijaya and Sugiharto, 2013).

2.3. Redbrick

Redbrick is one of the basic materials for structural and non-structural building construction that is often found and used in Indonesia. The existence of red brick products has been going on for decades. Badan Standarisasi Nasional (2000) explains that red brick is a building material in the form of a rectangular prism. Solid or perforated with a maximum volume of 15% and is used for the construction of building walls, which are made of clay with or without mixed active ingredients and burned at a certain temperature. Red bricks were made from molded clay, then burned. Not all clay can be used. Only consisting of certain sand content.

Redbricks on the market generally have sizes: length 17-23 cm, width 7-11 cm, thickness 3-6 cm. Average weight 3 kg / pcs (depending on the brand and origin of manufacture). The raw materials needed for red brick masonry plastering are cement and sieve sand. For watertight walls, a 1: 2 or 1: 3 mixture is needed (that is, 1 part cement combined with 3 parts sifted sand). Meanwhile, for walls that do not have to be waterproof, a ratio of 1: 4 to 1: 6 sand cement can be used.

2.4. Batako

Batako is a brick made from a mixture of hydraulic adhesive added with fine aggregate and water with or without other additives and has a hole cross-sectional area of more than 25% of the cross-section of the brick and the hole contents of more than 25% of the brick content (Pusat Penelitian dan Pengembangan Pemukiman, 1982). Brick material is made from a mixture of cement and coarse sand which is solidly molded or pressed. In addition, there are also those who make it from a mixture of tras, lime and water. Even now also circulating bricks made of a mixture of cement, sand and coal. With the manufacturing materials described above, bricks

have a lower compressive strength than red bricks, so they tend to crack the brick walls due to excessive forces, especially if the blanks are not filled with mixed species. The use of brick material for walls also makes buildings warmer and even tends to be stuffy and hot, unlike red bricks made of earth material. Brick tends to be lighter than red brick. The texture also looks smoother than red brick.

3. Research Place

The methods applied in this study are experimental and was Held out in the Becakayu Batching Plant laboratory, PT. Waskita Beton Precast, Jln. Raya Pondok Kelapa Selatan No. 26 003/005, Pondok Kelapa, Duren Sawit, East Jakarta.

4. Method

The methods applied in this study are experimental. The variable referred to here is anything that will be the object of observation. The independent variable in this study is the mortar with the composition of SNI materials and several manufacturing standard building materials or general raw materials that are sold freely in the market, namely, light brick type AAC, red brick, and brick which are purchased at a building shop around the test site. All materials will be grouped according to the research design and strong data will be taken.

Mortar specimens are printed in cubes with dimensions of 5 cm x 5 cm x 5 cm, The need for samples of cube white brick objects is 10 x 10 x 10 cm, The need for samples of cube red bricks is 4 x 4 x 4 cm in size and the last one The sample of concrete brick specimens, due to the uniqueness of the brick shape, was cut into 3 pieces in the form of blocks, namely the right part, the left side, and the middle part with an average dimension of 12 cm x 7 cm x 36 cm.

All processes or procedures in conducting this research refer to SNI (Indonesian National Standard), ASTM (American Society for Testing and Materials), and previous research journals related to this research. Before the implementation of fresh mortar production, the preparation of materials and equipment that will be used will be carried out. The tests carried out are physical aggregate testing, colloid content test, sieve analysis test, specific gravity, absorption, clay lump test, organic impurities for fine aggregates, density. Mortar mixture planning refers to (Badan Standarisasi Nasional, 2015).

The compressive strength test for all materials (compressive strength) will refer to (Badan Standarsisasi Nasional, 2002) the method of testing the compressive strength of Portland cement mortar for civil works.

Table 1. Research Design

VARIATION	MATERIALS	Mortar Plester	Light Brick	Red Brick	Batako
TEST	Days To	7, 14, 28	7, 14, 28	7, 14, 28	7, 14, 28
TREATMENT	SOAK	WATER	WATER	WATER	WATER
		BZK (0,1 %)	BZK (0,1 %)	BZK (0,1 %)	BZK (0,1 %)
		NaCIO (0,1 %)	NaCIO (0,1 %)	NaCIO (0,1 %)	NaCIO (0,1 %)
TREATMENT	SPRAY	AIR	AIR	AIR	AIR
		BZK (0,1 %)	BZK (0,1 %)	BZK (0,1 %)	BZK (0,1 %)
		NaCIO (0,1 %)	NaCIO (0,1 %)	NaCIO (0,1 %)	NaCIO (0,1 %)
SAMPLE QUANTI	SOAK WATER 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK WATER 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK WATER 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK BZK 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK BZK 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK BZK 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK NaCIO 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK NaCIO 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK NaCIO 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
SAMPLE QUANTI	SPRAY WATER 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY WATER 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY WATER 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY BZK 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY BZK 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY BZK 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY NaCIO 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY NaCIO 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY NaCIO 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
ALL SAMPLE QUANTITY		90 pcs	90 pcs	90 pcs	90 pcs
		360 pcs			

Source: Data in Research, 2020

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Figure 1. Process of Manufacturing and Testing Sample
Source: Data in Research, 2020

5. Result

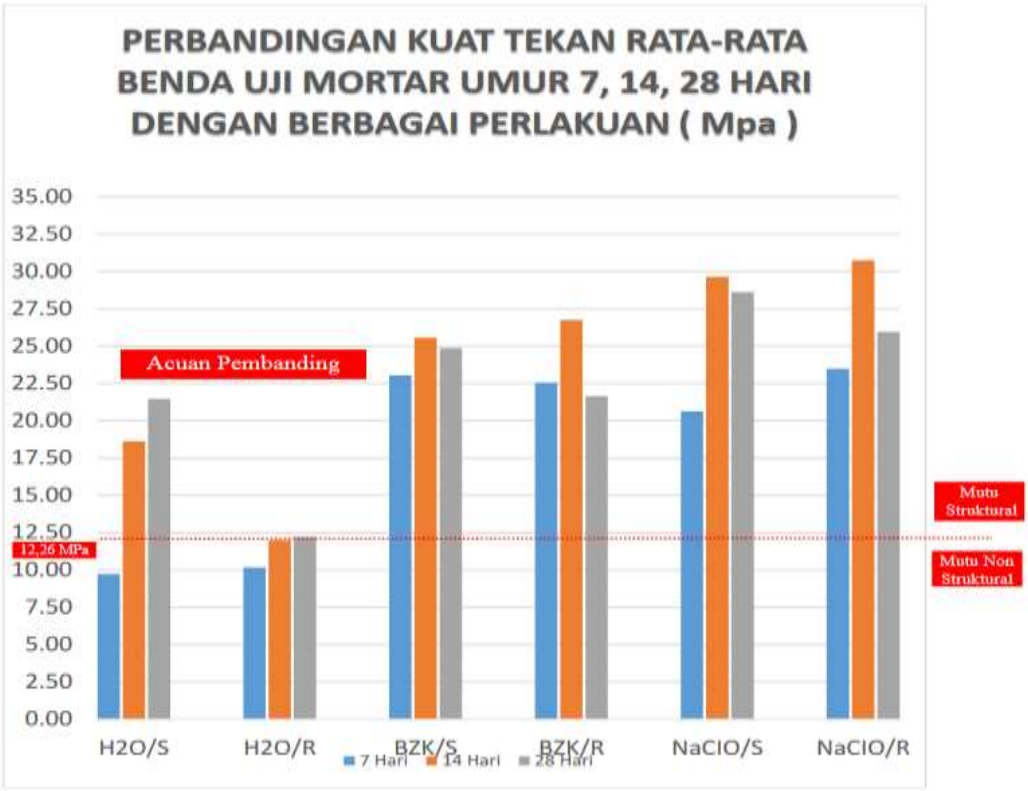

Figure 2. Histogram Comparison of The Average Compressive Strength of All Variations Mortar At Each Age
Source: Data in Research, 2020

Tabel 2. Comparison Results of Average Compressive Strength of All Mortar Variations at Each Age

	Type	Water		BENZALKONIUM		NaCIO	
	No.	1	2	3	4	5	6
	Unit	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
	Date / kode	H_2O/S (reference)	H_2O/R (reference)	BZK/S	BZK/R	NaClO/S	NaClO/R
a	7 Days	9,72	10,16	23,04	22,54	20,62	23,48
b	14 Days	18,62	11,99	25,57	26,74	29,65	30,74
c	28 Days	21,45	12,21	24,86	21,63	28,62	25,93

Source: Data in Research, 2020

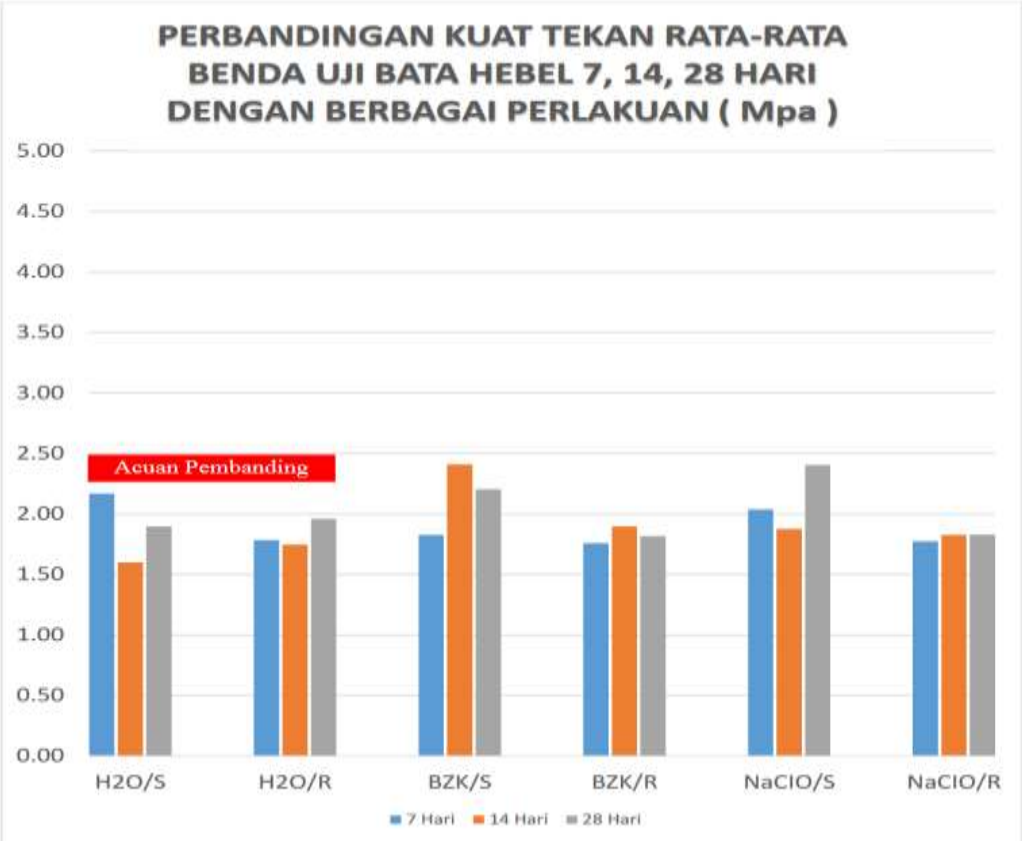

Figure 3. Histogam comparison of the average compressive strength of all variations Hebel Brick at each age
Source: Data in Research, 2020

Table 3. Comparison Results of Average Compressive Strength of All Mortar Variations at Each Age

	Type	Water		BENZALKONIUM		NaClO	
	No.	1	2	3	4	5	6
	Unit	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
	Date / kode	H_2O/S (reference)	H_2O/R (reference)	BZK/S	BZK/R	NaClO/S	NaClO/R
a	7 Days	2,17	1,78	1,83	1,76	2,04	1,77
b	14 Days	1,60	1,75	2,41	1,90	1,87	1,83
c	28 Days	1,90	1,96	2,20	1,82	2,40	1,83

Source: Data in Research, 2020

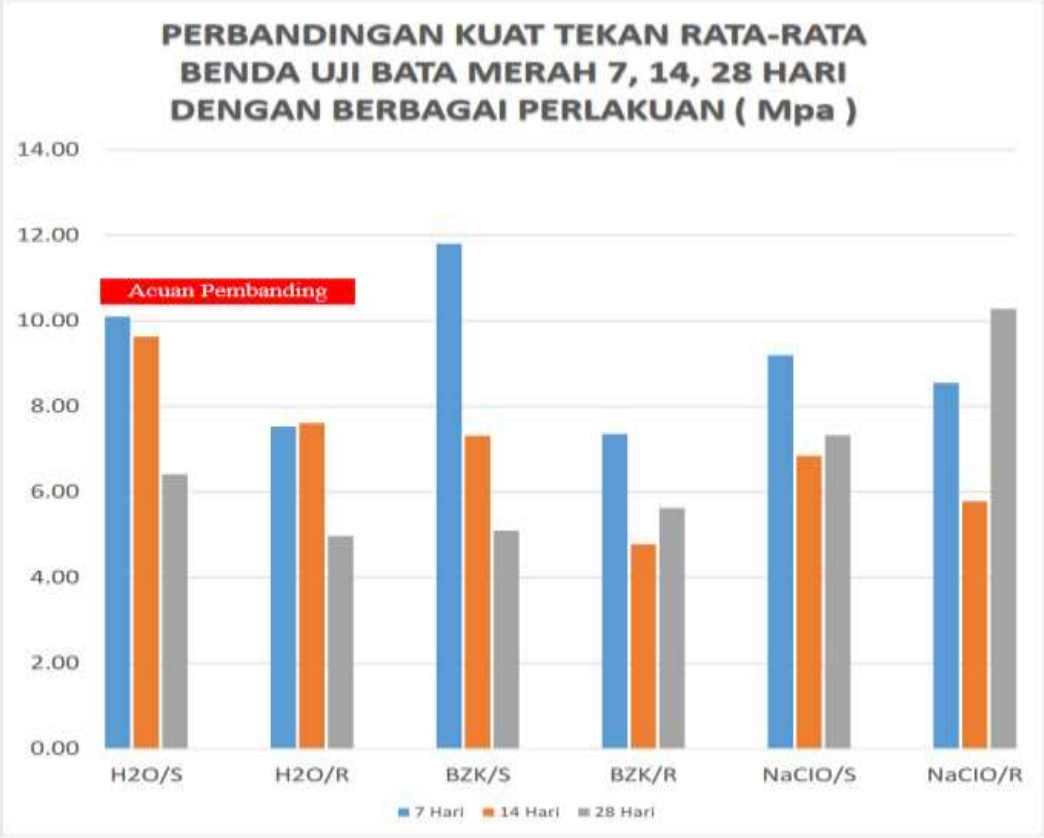

Figure 4. Histogram comparison of the average compressive strength of all variations Red Brick at each age
Source: Data in Research, 2020

Table 4. Comparison Results of Average Compressive Strength of All Red Brick Variations at Each Age

No	Type	Water		BENZALKONIUM		NaCIO	
	No.	1	2	3	4	5	6
	Unit	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
	Date / kode	H_2O/S (reference)	H_2O/R (reference)	BZK/S	BZK/R	NaCIO/S	NaCIO/R
a	7 Days	10,10	7,53	11,80	7,36	9,20	8,55
b	14 Days	9,63	7,61	7,32	4,78	6,84	5,78
c	28 Days	6,41	4,97	5,09	5,62	7,32	10,28

Source: Data in Research, 2020

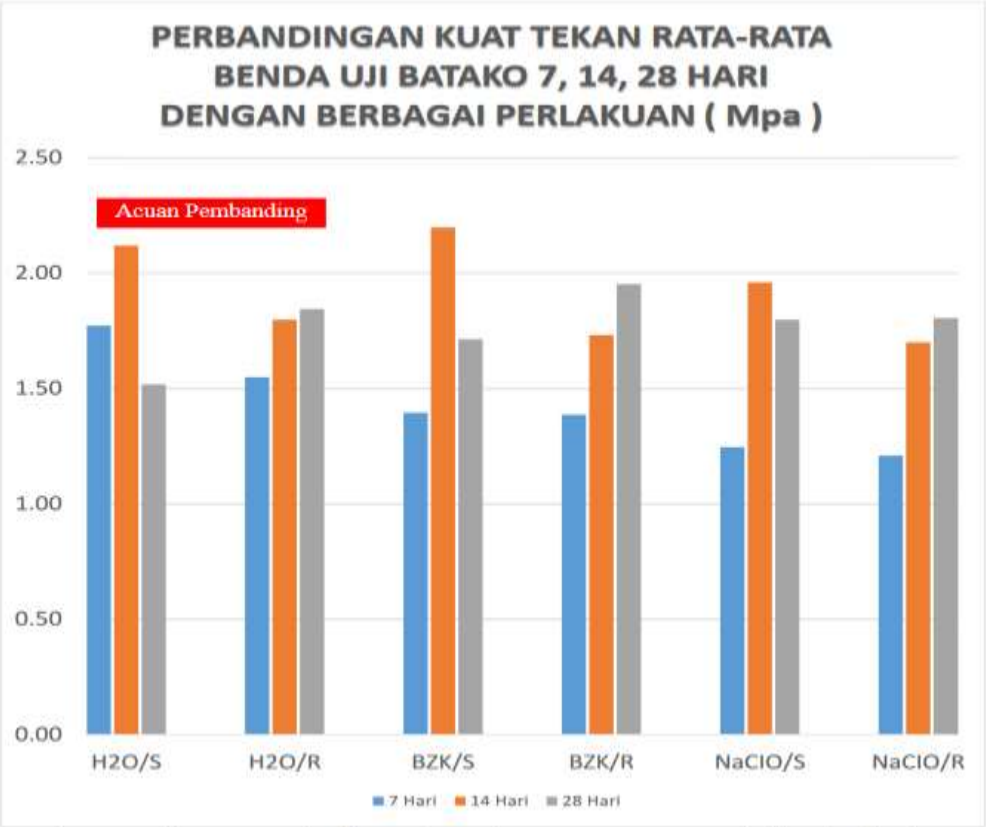

Figure 5. Histogram Comparison of The Average Compressive Strength of All Variations Batako Brick at Each Age
Source: Data in Research, 2020

Table 5. Comparison Results of Average Compressive Strength of All Batako Brick Variations at Each Age

No	Type	Water		BENZALKONIUM		NaClO	
	No.	1	2	3	4	5	6
	Unit	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
	Date / kode	H_2O/S (reference)	H_2O/R (reference)	BZK/S	BZK/R	NaClO/S	NaClO/R
a	7 Days	1,77	1,55	1,39	1,39	1,25	1,21
b	14 Days	2,12	1,80	2,20	1,73	1,96	1,70
c	28 Days	1,52	1,84	1,71	1,95	1,80	1,81

Source: Data in Research, 2020

6. Conclusions

1. From all photo data and observations of the test object material up to 28 days of treatment, there are no signs of damage either for mortar, white brick, red brick, and brick material
2. From the data above, at the age of 7, 14, and 28 days of specimens it can be concluded that:

a. The compressive strength of the Mortar specimen group as a whole shows a tendency to increase the maximum compressive strength of 91.59% from the age of 7 days to 14 days and 14 days to 28 days, although some variations are noted to have decreased a maximum of 15.64% from the 14 days against the 28-day specimen.

b. The compressive strength of the Hebel Bata specimen group as a whole shows a tendency of increasing the maximum compressive strength of 31.96% from the age of 7 days to 14 days and 14 days to 28 days, although some variations are noted to have decreased a maximum of 26.29% from the test object 7 days against the 14-day specimen.

c. The compressive strength of the Mortar specimen group as a whole shows a tendency to decrease in the maximum compressive strength of 38.00% from the age of 7 days to 14 days and 14 days to 28 days, although some variations are noted to have a slight increase in the maximum height of 77.89% of the 14 specimens. days against the test object 28 days.
d. The compressive strength of the Mortar specimen group as a whole shows a tendency to increase in the maximum compressive strength of 57.37% from the age of 7 days to 14 days and 14 days to 28 days, although some variations are noted to have decreased a maximum of 28.41% from 14 days of specimens. against the 28 day specimen.

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Effects of Using Benzalkonium Chloride (BZK) Disinfectant Against Density and Compressive Strength of Concrete

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Abstract

During the Covid-19 pandemic, where's the number of infections was increasing every day, there were many uses of massive disinfectants as a means of suppressing the spread of viruses in the environment. No exception, buildings, structures, and residential areas are also exposed to disinfectants every day to avoid and kill the growth of invisible viruses around us. The use of chemical disinfectants such as Benzalkonium Chloride contained on floor cleaning products is often used by the public and even disinfection officers because they are easy to get. The purpose of this study was to determine the disinfectant effect of Benzalkonium Chloride with the recommended level of disinfection dissolving spray and soak (penetration) on the density and compressive strength of concrete. The method used in this research was experimental by conducting trial mixes and special treatments that are carried out at the Becakayu Toll Road Concrete Batching Plant Laboratory - PT. Waskita Beton Precast, Tbk. From the results of the study, it was concluded that the decrease in density in the concrete with Benzalkonium Chloride spray treatment and normal water spray had an average density decrease and the concrete with Benzalkonium Chloride spray had a higher reduction value than that of water spray treatment, whereas in the samples the penetration treatment of Benzalkonium Chloride and normal water curing had an average density increase and the penetration treatment of Benzalkonium Chloride had a higher density value than that of normal water curing concrete. For the results of the compressive strength of the test objects at all qualities (K-175, K-300, and K-500), Benzalkonium Chloride spray treatment and water spray experienced an increase in compressive strength at the age of 14 days but the compressive strength decreased again at the age of 28 days, whereas the benzalkonium Chloride spray treatment sample on average has a lower compressive strength than the water sprayed test sample.

Keywords:
Benzalkonium Chloride, Compressive Strength, Density, Disinfectant Concrete.

1. Introduction

The spread of a new virus called SARS CoV-2 or what we usually call the Coronavirus originating from the city of Wuhan, China causes a disease called Covid-19 that has been confirmed by WHO as a world pandemic because of its uncontrollable spread. One of the easiest countermeasures is disinfection of parts of residential structures carried out every day to avoid and prevent possible growth of the virus

The disinfectant contains chloride which in a similar study shows that the chloride reduces the compressive strength of concrete, so it is necessary to study the spraying and penetration of disinfectant in concrete to the density and compressive strength after continuous spraying.

The research results of Meidiani and Septa Hartawan (2017) concluded that the use of acidic water pH, which is the lower the pH value of the water used, the resulting concrete compressive strength decreases from normal concrete compressive strength. In previous research by Sutandar (2016) concluded that maintaining hydration conditions when the concrete experiences hardening by maintaining the immersion method with water will increase the compressive strength of the initial plan concrete. The results of the research Hardianti, Kristiawan, and Wibowo (2017) state that concrete in an acidic environment will be exposed to corrosion more quickly which causes concrete degradation. The higher the percentage of chloride in the concrete, the shorter the service life of the concrete.

Due to the global Corona virus pandemic, massive spraying of disinfectants has continued to be carried out in every place to date, this research is expected to produce knowledge about the effects of disinfection activities on building structures and the assumption of density changes and a decrease in compressive strength in concrete using Benzalkonium Chloride solution.

2. Method

This study uses a trial or experimental method. According to Zulnaidi (2007) it explains that the experimental method is a study conducted to reveal the causal relationship of two or more variables by controlling the influence of the other variables. The independent variable in this study is Benzalkonium Chloride which is assumed to affect the density and compressive strength when sprayed and penetrated into a fixed variable that are concrete with quality variants of K-175, K-300 and K-500 with dimensions of Ø10,85cm x 20cm. The research process and procedures will refer to SNI (Indonesian National Standard), ASTM (American Society for Testing and Materials), and previous journals by related research. SNI 03-2834-2000 (2000), ASTM International (2010a), ASTM International (2010b)

Prior to the implementation of making research samples, the materials used will be tested for quality and specifications. The tests carried out for the physical aggregate test are coloid content test (SNI 2816 2014) (Statements and Size 2003), sieve analysis test (Pusat Penelitian dan Pengembangan Jalan dan Jembatan 1990), specific gravity (SNI 1970 2008), absorption (Badan Standarisasi Nasional 1990) (ASTM I n.d.), clay lump test (SNI.03-4141-1996 1996) (ASTM C 142-97 1998), organic impurities for fine aggregates (SNI 2816 2014)(SNI 03-2816-1992 1992), density (International 2003), and abration test(SNI 2417-2008 2008)

The dosage for Benzalkonium Chloride was 0.1% (The International Pharmacopoeia 2019) with a calculation of 0.1% x 1000 ml) /1.25% = 80 ml. The dissolving dose per liter is 80 ml.

3. Materials

Mix design sample made using OPC cement material type 1 (Semen Gresik), soft aggregate ex. Jambi, soft aggregate ex. Leles, coarse aggregate screening size 5 - 10 mm ex. Rumpin, clean water (PAM Aetra), additive type F (Console P200 New) and the use of benzalkonium Chloride concentrate 1.25% in the wipol product variant "Sereh & Jeruk" as a disinfectant and penetration solution.

The selection of concrete mixture materials by quantity or ratio will be presented in the following table:

Table 1. Trial Mix Design

Material	Unit	TM K175 K175 (Kg/m³)	TM K300 K300 (Kg/m³)	TM K500 K500 (Kg/m³)
OPC Type I	Kg/m³	270	350	440
Soft Aggregate Ex. Jambi	Kg/m³	480	429	495
Soft Aggregate Ex. Leles	Kg/m³	476	426	491
coarse Aggregate 5-10 Ex. Rumpin	Kg/m³	879	913	828
Clean Water Aetra	Ltr/m³	175	175	130
Admixture Type F	Ltr/m³	-	-	4,11
W/C Ratio		0,648	0,5	0,295

Source: Research Data, 2020

4. Results and Analysis

Testing and research analysis using Benzalkonium Chloride on concrete density and compressive strength of concrete with concrete qualities of K-175, K-300 and K-500.

In this section are the results of tests and analyzes treated for 7 days, 14 days and 28 days for each concrete quality.

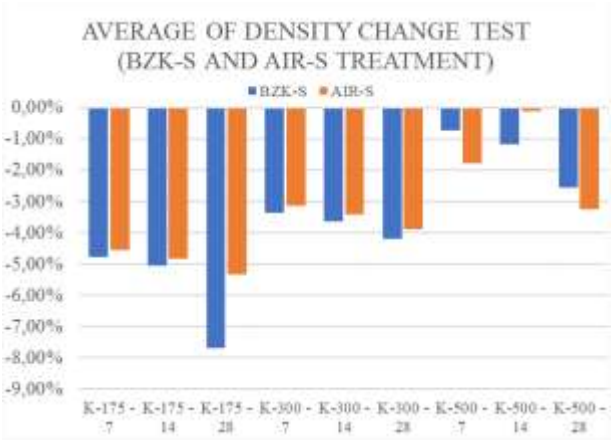

Figure 1. The Result Data Average Density Change of Concrete Treatment BZK-S and AIR-S
Source: Research Data, 2020

The next following is a table of information and details of the data from Figure 1:

Table 2. Result Data Average Density Change of Concrete Treatment BZK-S and AIR-S

Sample Code	BZK-S	AIR-S	Selisih
K-175 - 7	-4,79%	-4,57%	-0,22%
K-175 - 14	-5,06%	-4,83%	-0,23%
K-175 - 28	-7,68%	-5,34%	-2,34%
K-300 - 7	-3,35%	-3,14%	-0,21%
K-300 -14	-3,65%	-3,42%	-0,22%
K-300 -28	-4,20%	-3,88%	-0,32%
K-500 -7	-0,73%	-1,79%	1,06%
K-500 -14	-1,18%	-0,12%	-1,06%
K-500 -28	-2,57%	-3,26%	0,69%

Source: Research Data, 2020

From the data in Figure 1 and Table 1 shows that the samples BZK-S (Benzalkonium Chloride Spray) and AIR-S (Water Spray) make a decrease in density, and the average density reduction of the BZK-S treatment was higher than AIR-S treatment, except for the 7-day K-500 and 28-day K-500 samples.

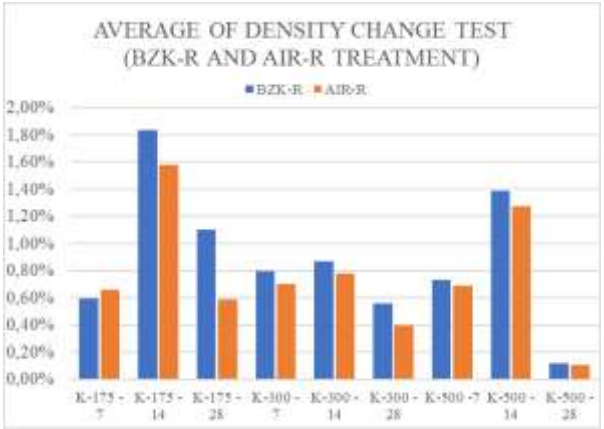

Figure 2. The Result Data Average Density Change of Concrete Treatment BZK-R and AIR-R
Source: Research Data, 2020

The next following is a table of information and details of the data from Figure 2:

Table 3. Result Data Average Density Change of Concrete Treatment BZK-R and AIR-R

Sample Code	BZK-R	AIR-R	Selisih
K-175 - 7	0,60%	0,66%	-0,07%
K-175 - 14	1,84%	1,58%	0,26%
K-175 - 28	1,10%	0,59%	0,52%
K-300 - 7	0,80%	0,70%	0,10%
K-300 -14	0,87%	0,78%	0,08%
K-300 -28	0,56%	0,40%	0,16%
K-500 -7	0,73%	0,69%	0,04%
K-500 -14	1,39%	1,27%	0,12%
K-500 -28	0,12%	0,11%	0,01%

Source: Research Data, 2020

From the data in Figure 2 and Table 3 shows that the sample BZK-R (Benzalkonium Chloride penetration) and AIR-R (water curing) make an increase in density and the average density increase in BZK-R treatment was higher than AIR-R treatment, except for the 7-day old K-175 sample.

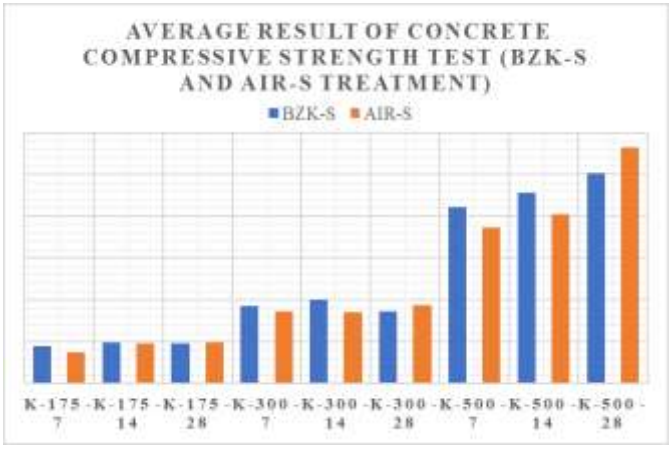

Figure 3. Average Results of Concrete Compressive Strength Tests for BZK-S and AIR-S Treatment
Source: Research Data, 2020

The next following is a table of information and details of the data from Figure 3:

Table 4. Data of Average Compressive Strength of BZK-S and AIR-S Treatment Objects

Sample Code	BZK-S	AIR-S	Difference (%)
K-175 - 7	89,61	75,47	18,75%
K-175 - 14	98,72	95,73	3,12%
K-175 - 28	95	98,65	-3,70%
K-300 - 7	184,68	172,5	7,06%
K-300 -14	200,55	171,52	16,92%
K-300 -28	171,92	187,87	-8,49%
K-500 -7	421,3	372,14	13,21%
K-500 -14	455,51	406,02	12,19%
K-500 -28	502,48	565,06	-11,07%

Source: Research Data, 2020

From the data in Figure 3 and Table 4 shows that the compressive strength of the test objects at all qualities (K-175, K-300 and K-500) treatment of BZK-S (Benzalkonium Chloride Spray) and AIR-S (Spray Water) made an increase in compressive strength at the age of 14 days but the compressive strength decreased at the age of 28 days.

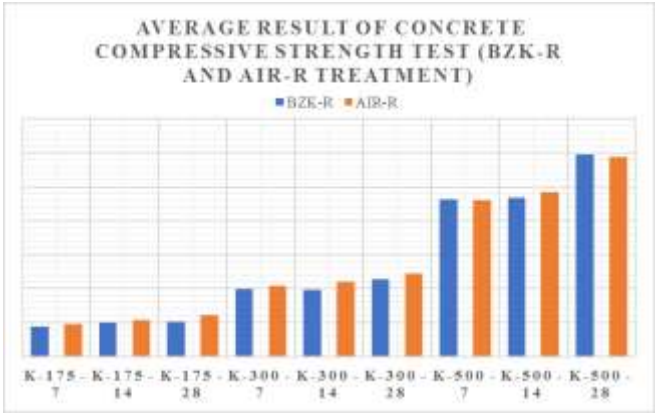

Figure 4. Average Results of Concrete Compressive Strength Tests for BZK-R and AIR-R Treatment
Source: Research Data, 2020

The next following is a table of information and details of the data from Figure 4:

Table 5. Data of Average Compressive Strength of BZK-S and AIR-S Treatment Objects

Sample Code	BZK-R	AIR-R	Diference (%)
K-175 - 7	87,11	95,26	-8,55%
K-175 - 14	100,84	106,95	-5,71%
K-175 - 28	1 03,7	122,96	-15,67%
K-300 - 7	198,3	209,39	-5,30%
K-300 -14	195,84	220,55	-11,20%
K-300 -28	228,52	243,34	-6,09%
K-500 -7	462,76	460,7	0,45%
K-500 -14	467,41	484,61	-3,55%
K-500 -28	595,95	587,11	1,50%

Source: Research Data, 2020

From the data in Figure 4 and Table 5 above, it shows that the BZK-R (Benzalkonium Chloride penetration) treatment sample on average makes a lower compressive strength compared to the treatment of the AIR-R (water curing) sample, except for the 7-days old K-500 sample 28-days old K-500.

5. Conclusions

The experimental results of BZK-S (Benzalkonium Chloride spray) and AIR-S (water spray) treatment made a decrease in density and concrete treatment with BZK-S had a higher reduction value than the AIR-S treatment concrete, whereas the BZK-R (Benzalkonium Chloride penetration) and AIR-R (water curing) treatment samples made the density increase, and the treated concrete with BZK-R had a higher density increase value than the AIR-R treated concrete.

The results of the compressive strength of the samples at all qualities concrete (K-175, K-300 and K-500) of the BZK-S (Benzalkonium Chloride spray) and AIR-S (water spray) treatment made an increase in compressive strength at the age of 14-days but compressive strength decreased at the age of 28-days, while the BZK-R (Benzalkonium Chloride penetration) treatment sample on average has a lower compressive strength compared to the treatment with AIR-R (water curing) sample.

The effect of Benzalkonium Chloride disinfectant liquid dissolved according to the rules of disinfection can reduce the compressive strength of concrete but it is not very significant because the percentage effect on compressive strength and density is not too much compared to normal water treatment.

6. Acknowledgment

This research was supported by Agung Sumarno and colleagues of the Becakayu Toll Road Concrete Batching Plant Laboratory - PT. Waskita Beton Precast, Tbk.

We would like to thank our colleagues from the Department of Civil Engineering, Faculty of Engineering, University of Mercu Buana who have provided insights and expertise that really helped this research, until this research was completed.

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Analysis of The Placement Pattern and The Needs of The Rain Station With Kagan-Rodda Methode on Das Progo Yogyakarta

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Abstract

Climate change that occurs has an impact on various fields. In the Yogyakarta region, most of the people work in agriculture and fishing. Where the two fields are closely related to rainfall data and rainfall patterns. Based on these conditions, it is necessary to conduct a study on the need for maximum rainfall data. From the data obtained from the Serayu Opak River Basin Center for the Progo Watershed in Yogyakarta, there are 8 active rain stations that are still operating, but they are not maximized because they are often damaged. So that it is necessary to analyze the needs of the rain station and the placement pattern needed to obtain the maximum rainfall data. The method used in this research is the Kagan-Rodda method. This method can analyze the needs and distribution patterns of the rain stations required by calculating the rainfall data from existing stations. From the calculation with this method, it is obtained that the need for rain stations for the Progo River Basin Yogyakarta region is 11 stations. It is recommended to add 3 new stations with a distribution pattern as described with the distance between stations of 12,742 km.

Keywords
Kagan-Rodda, Needs, Placement Pattern, Rain Station, Yogyakarta Progo Watershed

1. Introduction

Climate change that occurs has an impact on various fields. So it is necessary to carry out further analysis in order to obtain the latest data so that it can be used according to the needs of the community. One of the impacts of climate change is the rain pattern which is now difficult to predict.

Indonesia is a tropical country with 2 seasons, namely the rainy season and the dry season. In Yogyakarta, some people work as fishermen and most of them work in agriculture. The community's activities in these two fields are greatly influenced by the weather. So they need information about accurate weather data so that they can be used as a basis for carrying out activities. Especially in unpredictable rain so that analysis can be done by getting data from the rain station.

In order for the amount of rain to represent the actual depth of rain that occurs throughout the watershed, it requires a rain station with a certain number and density so that it can represent the amount of rain in the watershed. The rain station network must be planned according to the needs of the rainfall data to be collected. Especially in areas that have developed with a high level of density, the number of rain gauges needed must also be more.

Rain measurement data are obtained from rain stations that are spread over several points in a watershed area (DAS). In determining the rain that falls in a watershed, a number of rain stations are needed to be installed in such a way that data that represents the amount of rain in the watershed (Pulau Madura, 2018).

Hydrology is the science that talk about the water that is in the earth, namely the incident, turnover and distribution, physical properties and chemical, as well as his reaction to the environment, including its relationship with life (Linsley, R. K., Kohler, M. A., Joseph, P. L., & Hermawan 1996).

Cycle hydrology is one of the important aspects required in the hydrological analysis process. The hydrological cycle is the movement of seawater into the air, which then falls to the ground again as rain or other forms of precipitation, and eventually flows back into the ocean. In this hydrological cycle there are several interrelated processes, namely between the process of rain (precipitation), evaporation (evaporation), transpiration, infiltration, percolation, runoff and underground flow (soemarto 1987).

Watershed (DAS) is a land area which is an integral part of rivers and tributaries, which functions to accommodate, store, and flow from rainfall to lakes or to the sea naturally, where the land boundary is a topographical separator. and boundaries at sea to water areas that are still affected by land activities. A

subwatershed is a part of a watershed that receives rainwater and flows it through a tributary to the main river. Each DAS is divided into Sub-DAS-Sub DAS (law No 2004).

The watershed designation is indicated by the name of the river in question and is bounded by a control point, which is generally a hydrometric station. Paying attention to this means that a watershed can be part of another watershed (Harto s. 1993).

Rain or precipitation is a general term to describe water vapor that condenses and falls from the atmosphere to the earth in all its forms in a series of hydrological cycles (Dr. Ir . Suripin 2004). Others say that precipitation is the common name for steam condensing and falling to the ground in a series of hydrological cycle processes, usually the amount is always expressed by the depth of the prespitation (mm). If the water vapor that falls liquid called rain(rainfall) and if the solid form called snow (Sosrodarsono 1976).

Types of Rain include:

1. Convective Rain Orographic
2. Rain
3. Cyclonic Rain

Rainfall is the amount of water that falls in a certain period of time. Measurement of rainfall is carried out in units of height above the horizontal ground surface which is assumed to not occur evaporation or infiltration, run off, or evaporation.

Measurement of rainfall is carried out using a rainfall gauge. There are 2 (two) types of tools used in observing rainfall, namely:

1. Rain Gauge (OBS)
2. Automatic Rain Gauge

a. Type Automatic Rain Gauge Hellman
b. Rain Gauge Type Tipping Bucket

Kali Progo is a river that flows through Central Java and Yogyakarta Special Region. In DI Yogyakarta, this river is the natural boundary of Kulon Progo Regency with Sleman and Bantul Regencies. The following is the progo river data:

Long	: 140 km
Source	: Mount Sindoro
Muara	: Indian Ocean
Basin size	:
Total watershed area	= 2,380 km^2 (920 sq mi)
Watershed area of Yogyakarta	= 709.1 km^2

Figure 1 Progo Watershed Plan for Yogyakarta Region

From the data obtained from the Serayu-Opak River Basin, in the Progo River Basin for the Yogyakarta region there are 8 rain stations that are still active in recording rain data. However, the data is not always presented with galangal because sometimes there is damage to the equipment. So it is necessary to evaluate the need for rain stations in the Progo watershed area for Yogyakarta in order to obtain complete rainfall data. And also the placement pattern of rain stations also affects the rainfall data obtained, considering that one tool must have a maximum coverage. So that it can cause the rain data to be inaccurate.

2. Methodology

Rainfall data and location of rain stations are obtained from the Serayu-Opak River Basin, which covers the Progo Watershed. The researched Progo watershed is only in the Yogyakarta area. From these data,

calculation analysis can be done to obtain the needs and the required placement pattern of rain stations, namely the Kagan-Rodda method.

From the BBWS data, data on the coordinates of the existing rain station points will be obtained. This becomes an evaluation material in determining the coverage area of an existing rain station.

Rainfall data obtained from BBWS is the daily rainfall data recorded by the rain station. So that the data is processed and then the average annual rainfall value is obtained in the calculation.

The choice of the approach method for the average rainfall in a river basin area (DAS) can be determined by considering the following factors (Dr. Ir . Suripin 2004).

1. Post rain gauge nets in the watershed, namely:
   a. If there is enough rain gauge, the average method, Isohyet or Polygon Thiessen can be used;
   b. If the rain gauge is limited, use Thiessen's mean and Polygon methods;
   c. If only a single rain gauge post, then use the rain point method.
2. Watershed Area
   a. Large watersheds (> 5000 km2), with the Isohyet Method;
   b. Medium watershed (500 - 5000 km2), with the Thiessen Polygon Method;
   c. Small watershed, (< 500 km2), with the algebraic mean method.
3. Watershed Topography
   a. Mountain areas, with the Algebra Average Method;
   b. Plains, with the Thiessen Polygon Method;
   c. Illy and irregular areas, with the Isohyet Method.

Then selected the method with a watershed area. Where the area of the Progo watershed for the Yogyakarta region is 709.1 km^2 , the method used in determining the average rainfall is the Thiessen Polygon method.

Then, Kagan Rodda's calculations will be carried out to get the needs and patterns of placing rain stations.

2.1. Kagan-Rodda Method

Determining the rain station network is not only limited to determining the number of rain stations required in a watershed, but also the location and distribution pattern. Information about rain conditions in a watershed (DAS) can be obtained by installing a rain gauge. The rain station network has a very important function, namely to reduce the variability of the magnitude of events or reduce uncertainty and increase understanding of measured and interpolated quantities (Harto s. 1993). WMO (World Meteorological Organization) states that in tropical areas such as Indonesia, a minimum network density of 100-250 km^2 of rain stations is required for normal conditions.

For physically difficult conditions, a density of 250-1000 km2 is recommended. Narayanan in 1962 (Harto s. 1993) determined the method of placing a rain station by connecting the network density and statistical rainfall data. Themethod joint mapping technique is to apply the hydrological network relationship with the standard error of estimate which is then used to determine the density of the hydrological network with a certain level of accuracy (Solomon 1972). Meanwhile, the method of determining the rain network has the final result in the form of the number of rain stations, the distance between stations, and the distribution pattern in the form of an equilateral triangle (Rodda 1967).

The World Meteorological Organization or WMO (World Meteorological Organization) recommends the minimum density of rain station networks as follows:

Table 1 Minimum Density of Rain Station Network WMO Recommendation

No	Type	Area (km2) per One Post	
		Normal	Difficult Conditions
1	Regional tropical plains and moderate Mediterranean	600-900	3000-9000
2	Mediterranean and tropical mountainous terrain was	100-250	1000-5000
3	Mountainous region mediterranean tropical and being	140-300	
4	Arid Region and the poles	1500-10000	

Source: (Linsley, Kohler, & Paulhus, 1986)

Qualitative guidance is given by Rodda (1967), namely by utilizing the rainfall correlation coefficient (Harto s. 1993). Determination of a rain station network is not only limited to determining the number of stations required in a watershed, but also the location and distribution pattern of rain stations within the relevant watershed. In the research conducted by Pulau Madura, (2018), for tropical areas where local rainfall with a

very limited spread area has a variety of spaces for rain with certain periods, it is very uncertain even though it actually shows a relationship to some degree (Harto s. 1993).

Steps :

1. Data collection
2. Calculation of the maximum annual daily bulk at each station
3. Determination of the area covered by each station using the Thiessen polygon method, then the thiessen average rainfall value is obtained with the formula:

$$R = \frac{A_1R_1 + A_2R_2 + \ldots + A_nR_n}{A_1 + A_2 + A_3 + \ldots + A_n}$$

4. Measuring the distance between stations and determining the correlation value. The correlation value is obtained by making a graph of the rainfall relationship between stations.
5. Creating an exponential graph of the relationship between distance and correlation, which will then obtain the parameter for the Kagan-Rodda calculation, namely the correlation coefficient ($r_{(0)}$) and correlation radius ($d_{(0)}$)
6. Determine the mean value of the average CH value of each station (X), Standard Deviation (Sd), and Coefficient of Variation (Cv) where $Cv = \frac{Sd}{X}$
7. From the parameters that have been obtained, then proceed to analyze the interpolation error (Z2), the average error (Z1) and the distance between stations as well as the ideal number of stations available based on the error rate.

$$Z1 = Cv\sqrt{\frac{\left[1 - r(0) + \left(0.23\frac{\sqrt{A}}{(d(0)\sqrt{n})}\right)\right]}{n}}$$

$$Z2 = Cv\sqrt{\frac{1}{3}\left[1 - r(0)\right] + 0.52\frac{r(0)}{d(0)}\sqrt{\frac{A}{n}}}$$

8. The value of Z1 is used to determine the value of L, where L is the value of the distance to create a Kagan-Rodda net. Furthermore, these nets serve as the basis for determining the placement pattern and requirements of the rain station based on the Kagan-Rodda recommendation.

3. Result and Discussion

3.1. Analysis of The Maximum Daily

The rainfall data used is the data obtained from the Serayu Opak River Basin, Yogyakarta. There are 8 stations rainfall in Progo watershed for the region of Yogyakarta in Yogyakarta watershed area of 709.1 km^2. The data obtained is daily rainfall data which is then taken the maximum annual rainfall data which is presented in the following table:

Table 2 Annual Maximum Daily Rainfall Data (mm)

No.	Year	Maximum Annual Daily Rainfall (mm)
1	2009	72
2	2010	97,1
3	2011	93,8
4	2012	130,6
5	2013	129,3
6	2014	100,6
7	2015	121,0
8	2016	139,8
9	2017	211,6
10	2018	98,7

Source: Data in Research, 2020

The Thiessen polygon method was chosen because the area of the Progo watershed in the Yogyakarta area is 709.1 Km^2 > 500 Km^2 in the hydrological analysis. To calculate the Thiessen Average Rainfall, the coverage area of each rain station must be found. The area is calculated using autoCAD.

Draw an area map using the Thiessen Polygon method

Figure 2 Area Map Using The Thiessen Polygon Method

Based on Figure 2 above which has been adjusted to the coordinates of the rain station, the results of the area analysis are as follows:

Table 3 Data on The Area of The Rain Station

Post CH Station	y	x	Area (Ha)	Area (Km^2)
Kalibawang	-7.091716	110.684722	14 680	146.8
Godean	-7.73425	110.30107	13 050	130.5
Kenteng	-7.76159	110.19672	11950	119.5
Kalijoho	-7.82217	110.23751	6120	61.2
Display	-7.8391	110.27467	6970	69.7
Gembongan	-7.85697	110.21126	6400	64
Brosot	-7.94022	110.23313	9500	95
Sanden	-7.95394	110.26765	2240	22.4
		Total Size	70 910	709.1

Source: Data in Research, 2020

It can The average rainfall data is obtained by calculating the Thiessen polygon as follows:

$$R = \frac{A_1R_1 + A_2R_2 + \ldots + A_nR_n}{A_1 + A_2 + A_3 + \ldots + A_n}$$

Table 4 Calculation of CH 3 Average Thiessen

No	Year	Pos/Rainfall station								Average of CH Thiessen
		Kalibawang	Godean	Kenteng	Kalijoho	Pajangan	Gembongan	Brosot	Sanden	
		146.80	130.50	119.50	61.20	69.70	64.00	95.00	22.40	
1	2009	100.0	0.0	68.0	68.3	120.5	121.0	98.0	0.0	44694.81
2	2010	95.0	0.0	67.0	132.0	55.0	132.0	143.0	153.0	47454.23
3	2011	82.0	109.0	54.0	109.0	62.3	104.0	93.0	137.0	52567.54
4	2012	150.0	106.0	95.0	115.0	111.9	85.0	124.0	258.0	73831.08
5	2013	93.0	79.0	170.0	140.0	87.5	150.0	165.0	150.0	74623.39
6	2014	85.0	103.5	88.0	76.0	55.0	97.0	160.0	140.0	60189.87
7	2015	93.0	80.8	81.0	127.0	95.0	180.0	122.0	189.0	59866.17
8	2016	100.0	118.5	147.0	120.0	94.5	207.0	158.0	173.0	76656.86
9	2017	93.0	125.0	163.0	343.0	339.0	148.0	214.0	268.0	114401.77
10	2018	90.0	154.5	77.0	97.0	97.0	38.0	118.0	118.0	66486.78

Source: Data in research, 2020

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Distance Between Stations And Correlation Coefficient

From the available rain station data, it can be found the distance between rain stations and the correlation coefficient between these stations. Measurement of the distance between stations was carried out using AutoCAD and the correlation coefficient was searched using rainfall data. From the two data, a regression graph of the relationship between monthly rainfall data is made between the two stations. The following is an example of correlation calculation obtained from the graph

Table 5 Rainfall Data

Station	Rainfall											
Kalibawang	69	59.2	63.1	62.5	45.7	30.4	24.2	9.9	23.9	34.1	69.7	83.8
Godean	41.74	53.7	34.94	33.99	33.15	16.8	12.83	1.51	8.53	26.2	71.93	44.65

Source: Data in research, 2020

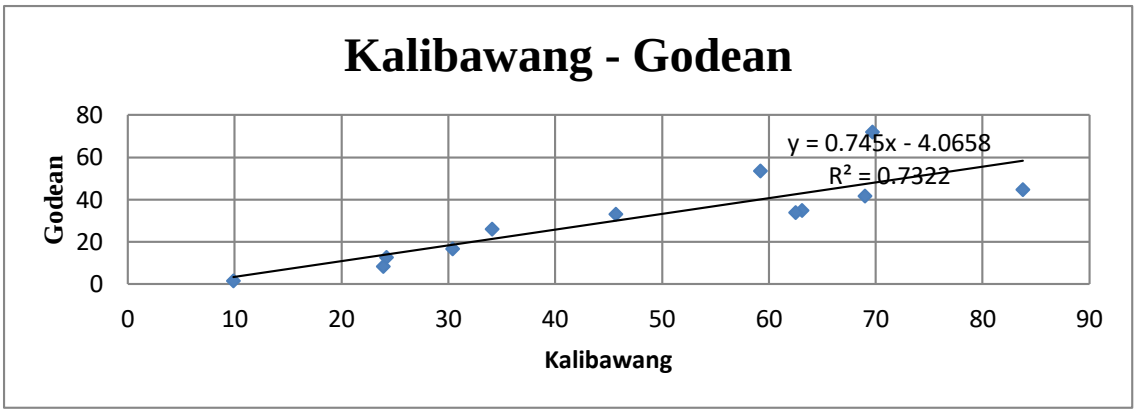

Figure 3 Graph Correlation between Kalibawang Station to Station Godean

From reading the chart above correlation values of $R^2 = 0.7322$. Correlation grafic phing was then continued for all stations, and the results can be presented in the following table:

Table 6 Calculation of Distance Between Stations and Correlation

Rainfall Station	Kalibawang	Godean	Kenteng	Kalijoho	Pajangan	Gembongan	Brosot	Sanden
Kalibawang	0.000	27.540	37.960	51.940	63.920	65.640	93.440	103.57
korelasi		0.732	0.860	0.883	0.875	0.918	0.947	0.910
Godean		0.000	38.400	33.510	40.840	46.990	71.950	80.13
korelasi			0.807	0.846	0.871	0.801	0.631	0.788
Kenteng			0.000	29.690	45.380	39.110	66.770	79.69
korelasi				0.809	0.872	0.907	0.790	0.7653
Kalijoho				0.000	15.680	13.900	41.570	52.61
korelasi					0.940	0.794	0.894	0.9113
Pajangan					0.000	14.010	31.440	39.77
korelasi						0.879	0.833	0.8721
Gembongan						0.000	28.330	40.65
korelasi							0.785	0.8648
Brosot							0.000	14.31
korelasi								0.8608
Sanden								0.000

Source: Data in Research, 2020

From making a graph of the distance relationship between stations, the correlation value is obtained. The next step is to make an exponential graph of the relationship between distance and correlation to obtain the correlation coefficient ($r_{(0)}$) and correlation radius ($d_{(0)}$).

The next step is to find the coefficient of variation (Cv).

Table 7 Calculation of Coefficient of Variation (Cv)

o	Year	CH	Average of X	Sd	Cv
	2009	20	44694.811	67077.2501	20083.96	0.2994
	2010	7	47454.2331			
	2011	4	52567.5377			
	2012	5	73831.0800			
	2013	20	74623.3884			
	2014	1	60189.8725			
	2015	8	59866.1703			
	2016	6	76656.8649			
	2017	9	114401.765			
0	18	4	66486.7775			

Source: Data in Research, 2020

Where:
X = Average of All CH Mean
Sd = Standard Deviation

$$Cv = \frac{Sd}{X} = \frac{20083,96}{67077,2501} = 0,299415$$

From the parameters that have been obtained from the above calculations, an analysis of the existing rain post network in the Progo River Basin is carried out in Yogyakarta. The analysis carried out includes the interpolation error, the average error and the distance between the posts as well as the ideal number of posts available based on the error rate. Here is the calculation:

$$Z1 = Cv\sqrt{\frac{\left[1 - r(0) + \left(0.23\frac{\sqrt{A}}{(d(0)\sqrt{n})}\right)\right]}{n}}$$

$$Z2 = Cv\sqrt{\frac{1}{3}[1 - r(0)] + 0.52\frac{r(0)}{d(0)}\sqrt{\frac{A}{n}}}$$

Table 8 Calculation of Interpolation Error Analysis

n	Cv	r(0)	A (Km^2)	d(0)	$\sqrt{A}$	$\sqrt{n}$	$\sqrt{\frac{A}{n}}$	Z_1 (%)	Z_2 (%)
1	0.299	0.845	709.100	-11111.11111	26.6	1.000	26.629	11.77	6.74
2	0.299	0.845	709.100	-11111.11111	26.6	1.414	18.829	8.32	6.76
3	0.299	0.845	709.100	-11111.11111	26.6	1.732	15.374	6.80	6.77
4	0.299	0.845	709.100	-11111.11111	26.6	2.000	13.314	5.89	6.77
5	0.299	0.845	709.100	-11111.11111	26.6	2.236	11.909	5.27	6.77
6	0.299	0.845	709.100	-11111.11111	26.6	2.449	10.871	4.81	6.78
7	0.299	0.845	709.100	-11111.11111	26.6	2.646	10.065	4.45	6.78
8	0.299	0.845	709.100	-11111.11111	26.6	2.828	9.415	4.17	6.78

Source: Data in Research, 2020

Based on the above, the acquisition count of the amount of rainfall in the watershed tasiun Progo, Yogyakarta as many as eight stations with average error value - average (Z_1) exceeds 5% there are 5 stations. Next is to make a equilater tringle net with the distance between the rain stations is L. Where the value of L can be obtained from the following calculations:

$$L = 1.07\sqrt{\frac{A}{n}} = \sqrt{\frac{709,1}{5}} = 12,742\ km$$

Which is then drawn on the map of the Progo watershed according to the distance L that has been obtained to determine the distribution of rain stations / posts on the Kagan Rodda network. The following is presented in the following image.

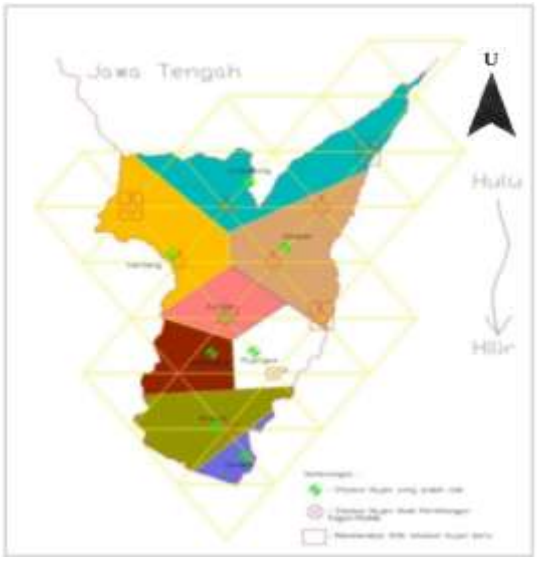

Figure 4 Rain Station Network Map Recommended by Kagan Rodda

From the calculation and manufacture of the Kagan-Rodda nets, 11 rain station points should have been installed with an L value of 12.742 Km. There are 8 existing and installed rain stations, so it is advisable to add 3 new rain stations according to the recommendations from the calculation results and the creation of the Kagan-Rodda nets, which are adjusted to the distance values that have been obtained and the existing ones from existing rain stations or installed.

4. Conclusion

Based on the results of the analysis and discussion in the previous chapter, the following conclusions can be drawn:

1. The results of the needs analysis and placement pattern using the Kagan Rodda method in the Progo Watershed in Yogyakarta, it is found that the Progo Yogyakarta watershed requires 11 rain stations.
2. The existing and installed network of rain stations are 8 stations, so it is necessary to add 3 new rain stations based on the map of the rain station network recommended by Kagan-Rodda with a side length of triangle (L) = 12,742 km.

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Analysis of Bekasi River to Flood in Pondok Gede Permai Housing

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Abstract

The Bekasi River flow that crosses Pondok Gede Permai Housing is a river network that flows in the housing of Pondok Gede Permai. With a good river flow system, economical and as needed from housing, the passing water flow is expected to flow smoothly according to the dimensions that have been taken into account. The methodology done in this research is a descriptive analysis of evaluative is a method that evaluates the objective conditions in a situation that becomes the object of research and the object of the study, the flow of rivers surrounding the housing Pondok Gede Permai. From the results of this research can be concluded that the cause of flooding in Pondok Gede Permai housing is caused by the confluence of two currents between the Cikeas river flow and the Cileungsi River. And also because of the widespread water from the river Cikeas to the Bekasi River, and because the meeting between the two rivers of Bekasi and Sunagi Cikeas are very small.

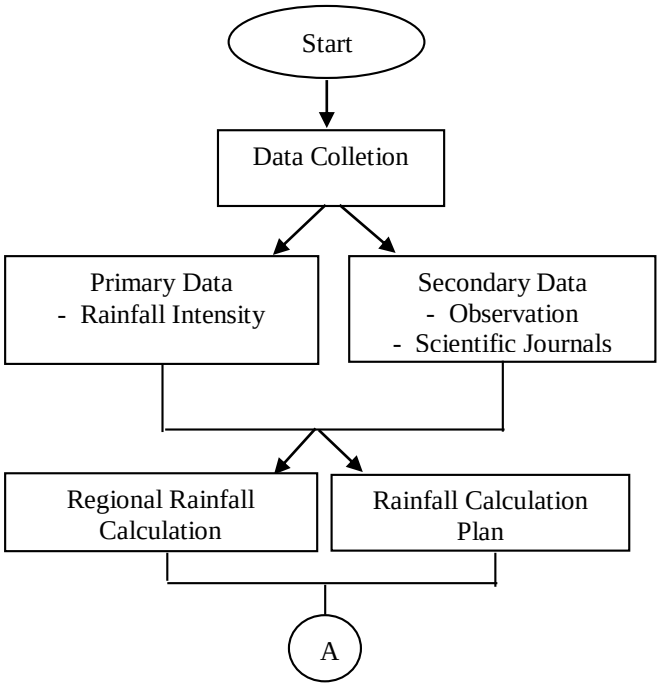
Keywords
Floods, Hydrology, River Flow

1. Introduction

The change in soil form into housing in one residential area leads to increased soil coefficient and decreased recation rate, because water that does not sink into the ground properly will go to ground level and flood. The Bekasi River flow that crosses the house of Pondok Gede Permai is a river network that flows in the housing of Pondok Gede Permai. With a good river flow system, economical and as needed from housing, the passing water flow is expected to flow smoothly according to the dimensions that have been taken into account (Azwarman, 2017).

2. Methodology

In this research methodology is used in literature study methodology which is a series of activities related to data collection methods, reading and recording. And the processing of research materials.



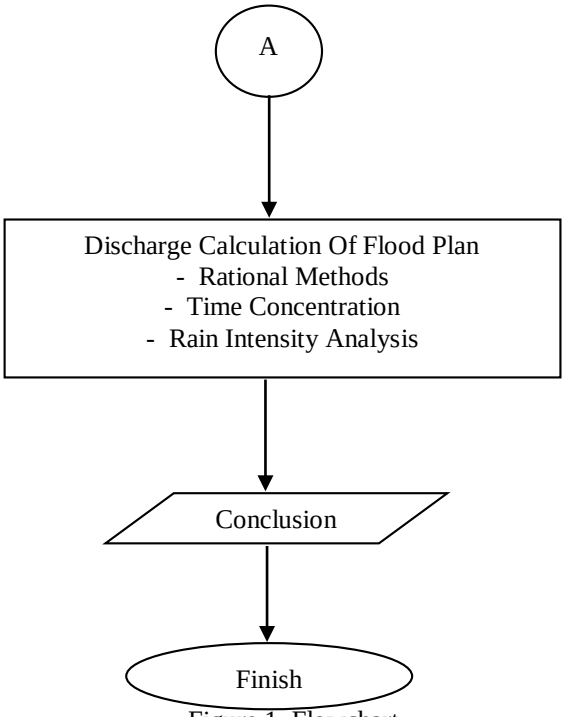


Figure 1. Flowchart

3. Result and Analysis

The intensity of rainfall is the magnitude of the amount of rain that is expressed in high rainfall or the volume of rain per unit of tim (Novatrianto, Anwar and Prasetyo, 2020). The amount of rain intensity is different, depending on the length of rainfall and frequency of occurrence. This research uses Dr. Mononobe's method to calculate the intesity of rainfall.

Table 1. Calculate The Intesity of Rainfall

t(jam)	R2	R5	R10	R25	R50	R100
	214,07	277,25	319,08	371,66	411,15	450,08
1	74,21	96,12	110,62	128,85	142,54	156,03
2	46,75	60,55	69,69	81,17	89,79	98,29
3	35,68	46,21	53,18	61,94	68,53	75,01
4	29,45	38,14	43,90	51,13	56,57	61,92
5	25,38	32,87	37,83	44,07	48,75	53,36
6	22,48	29,11	33,50	39,02	43,17	47,26
7	20,28	26,27	30,23	35,21	38,95	42,64
8	18,55	24,03	27,65	32,21	35,63	39,01
9	17,15	22,21	25,57	29,78	32,94	36,06
10	15,99	20,71	23,83	27,76	30,71	33,62
11	15,00	19,43	22,36	26,05	28,82	31,55
12	14,16	18,34	21,10	24,58	27,19	29,77
13	13,42	17,38	20,01	23,31	25,78	28,22
14	12,78	16,55	19,04	22,18	24,54	26,86
15	12,20	15,80	18,19	21,18	23,44	25,65
16	11,69	15,14	17,42	20,29	22,45	24,57
17	11,22	14,54	16,73	19,49	21,56	23,60
18	10,81	13,99	16,11	18,76	20,75	22,72
19	10,42	13,50	15,54	18,10	20,02	21,91
20	10,07	13,05	15,01	17,49	19,35	21,18
21	9,75	12,63	14,53	16,93	18,73	20,50
22	9,45	12,24	14,09	16,41	18,15	19,87
23	9,18	11,88	13,68	15,93	17,62	19,29
24	8,92	11,55	13,29	15,49	17,13	18,75

3.1 Calculation Method Nakayasu

One method that authors use in the calculation of flood discharge is the method Nekayasu. To get a flood discharge plan need to be searched for the charateristic or parameter on the stream area. The characteristic are :

1. Time period from the beginning of rain to the top of the hydrogaf
2. Time period of the heavy rain point until the heavy point of hydrogaf
3. Time period of hydrogaf
4. Area of the flush

5. Main river groove length

The Hydrogaf equation of the sinetic :

$$Q_p \frac{A.R_0}{3{,}6\ (0{,}3\ t_p + T_{0,3})}$$

Qp = discharge peak flood
R0 = rainy unit
Tp = time from the beginning of rain to the peak of floding
T0,3 = time required by the decrease in discharge, from the peak discharge to 30% of the peak debit.

The required parameters in the calculation are :

Characteristic DAS :	
Spacious DAS (A)	= 39.2 km2
Main river length (L)	= 20.6 km2
Coefficient characteristic DAS (α)	= 2
Effective Rainfall (Re)	= 1 mm/hour
Hydrograph parameters :	
Time concentration (Tg)	= 1.595 hour
The duration of rain standart (Tr)	= 1.196
Flood start time (Tp)	= 2.552
Flood reduction time (T0,3)	= 3.190
Top Debit (Qp)	= 2.753
Base Stream (Qp)	= 2.753

The calculation of Nakayasu Hydrograph unit

A. On the UP curve (0 < t < Tp)

Table 3.1. UP curve

t(jam)	Q (m3/s)
0	0,000
1	0,291
2	1,534
2,552	2,753

Source : Calculation Data

B. On the Down Curve (Tp < t < Tp + T0,3)

Tabel 3.2. Down Curve

t(jam)	Q (m3/s)
3	2,325
4	1,594
5	1,093
5,741	0,826

Source : Calculation Data

C. On the Down Curve (Tp+T0,3 < t < Tp + T0,3 + 1,5T0,3)

Tabel 3.3 Down curve (Tp+T0,3)

t(jam)	Q (m3/s)
6	0,7739
7	0,6017
8	0,4678
9	0,3638
10	0,2828
10,52568	0,2478

Source : calculation data

D. On the Down curve (t > Tp + T0,3 + 1,5T0,3)

Table 3.4. Down Curve (t>Tp)

t(jam)	Q (m3/s)
11	0,226564
12	0,187596
13	0,155331
14	0,128615
15	0,106494
16	0,088178
17	0,073012
18	0,060454
19	0,050056
20	0,041447
21	0,034318
22	0,028416
23	0,023529
24	0,019482

Source : Calculation Data

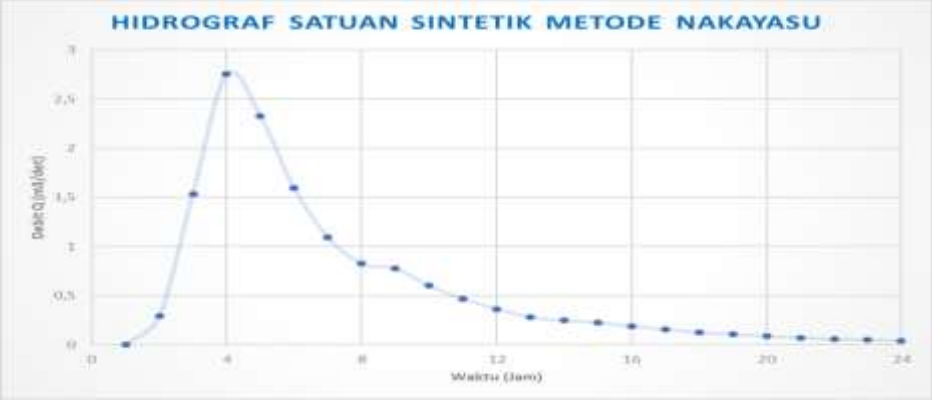


Figure 4. Hidrograf Satuan Sintetik Metode Nakayasu

3.2 Hec-Ras Modeling from The Above Calculations

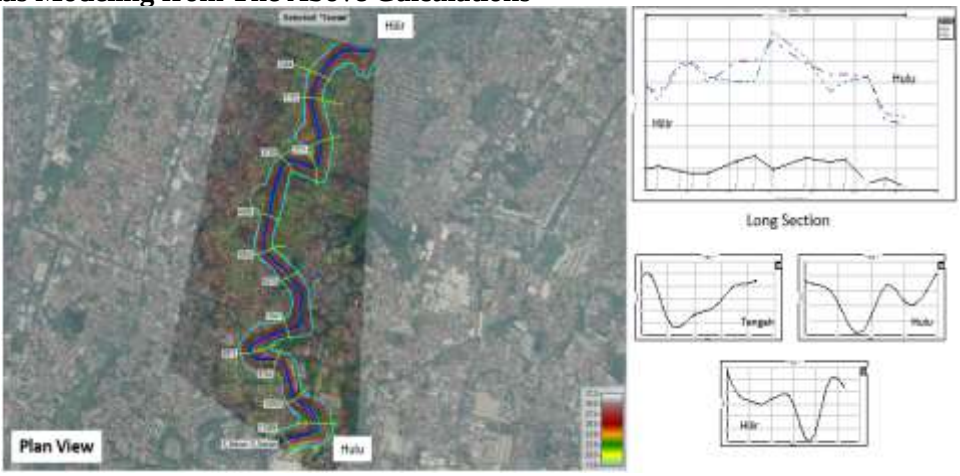


Figure 5. Plan View

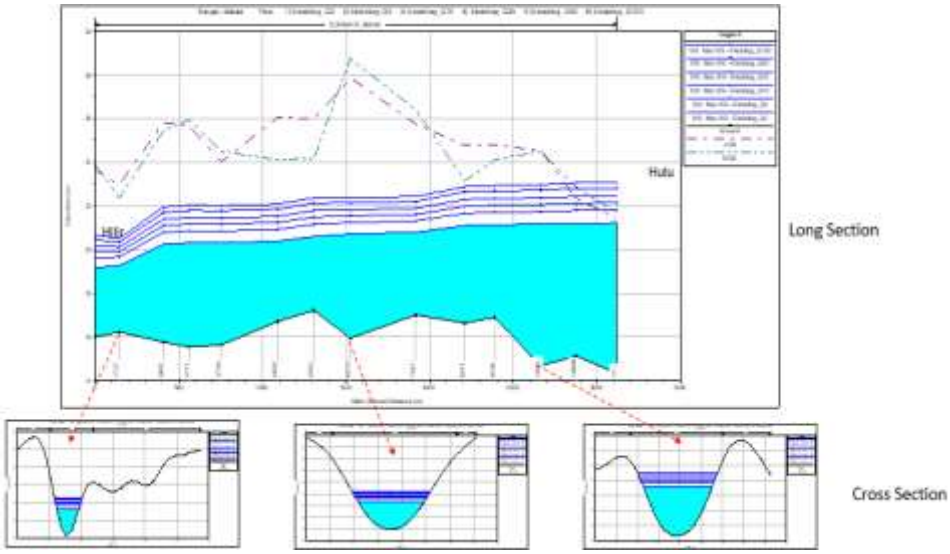


Figure 6. Long Section and Cross Section

4. Discussion and Conclusions

From the results of the analysis and discussion in the previous chapter, the following conclusions can be taken:

1. The cause of flooding in Pondok Gede Permai housing is caused by the confluence of two currents between the Cikeas river flow and the Cileungsi River. And also because of the widespread water from the river Cikeas to the Bekasi River.
2. Because the meeting between both Cikeas rivers and Bekasi River is very small.
3. To recapitulation the flood plan. Can be seen from the following table:

Table 4. Debit Maksimum

Periode T tahun	Debit Maksimum (m3/det)			
	Sub DAS Sungai Bekasi (Q3)		Sub DAS Sungai Cileungsi (Q3)	
	Nakayasu	ITB	Nakayasu	ITB
2	175,191	134,131	62,938	54,544
5	226,086	172,908	96,610	81,113
10	259,779	198,577	118,900	98,702
25	302,138	230,850	132,226	120,816
50	333,949	255,086	167,971	137,422
100	365,301	278,974	188,713	153,790

It can be concluded that the flood discharge period of 2 to 100 years is calculated using Nakayasu method is greater than count using the ITB method.

Advice:

1. The need for land acquisition efforts around the Bekasi River so there is no current barrier to the meeting of the Three rivers.
2. Need efforts from the government and local communities to realize times that are clean and environmentally friendly.

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Biography

Fakhri Jauhar Akbar Bima Putra is a student from Mercu Buana University in Bekasi with a Civil Engineering Studies program. Prior to majoring in civil engineering, at the previous level of high school, he majored in Natural Sciences at a private school in Bekasi, Sandikta. The writer graduated from high school in 2016 and then immediately continued his studies at Mercu Buana University in 2016. During his lectures, writers were active at various campus events such as creative evening events committees, Cultural seminar committees. For the smoothness in the department, as the committee of Civil Expo General 2019, as the organizer of the national transportation seminar event.

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Hydraulic Analysis of The Upper Segment of Cileungsi River, Bogor District Using Hecras 5.0.7 Program

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Abstract

Regional Flow of the River Cileungsi has extensive DAS 266 , 15 km^2 and a length of 39.11 km, crossing the district of Bogor and Bekasi. Downstream of the Cileungsi River is the Bekasi Hulu River which is the confluence of the Cileungsi River and Cikeas River . With the condition of land-use land DAS Cileungsi the first form forests changed into land estates and settlements led to discharge runoff were high and result in the occurrence of flooding in the summer rain . Flood prevention efforts are planned by making a dam . Analysis profiles flow conducted by using software HEC-RAS 5.0.7, Planning control flooding river Cileungsi using debit flood plan Q25th which amounted to 1271.45 m^3 / sec and Q50th which amounted to 1376.99 m^3 / sec. In the results of simulation of unsteady flow with HEC-RAS can be concluded that the control of flooding with the manufacture of a dam on the upstream river Cileungsi , already managed to overcome the flow of water excess in the upper reaches of the river

Keywords
DamKeywords, Flood, HEC-RAS

1. Introduction

1.1. Research Backgorund

Bogor Regency is one of the areas in West Java province that has relatively high rainfall and also has a very varied topography, which is a mountainous area in the south bordering Sukabumi and Cianjur regencies, to lowland areas in the north that borders with Tangerang Regency, South Tangerang City, Depok City, Bekasi Regency / City, because the high level of rainfall in the Bogor Regency area causes rivers in this area to have a high enough potential for water disasters in lowland areas.

One of the rivers in Bogor Regency that is prone to causing disasters is the Cileungsi river, which has an impact on flood disasters in Bekasi City, the Cileungsi river is the upstream of the Upper Bekasi river which is dammed by the Bekasi Dam, where if the flood occurs due to the discharge of water sent from the upper reaches of the Cileungsi River and the river Cikeas which is quite high.

The Cileungsi River is one of the rivers in the Bogor Regency area, which stretches across Bogor Regency in the north with a length of its main river 39.11 km from the district. Sukamakmur, which is located in Bogor Regency, until it empties at the Bekasi Dam. This river accommodates the flow of water from the Cileungsi watershed which has an average annual rainfall of less than 2,500 mm / year.

There are various problems encountered along the Cileungsi river flow. Among them are changes in the designation of protected forests and green open spaces around the Cikeas River and Cilungsi River converted into buildings, housing and industry, then in the upstream segment, there is no flood control building so that high water discharge causes flooding in the downstream segment, namely the Bogor and Bekasi border areas. Based on this, it is necessary to carry out an impact analysis of the construction of flood control facilities / infrastructure in the Cileungsi River to plan the appropriate treatment conditions.

1.2. Identification of Problem

Based on the above problems, problems that exist in the Cileungsi River can be identified, including:

1. There are no flood control facilities / infrastructure upstream, so that when the water discharge is high, it will cause flooding in the downstream area of the river.

2. Changes in the designation of protected forests and green open spaces around the Cikeas and Cilungsi River are converted into buildings, housing and industry, this has contributed to the increase in surface runoff, resulting in the existing river storage capacity being unable to accommodate flood discharge.

2. Literatur Riview

2.1. General Riview

Flood control is part of the management of water resources more specifically to control flood discharge, generally through flood control dams, or improvement of the carrier system (river, drainage) and prevention of potential damage by managing land use and flood plains. (Kodoatie, Robert.J., dan Roestam, 2005)

The implementation of this flood control effort is carried out by normalizing the river. Flood control planning is carried out as an effort to optimize channel capacity and minimize discharge through rivers and channels so that river water does not overflow at flood-prone points.

2.2. Hydrological Analysis

The hydrological analysis in this study is intended to estimate the magnitude of the design flood discharge with a certain return period in the observed area. The design discharge calculation is done by transferring the design rain to the design discharge. The steps for calculating the design discharge by transferring the design rain are as follows:

d. Calculating the mean watershed rainfall.
e. Perform design rainfall calculations , which will be calculated with a return period of 25 years and 50 years using the Log Pearson III distribution method.
f. Conducting a Distribution Suitability Test, using the Chi-Square and Smirnov Kolmogorov methods.
g. Perform design discharge calculations.

In the calculation of the flood discharge plan there are several methods / theoretical approaches, in this study using one method (Nakayasu) without having to compare the results of calculations using other methods. This is because in carrying out the hydraulic analysis, the amount of planned flood discharge will be used as input data to determine the modeling results with running unsteady flow mode.3. Results and Discussion

3. Research Methods

3.1. Study Area Location

Watershed Cileungsi is located between 106˚1 '- 107 ˚ 103' East Longitude and 6 ˚ 19 '- 6 ˚ 47' South Latitude with a watershed area of 266.15 Km2. The area that is passed by the Cileungsi River which has a length of 39.11 Km from downstream to upstream is Kec. Rawa Lumbu, Kec Bantar Gebang, Kec, Cileungsi, Kec. Gunung Putri, Kec. Klapa Nunggal, Kec Citeureup, and Kec. Sukamakmur located in Bogor Regency. And for this study it is located in one of the upstream segments of the Cileungsi River, namely in the area of Dayeuh Village, Cileungsi District.

3.2. Diagram Alir

In order for this research to be structured, the flow of thought in the research of the Cileungsi River Hydraulic Analysis with HEC-RAS 5.0.5 is shown in the flow image below:

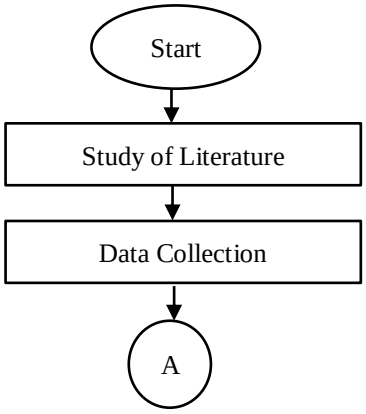

Figure 1. Flowchart

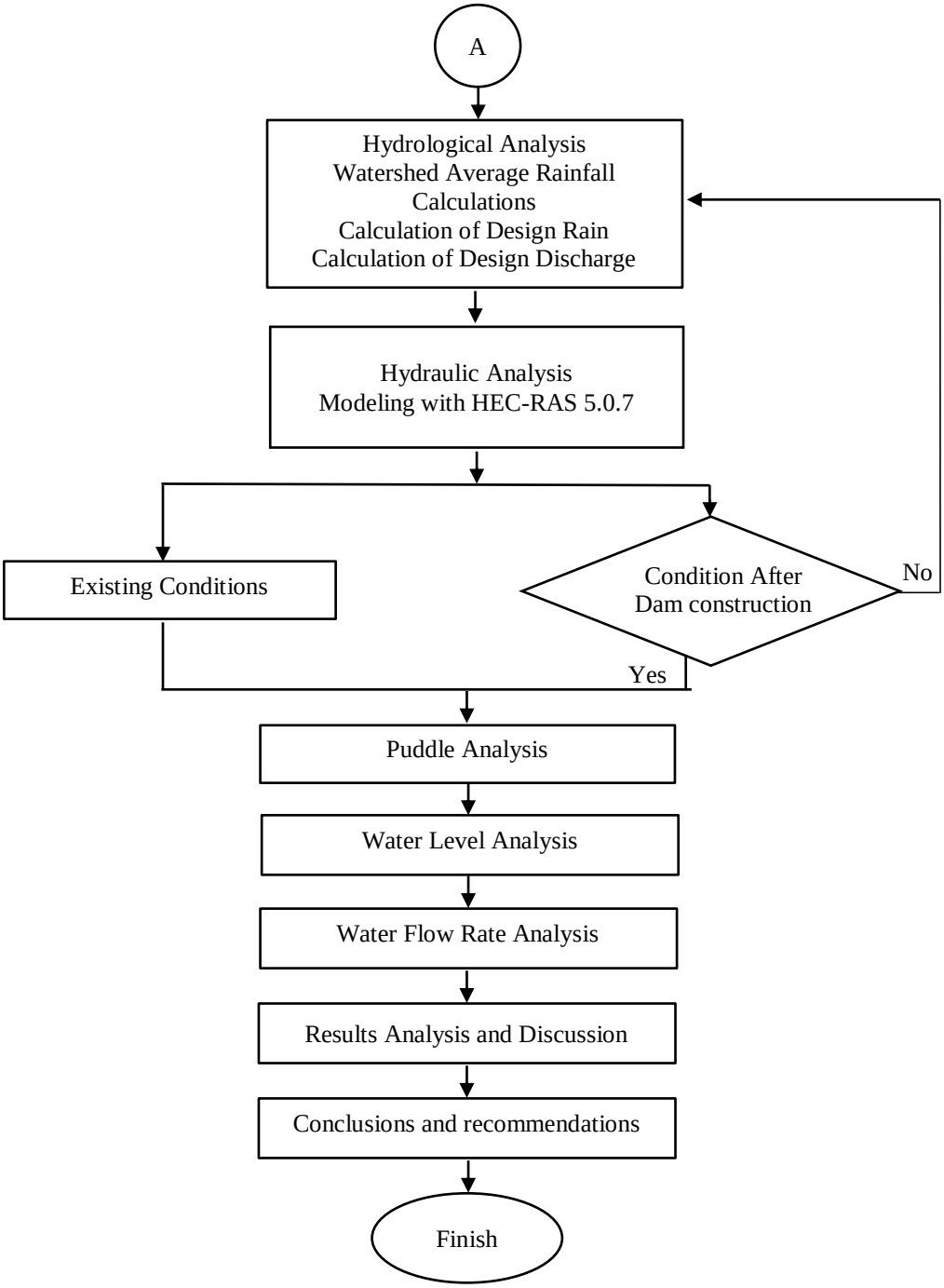

Figure 2. Flowchart

3.3. Necessary Data

In the preparation of this study, supporting data is needed, both primary and secondary data. In general, the data needed in this study are:

1. Topographic data rainfall data and watershed area are used to analyze the design flood discharge.
2. River characteristics data used to analyze the discharge flow of the Cileungsi River using HEC-RAS 5.0.7. In this analysis the authors used 2015 data.(Permatasari, A., Suprijanto, H., & Dermawan, 2015)

4. Results and Analysis

4.1. Hydrological Analysis

1. Calculation of Average Watershed Rainfall and Design Rainfall

Because in this study only rainfall data was obtained from one rain station, namely the Citeko Meteorological Station, from that station the maximum annual daily rainfall data were taken, without using the Thiessen Polygon method.

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Table 1. Frequency of Maximum Rainfall at Citeko Meteorological Station

Month	Year									
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
January	56	123	69	54	44	63	69	146	37	46
February	69	114	35	51	74	47	105	123	129	59
March	83	63	58	88	44	26	111	47	36	36
April	58	37	59	41	29	58	52	110	69	79
Mei	74	32	67	71	80	67	80	11	37	43
June	37	27	5	58	37	36	51	69	10	31
July	49	36	4	45	22	95	22	47	0	32
August	3	70	7	37	39	17	24	28	84	4
September	70	35	20	38	48	48	28	18	54	63
October	35	60	11	23	42	41	68	20	81	73
November	69	78	46	37	37	64	57	37	43	27
December	119	66	69	25	54	20	46	55	52	72
Xi (mm)	119	123	69	88	80	95	111	146	129	79

Source: Online Data BMKG

Furthermore, the calculation of the design rainfall with the Log-Pearson III distribution method, from the maximum rainfall data, the following calculation results are obtained.

Table 2. Pearson Type III Log Distribution.

No.	Xi	Log Xi	(Log Xi - average Log X)	(Log Xi - average Log X)^2	(Log Xi - average Log X)^3	(Log Xi - average Log X)^4
1	69.0000	1.8388	-0.1659	0.0275	-0.0046	0.0008
2	79.0000	1.8976	-0.1071	0.0115	-0.0012	0.0001
3	80.0000	1.9031	-0.1017	0.0103	-0.0011	0.0001
4	88.0000	1.9445	-0.0603	0.0036	-0.0002	0.0000
5	95.0000	1.9777	-0.0270	0.0007	0.0000	0.0000
6	111.0000	2.0453	0.0406	0.0016	0.0001	0.0000
7	119.0000	2.0755	0.0708	0.0050	0.0004	0.0000
8	123.0000	2.0899	0.0852	0.0073	0.0006	0.0001
9	129.0000	2.1106	0.1058	0.0112	0.0012	0.0001
10	146.0000	2.1644	0.1596	0.0255	0.0041	0.0006
Total	1039.0000	20.0475	0.0000	0.1043	-0.0008	0.0019

Log Average X = 2.0047
Standard Deviation (S . Log X) = 0.1076
CS = -0.0884
CK = -1.3082

Source: Calculation

2. Distribution Suitability Test

Table 3. Calculation of the Chi-Square Test for the Pearson Type III Log Distribution.

P(%)	Cs	G	Log X	X (mm)
20	-0.0884	0.8688	2.0983	125.3928
40	-0.0884	0.2964	2.0367	108.8057
60	-0.0884	-0.2815	1.9744	94.2854
80	-0.0884	-0.8649	1.9117	81.5927

Examination of the suitability test is dim aksudkan to know a truth frequency distribution hypothes

No.	Value Limit Sub Class				Amount of Data Oi	Amount of Data Ei	$(Oi - Ei)^2$	$(Oi - Ei)^2$ / Ei
1	X	<		81.593	3.000	2.000	1.000	0.500
2	81.593	<	X	< 94.285	1.000	2.000	1.000	0.500
3	94.285	<	X	< 108.806	1.000	2.000	1.000	0.500
4	108.806	<	X	< 125.393	3.000	2.000	1.000	0.500
5	X	>		125.393	2.000	2.000	0.000	0.000
	Jumlah :				10.000	10.000	4.000	2.000

Source: Calculation

The critical value for the Chi-Square distribution is obtained α = 5% and degrees of freedom DK = 5 - (2 + 1) = 2 For DK = 2 and α = 5% get X^2 count = 5.991, then X^2 count <X^2 table then Ho is accepted.

Table 4. Calculation of the Chi-Square Test for the Pearson Type III Log Distribution.

Year	X	Log X	G	M	S_n (X)	Pr	Px (X)	D I P_X (X) - S_n (X)
1995	69.00	1.839	-1.541	1.000	0.091	0.941	0.059	0.032
1996	79.000	1.898	-0.995	2.000	0.182	0.815	0.185	0.003
1997	80.000	1.903	-0.944	3.000	0.273	0.809	0.191	0.082
1998	88.000	1.944	-0.560	4.000	0.364	0.695	0.305	0.059
1999	95.000	1.978	-0.251	5.000	0.455	0.590	0.410	0.044
2000	111.000	2.045	0.377	6.000	0.545	0.374	0.626	0.080
2001	119.000	2.076	0.658	7.000	0.636	0.278	0.722	0.086
2002	123.000	2.090	0.791	8.000	0.727	0.232	0.768	0.040
2003	129.000	2.111	0.983	9.000	0.818	0.160	0.840	0.022
2004	146.000	2.164	1.483	10.000	0.909	-0.014	1.014	0.105
							D Maks.	0.1054

Log Average X	=	2.0047
Standard Deviation (S)	=	0.1076
D Max.	=	0.1054
N (Amount of Data)	=	10
α (Degree of Confidence)	=	5%
D Critical	=	0.4090

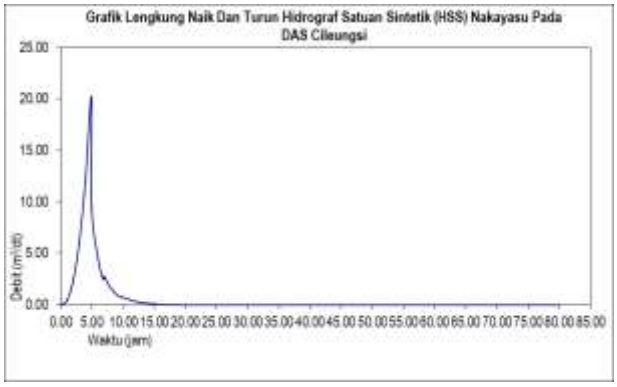
The calculation is carried out until the last data, then obtained Δ max of 0.1054 with N = 10 and the value of α = 5% from the table, it is obtained that Δ is critical of 0.4090. Since Δ max <Δ is critical, the equality of distribution is acceptable.

3. Debit Plan Calculation

The calculation of the planned flood discharge uses the Nakayasu synthetic hydrograph method.

River Data:

1. Koef. Flow (C) = 0.60
2. Length of the Main River (L) = 39.11 km
3. Watershed area (A) = 226.15 km^2
4. R0 = 1.00 mm (unit rain)



Source: Calculation

Figure 3. Up and down curve graph of Nakayasu synthetic hydrograph (HSS) in the Cileungsi watershed

Table 5. Design Flood Discharge.

No.	Return (Year)	Design Flood discharge (m^3/dtk)
1	2	831.7056
2	5	1028.9660
3	10	1147.6720
4	20	1249.9314
5	25	1271.4517
6	50	1376.9945
7	100	1465.5368

Source: Calculation

4.2. Hydraulics Analysis

1. HEC-RAS Model Simulation

HEC-RAS is an application program for modeling flow in rivers, the River Analysis System (RAS), created by the Hydrologic Engineering Center (HEC) which is a division within the Institute for Water Resources (IWR), under the US Army Corps of Engineers (USACE). HEC-RAS is a one-dimensional model of permanent and non-permanent flow (steady and unsteady one-dimensional flow model). The HEC-RAS has four components to the one-dimensional model:

1) Permanent flow water level profile count,
2) Non-permanent flow simulation,
3) sediment transport count, and
4) Water quality count.

One important element in HEC-RAS is that the four components use the same geometry data, the same hydraulic counting routine, and several hydraulic design features that can be accessed after a successful water level profile calculation. In this study, the HEC-RAS model simulation conducted is a flood model simulation.

2. Channel System Schematic

The schematization used in this modeling is limited to sections that have been surveyed for cross-sectional measurements, namely cross-sections and longitudinal sections. for this Hec-Ras modeling presented the Cileungsi River which has a length of 39.11 Km. from upstream to downstream, however in this modeling only 200 m long river is simulated. from the upstream, can be seen in Figure 4.2. on the CrCls peg. 388.

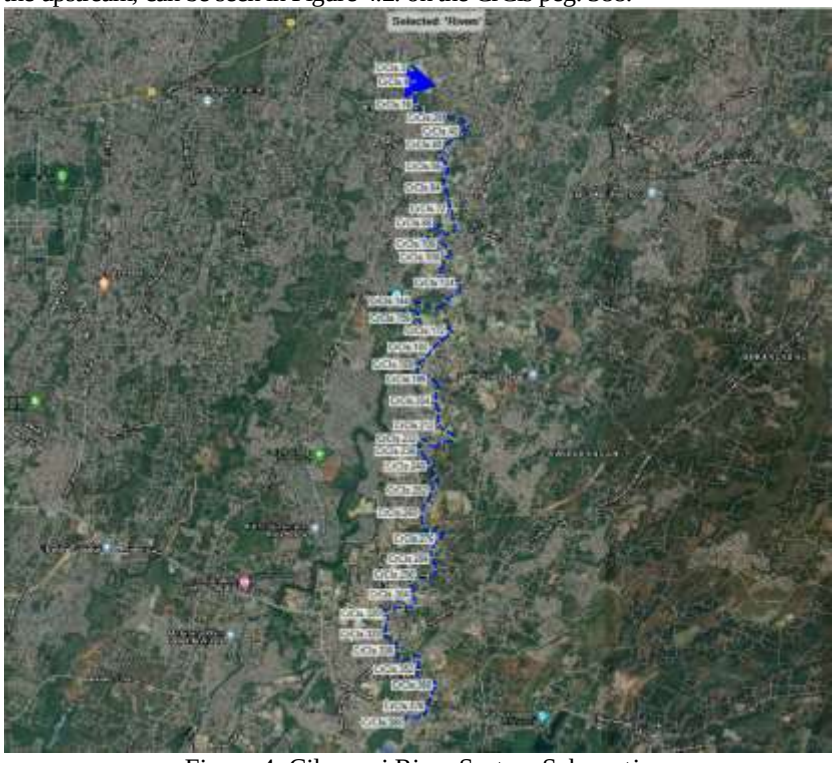


Figure 4. Cileungsi River System Schematic

3. Simulation Results of Existing Conditions and Conditions of The 25 Year Return Dam Plan

Flood simulation results using hydrograph loads for a 25 year return period in the existing conditions and conditions of the dam plan. From the simulation results of the Cilungsi River, it is concluded that for a 25 year return period in the existing conditions the water level upstream at a maximum condition reaches 40.89 m. and the water level downstream reaches 27.15 m. The water discharge in the existing condition reaches 23,030.28 m3, while with the dam the water level upstream at the maximum condition reaches 43.52 m. and the water level downstream reaches 24.41, the discharge is reduced by 666.07 m3 / s. However, the peak discharge time is shifted by 5 hours.

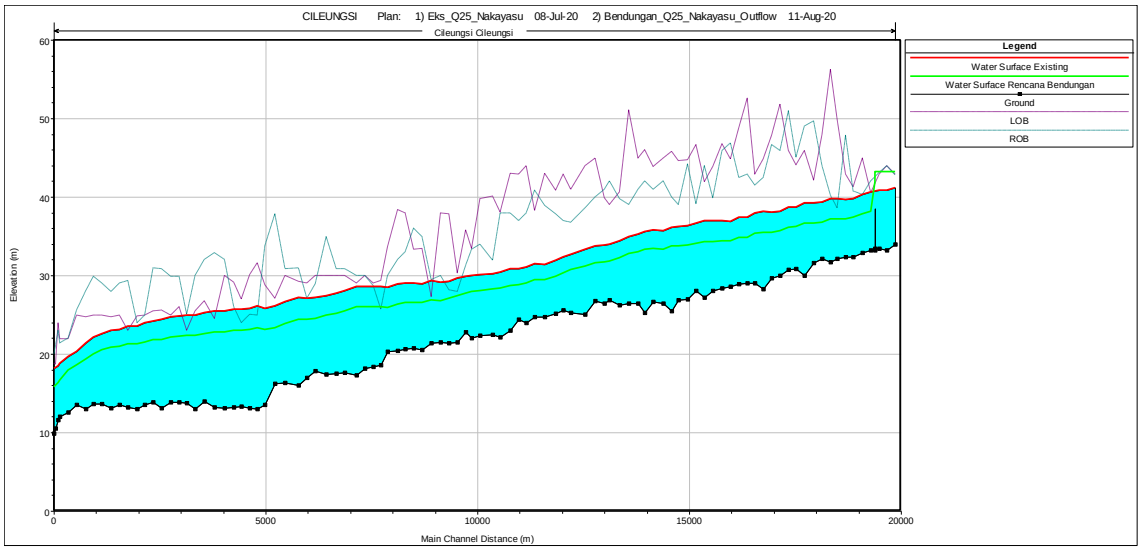


Figure 5. Results of Existing Running and Dam Plan Q25.

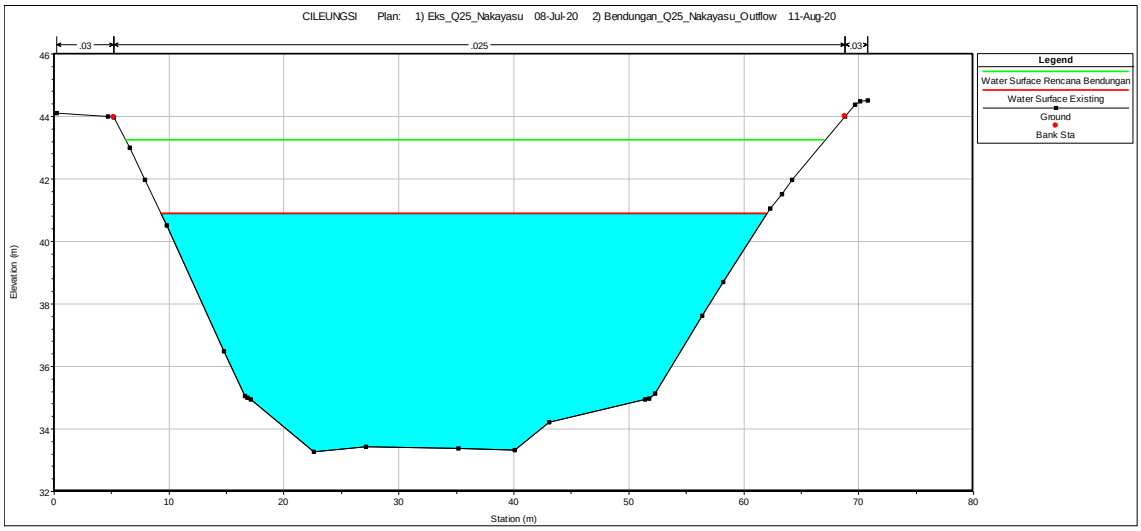


Figure 6. Results of Existing Running and Dam Plan Q25 (CrCls.384).

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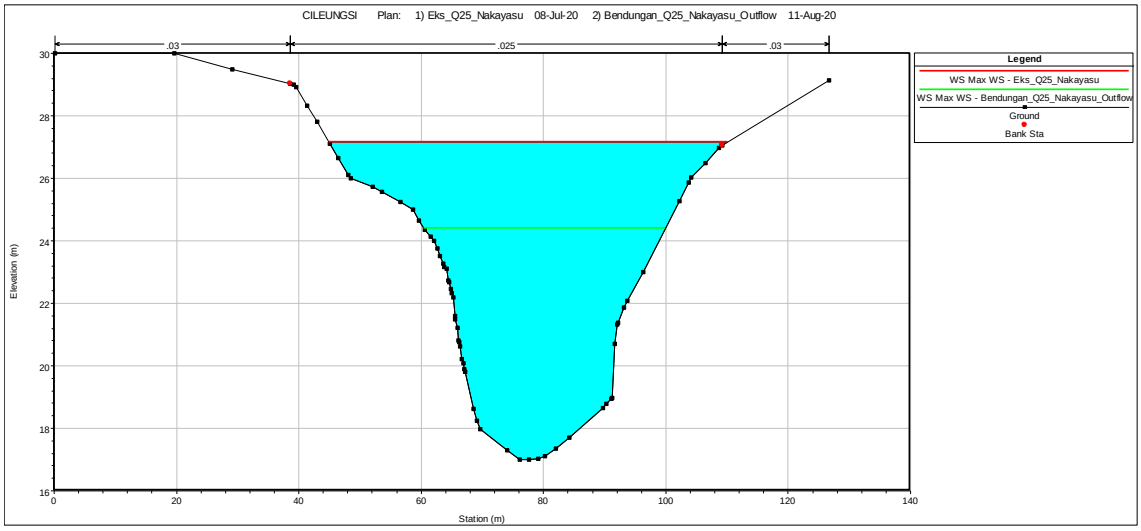

Figure 7. Existing Running Results and Q25 Dam Plan (CrCls.116).

4. Simulation Results of Existing Conditions and Conditions of the 50 Year Return Dam Plan

Flood simulation results using hydrograph loads for a 50 year return period in the existing conditions and conditions of the dam plan. From the simulation results of the Cilungsi River it was concluded that for a 50 year return period in the existing conditions, the water level upstream at a maximum condition reached 41.21 m. and the water level downstream reaches 27.54 m. The water discharge in the existing condition reaches 24,593.29 m3, while with the dam the water level upstream at the maximum condition reaches 43.82 m. and the water level downstream reaches 25.56, the discharge is reduced by 610.96 m3 / s. However, the peak discharge time is shifted by 5 hours.

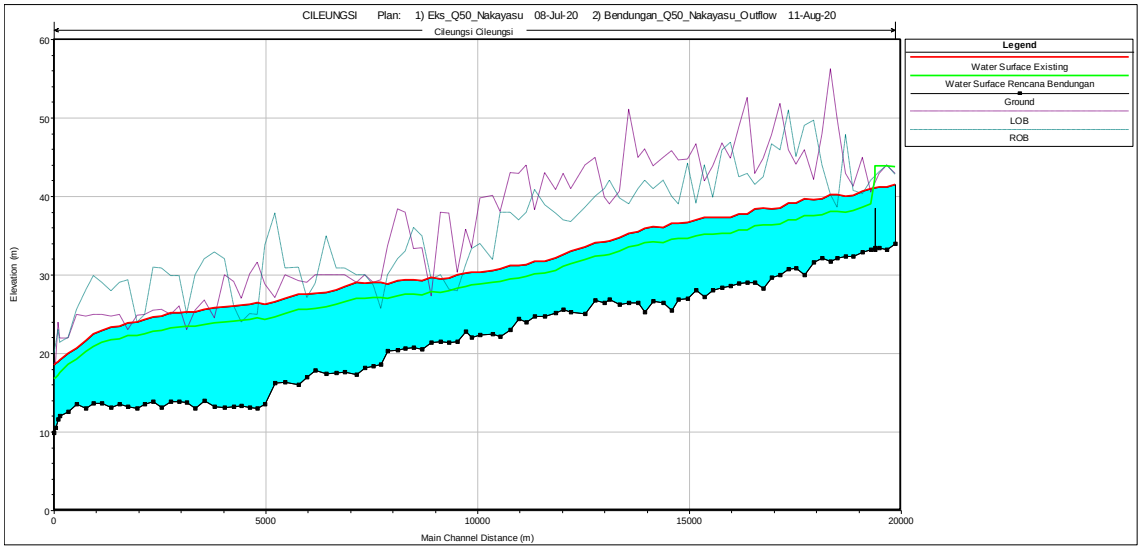

Figure 8. Running Results Ex isting and Dam Plan Q50.

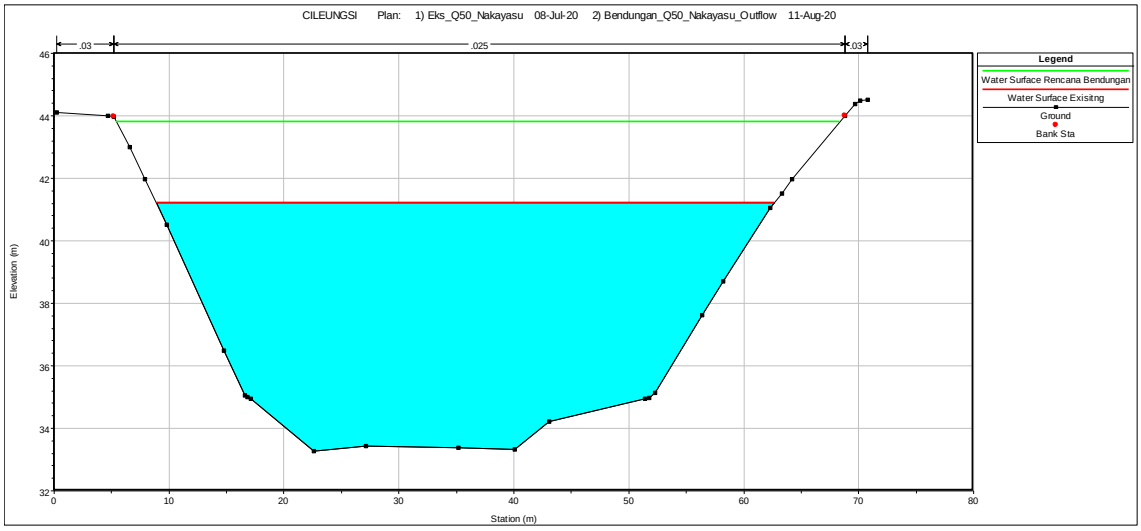

Figure 9. Results of Existing Running and Dam Plan Q50 (CrCls.384).

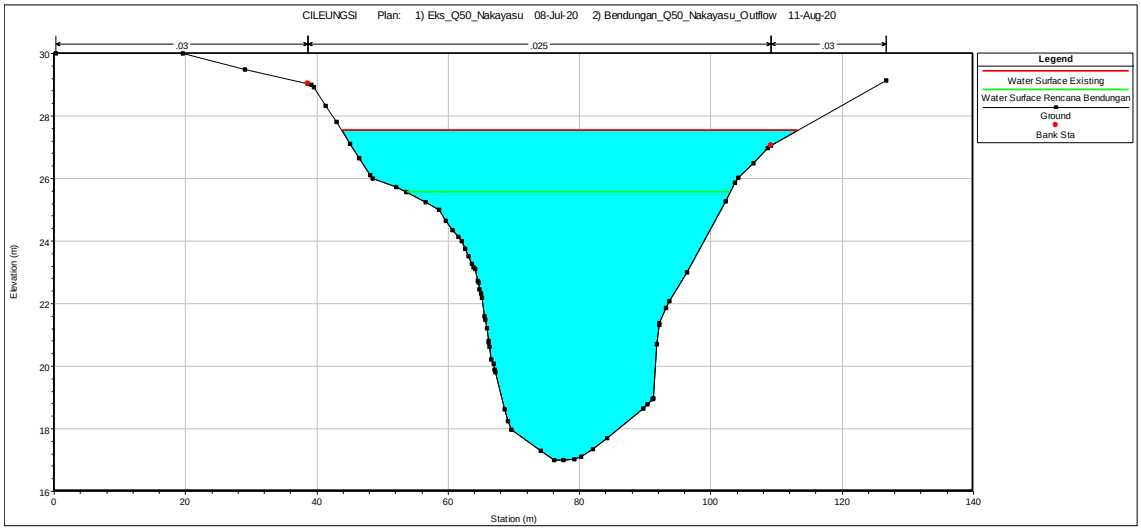

Figure 10. Existing Running Results and Dam Plan Q50 (CrCls.116).

5. Conclussion and Suggestions

Based on the results of calculations and analysis carried out in the previous chapter, several conclusions can be drawn as follows:

1. The results of the design flood discharge hydrological analysis using the Nakayasu Method on the Cileungsi River obtained a discharge of:
   831.71 m3 / s (2nd time),
   1,028.97 m3 / s (5th return),
   1,147.67 m3 / s (10th birthday),
   1,249.93 m3 / s (20th return),
   1,271.45 m3 / s (25th birthday),
   1,376.99 m3 / s (50th birthday),
   1,465.54 m3 / s (100th reset).
2. The flood prevention efforts on the Cileungsi River are planned in the form of building a dam in the upper reaches of the Cilungsi River, assuming the height of the dam is 40 m.
3. With the dam:
   a. at the flood discharge design Q25 year the water level upstream increased by an average of 2.25 m and the water level downstream decreased by an average of -2.41 m.
   b. at the flood discharge design Q50 year the water level upstream increased by an average of 2.49 m and the water level downstream decreased by an average of -1.84 m.
   c. In the existing conditions, the design flood discharge of Q25 in the Cileungsi River reached 1,261.47 m3 / s with the design flood discharge dam reduced to 595.4 m3 / sec.

d. in existing conditions with the design flood discharge Q50 in the Cileungsi River it reached 1,376.99 m3 / s with the design flood discharge dam reduced to 766.03 m3 / sec.

This means that the presence of a dam on the Cileungsi River is quite effective in overcoming flooding due to the too high water discharge in the downstream of the Cileungsi River.

1. In addition to the above conclusions, some suggestions can be made, including:
   In supporting efforts to control floods in the Cileungsi River, it is necessary to include efforts to protect and organize the river area. In view of the high population growth in the riverbank area, it is also necessary to have firmness from government officials and the community in managing residential areas, especially for settlements located along river boundaries, so that river bodies do not narrow.
2. Further studies are needed for flood management in the Cileungsi watershed by non-structural means that can be carried out by improving land use in the upstream area.

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Analysis of The Supporting Capacity of The Stake Foundation on Soekarno Hatta Airport Accessibility Project

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Abstract

The construction of a foundation is very large function in a construction. In general the foundation is defined as an underground building that passes on the load derived from the weight of the building itself and the outer load that works on the building to the surrounding land. The foundation of the stake is a relatively long and slim rod that is used to channel the foundation load through the soil layer with a low support capacity of hard soil layer that has a high carrying capacity that is relatively deep compared to the shallow foundation. The carrying capacity of the stake is derived from the end bearing capacity obtained from the pressure of the end of the pole and the friction bearing capacity obtained from the carrying capacity of the friction or adhesion force between the stake and the surrounding soil. This research uses an analytical research method in which in the calculation of the planning of the foundation of the stake using the calculation of the capacity of carrying capacity with the method of bagemann and mayerhoff. From the calculation of vertical style carrying capacity based on sondir data using bagemann method at the first stake point of 1059.50 kN and at the second point of 1015.95 kN, and the result of SPT data using mayerhoff method at the first stake point of 663.88 kN and at the second point of 498.76 kN. Qultimate single pole horizontal carrying capacity calculation of 216 kN, Single Qizin amounted to 72 kN, Group of 228 kN.The result of the calculation of vertical carrying capacity of the group stake is 734.1732 kN.The result of the calculation of tuggal pole reduction is 11.62 mm, The stake group is 10.77 mm, so the calculation result for the drop of a single pole is smaller than the permit drop which is smaller than 100mm.

Keywords :
Stake, Stake Carrying Capacity, Struktur Foundation Structure.

1. Introduction

The construction of a construction, first carried out and carried out in the field is the work of the foundation (bottom structure) and then carrying out the work of the upper structure. The construction of a foundation is very large function in a construction. In general the foundation is defined as an underground building that passes on the load derived from the weight of the building itself and the outer load that works on the building to the surrounding land.

The bottom structure as a foundation can also generally be divided into two types, namely shallow foundation and deep foundation. The selection of this type of foundation depends on the type of upper structure, whether it includes light load construction or heavy load and also the type of soil. For light load construction and surface soil layer conditions are quite good, usually the shallow foundation type is adequate. But for heavy load construction usually the type of deep foundation is an option, and in general the issue of deep foundation planning is more complicated than shallow foundations.

For this, the author tries to concentrate this Final Task on the deep foundation problem, namely the stake. The foundation of the stake is a relatively long and slim rod that is used to channel the foundation load through the soil layer with a low support capacity of hard soil layer that has a high carrying capacity that is relatively deep compared to the shallow foundation. The carrying capacity of the stake is derived from the end bearing capacity obtained from the pressure of the end of the pole and the friction bearing capacity obtained from the carrying capacity of the friction or adhesion force between the stake and the surrounding soil.

In general, stakes can be classified among others: in terms of materials there are reinforced stakes, pretekan stakes, steel stakes, and wooden stakes. In terms of cross-sectional spans, square-length poles, triangles, hexagons, solid rounds, pipes, letters H, letters I, and specific shapes. In terms of mounting techniques, it can be done with drop hammer, diesel hammer, and hydrolic hammer.

The stake interacts with the ground to produce a carrying capacity that is able to carry and provide security to the upper structure. To produce accurate carrying capacity, an accurate soil investigation is required

as well. There are two methods commonly used in determining the carrying capacity of the stake, namely by using static methods and dynamic methods (Tambunan, 2012).

Soil investigation using static methods is sondir investigation and standart penetration test (SPT). Sondir's investigation aims to determine the resistance of konus penetration and soil ration resistance which is indicative of the strength of the carrying capacity of the soil layer using empirical formulas.

Standardized penetration test (SPT) investigation aims to get an idea of soil layer based on soil type and color through visual observation, soil properties, soil characteristics. Standardized data penetration test (SPT) can be used to calculate carrying capacity (Princess, 2017).

The planning of the stake foundation includes a series of activities carried out with various stages including feasibility studies and technical planning. All of this is done to ensure the end result of a strong, safe and economical construction.

2. Methodology

The Analysis Method is a way of knowingtheu-turn to find the supporting capacity of the foundationsystemically, logically and empiris using the analysis method.So in this study the authors useda method of analysis.

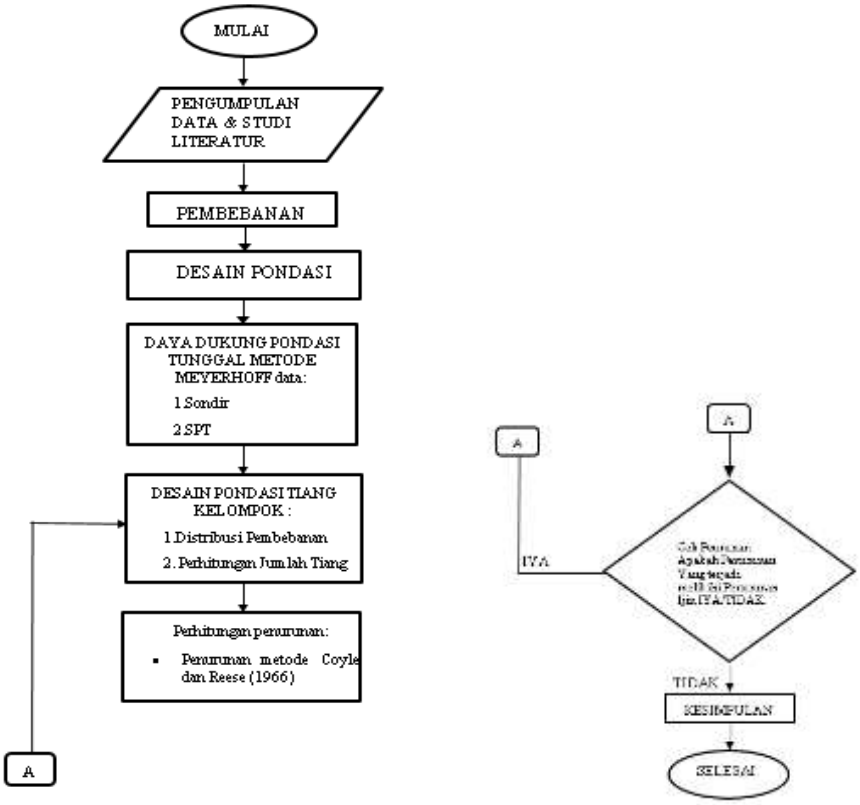

Figure1. Flowchart
Source : Processed Researcher

To review the calculation of stake foundation planning on the project, the authors obtained data among others obtained structural load data. From Sub Contractors is obtained in the form of data from sondir, SPT results, and structural drawings. The data is as follows:

1. Stake Length : 16 m
2. Poledimensions : D60cm
3. Concrete Quality Stake : fc'35
4. Steel Quality : fy' 35

3. Result and Discussion

3.1. Calculation of Stake Carrying Capacity From Sondir Data (Bagemann Method) Metode

a. Prisoner Tip

Table 1. Prisoner Tip

Diameter Tiang Pancang	D =	0,60	m
Panjang Tiang Pancang	L =	16,00	m
Kuat Tekan Beton Tiang Pancang	f_C'=	35	Mpa
Berat Beton Bertulang	w_c =	24	kN/m^3

Pb = w * Ab * qc : 0.50x0.2827x5300 : 749,270 kN (Titik Point S-1 and S-2)

b. Swipe Prisoner

Table 2. Swipe Prisoner

No	Kedalaman Z1 (m)	Kedalaman Z2 (m)	L_1 (m)	A_s (m^2)	Q_f (kN/m^2)	P_s (kN)
1	0,00	5,00	5,0	9,4248	6,00	56,55
2	5,00	10,00	5,0	9,4248	30,80	295,00
3	10,00	15,00	5,0	9,4248	55,40	522,13
4	15,00	16,00	1,0	1,8850	78,30	147,59
				$P_s = \sum [A_s{}^* q_f] =$		1016,56

Results at Point S-1
Titik S-2 Point Result

c. Stake Axial Prisoners
Nominal prisoner stake : Pn : Pb + Ps :749,270 + 1016.56 : 1765.83 kN
Φ strength reduction factor : 0.60

Table 3. Stake Axial Prisoner

No	Kedalaman Z1 (m)	Kedalaman Z2 (m)	L_1 (m)	A_s (m^2)	Q_f (kN/m^2)	P_s (kN)
1	0,00	5,00	5,0	9,4248	6,0	56,55
2	5,00	10,00	5,0	9,4248	31,30	295,00
3	10,00	15,00	5,0	9,4248	47,20	444,85
4	15,00	16,00	1,0	1,8850	78,30	147,59
				$P_s = \sum [A_s{}^* q_f] =$		943,99

Axial prisoner stake Φ x Pn : 1059.50 (Titik S-1 Point Result)
Nominal prisoner stake : Pn : Pb + Ps :749,270 + 943.99 : 1693.26 kN

Φ strength reduction factor : 0.60
Axial Titik prisoner stake Φ x Pn : 1015.95 kN (S-2 Point Result)

3.2. Calculation of Stake Carrying Capacity From N-SPT Data (Mayerhoff Method)

Table 4. Calculation of Stake

No	Kedalaman Z1 (m)	Kedalaman Z2 (m)	Nilai SPT N	L1 (m)	L1 * N
1	0,00	5,00	5	5,0	25,0
2	5,00	10,00	18	5,0	90,0
3	10,00	15,00	37	5,0	185,0
4	15,00	16,00	41	1,0	41,0
				16,0	341,0

Pn =: 40 x Nb x Ab + Ň x As =40 x 41 x 0.2827 + 21.31 x 30.1593 =1106.468 kN
Pn < = 380 x Ň x Ab = 380 x 21.31 x 0.2827 = 2289.87 kN
Stake nominal capacity : Pn = 1106,468 kN
Φ strength reduction factor = 0.60

Axial prisoner stake Φ x Pn = 663.88 kN (S-1 Point Result).

Table 5. Point Result

No	Kedalaman		Nilai SPT N	L1 (m)	L1 * N
	Z1 (m)	Z2 (m)			
1	0,00	5,00	4	5,0	20,0
2	5,00	10,00	10	5,0	50,0
3	10,00	15,00	28	5,0	140,0
4	15,00	16,00	33	1,0	33,0
				16,00	243,0

Pn =: 40 x Nb x Ab + Ň x As = 40 x 33 x 0.2827 + 15,19 x 30.1593 = 831,265 kN
Pn < = 380 x Ň x Ab = 380 x 15.19 x 0.2827 = 1631.78 kN
Stake nominal capacity : Pn = 831,265 kN
Φ strength reduction factor = 0.60
Axial prisoner stake Φ x Pn = 498.76 kN (S-2 Point Result).

3.3. Horizontal Carrying Capacity (Meotde Brooms)

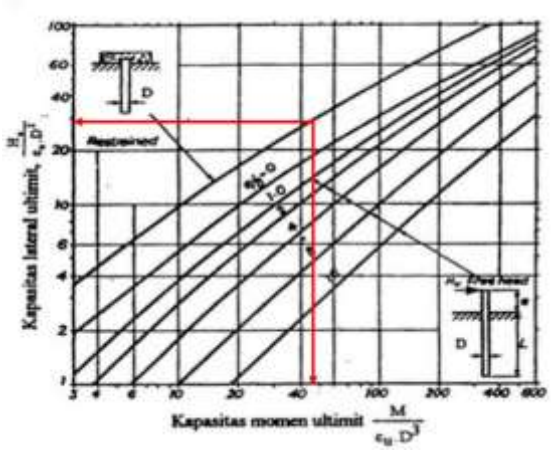

Figure 2. Horizontal Carrying

Hu = 15. Cu. D^2
Hu = 15 x 40 x 0.6^2
Hu = 216 *kN*
Hizin = 216 kN
3
Hizin = 72 kN or 7.2 tons

Based on the calculation results, the horizontal carrying capacity of the foundation's single pole permit is obtained.. izin

3.4. Calculate Stake Group Capacity Based on Efficiency

$$\text{Eg}: \frac{1-\theta}{90.m.n''}\ (n'-\square 1).m\ \square\ (m-1).n''$$

$$\text{Eg}: 1-13{,}495.\frac{(3-1).1\square\ (1-1).3}{90.1.3}$$

: 0,9

3.5. Calculating Horizontal Carrying Capacity of Pole Groups

Qhorizontal.group = n.Qhorizontal

Qhorizontal.group = 3 x 76 kN
Qhorizontal.group = 228 kN

3.6. Calculating Single Pole Drop (Poulus and Davis Method)

Io : 0.065
Rk : 1.3
Rμ :0.94
Rh : 0.28
Rb :0.65

a) For floating poles or friction poles

$I : I_o . R_k . R_h . R_\mu$
: 0.065 . 1,3 . 0,28 . 0.94
: 0,022
$S : \frac{Q.I}{Es.D}$
$: \frac{150778kg . 0.022}{159\ kg/cm^2 . 60cm}$
: 0.347 cm
: 3.47 mm

b) For the end of the support

$I : I_o . R_k . R_b . R_\mu$
: 0.065 . 1,3 . 0,65 . 0.94
: 0,0516
$S : \frac{Q. I}{Es.D}$
$: \frac{150778kg . 0.0516}{159\ kg/cm^2 . 60\ cm}$
: 0.815 cm 8.15 mm
Recap of The Decline Results..

Table 6.

No.	Form of decline	Pole drop (S)
1	For floating poles or friction poles For end support poles	3.47mm
2		8.15mm
	Estimated total decrease	m

3.7. Calculating The Drop Of The Group Pole

$Sg : \frac{q.Bg.I}{2.qc}$

Where:

$q : \frac{Q}{Lg.Bg}$
$: \frac{150778}{400 .300}$
: 1,256 kg/cm^2
$I : 1 - L \geq 0.5$
$\frac{}{8. Bg}$

: 1- $\frac{2500 \geq 0.5}{8.300}$

: 0.041 < 0.5

Then:

Sg : $\frac{q.Bg.I}{2.qc}$

Sg : $\frac{1,256,300.0,5}{2.53}$

: 1.77 cm

4. Conclusion

a. Based on the calculation results, then for the size of the vertical style that the foundation is able to accept is 2860.65 kN. While the size of the horizontal style that the foundation is capable of is 228 kN.

b. The results of the calculation of the reduction of a single pole and a pile group are:

Table 7. Single Pole and A Pile group

Single Pole Drop (mm)	Decline Pole Group (mm)	<Decrease in permits (mm)
11. 62, 2014 in New	10,77	65

From the above calculation results for the drop of a single pole is smaller than the decrease in permits so that it can be concluded the decrease is safe and qualified.

c. Differences in carrying capacity can be caused by different soil types and properties at even the closest distances that can affect the carrying capacity of the pole..

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Biography

Muhammad Wira Kaloka is a student from Mercubuana University Bekasi with civil engineering study program. Prior to majoring in civil engineering, at the previous level, SMK Negeri 1 Sukabumi,majoring in Building Drawing Engineering, penulis graduated from SMKN in 2016 in 2016 the author continued his education at Mercu Buana University Bekasi with a major in Civil Engineering, during which time the author had participated in seminar events as an event division. With this study the authors hope the research can be something of a learning and hope for further research can be well developed.

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Comparison Analysis of Conventional Method Floor Slabs With Half Slab Method Against Cost and Time of XYZ Project

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Abstract

Development in the infrastructure and construction sector in Indonesia has been growing from year to year both in terms of design and the system used. Some of these systems include conventional and precast (Half Slab) systems. Implementation of the conventional system is casting on site or it can be called Cast in situ, while the precast for the implementation of the production process is carried out in a special place, then taken to the project site (transportation) to be compiled into one intact structure. In the implementation of the conventional system there are several shortcomings, namely it takes a long time, is of poor quality and requires a lot of formwork and workers, resulting in a long implementation time. But behind these many shortcomings, of course, there are advantages, namely low implementation costs. In this research, the writer will compare the conventional floor slab system with the half slab floor plate on the bridge project as the object of this final project to compare the effect between the conventional system and the half slab on the project implementation cost requirements and the implementation period and the implementation method. The comparative analysis of the conventional method floor slab and the half slab method floor plate has obtained results. For the conventional method floor plate costs Rp. 2,353,749,140 with an implementation time of 67 days. While the half slab floor plate costs Rp. 2,598,711,750 with an implementation time of 49 days. So conventional floor plate work is cheaper by Rp. 244,962.

Keywords:
Conventional, Cost, Floor Slabs, Half Slab, Time.

1. Preliminary

At this time, the method of superstructure work such as beams, columns and floor slabs was developed so that time could be controlled precisely. One of the construction methods developed to produce time efficiency in construction work is the precast concrete structure system. Precast concrete is widely used as an alternative to conventional concrete systems (Syamsuddin, Warastuti, and Arini 2019).

The choice of a method is very important in the implementation of a construction project because the right method of implementation can provide maximum results, especially when viewed from a cost and time perspective. One of the efforts made by the project manager is to replace conventional methods to be more modern, namely by applying precast concrete (Najoan, Tjakra, and Pratasis 2016).

According to Affandi (2004) there are several differences between conventional and precast systems. The disadvantages in conventional are that it requires a longer construction time, because each interdependent structural element must be done sequentially, the quality is not guaranteed, especially the concrete surface is not as smooth as precast concrete, requires a lot of formwork and workers, depending on the weather, it really depends on the expertise of the implementer. The advantages of the precast system compared to conventional systems are that it has the advantage of being more economical in the use of formwork, more guaranteed quality because it is done in a factory with good supervision, is less affected by weather conditions and higher productivity. The definition of conventional concrete is concrete that is cast directly at the location of the planned structural elements or (cast in-situ). While the definition of Half Slab Concrete is precast concrete or precast concrete that is cast and treated (Curing) in another location, for example a workshop or factory (not where the concrete structural elements are installed) but requires Overtopping at the location of the planned structural elements.

The Half Slab and Conventional methods themselves have their own advantages and disadvantages. In general, the Half Slab method has the advantage of being fast and does not require a lot of workers. So that in order to determine which method is more effective, efficient, and economical in this xyz project, the conventional method and the Half Slab method need to be researched, especially in terms of cost and time.

2. Methodology

Research methodology is the argumentative background that makes a study used in a research activity. In a study, it is necessary to have a method used in carrying out the research. Well-designed and structured methods will produce data that meets the research objectives.

In this research, the comparison used is the conventional method with the half slab method, to find a more efficient cost and time for both methods. This research was conducted on the xyz project in the Soekarno-Hatta International Airport area (Perimeter Area).

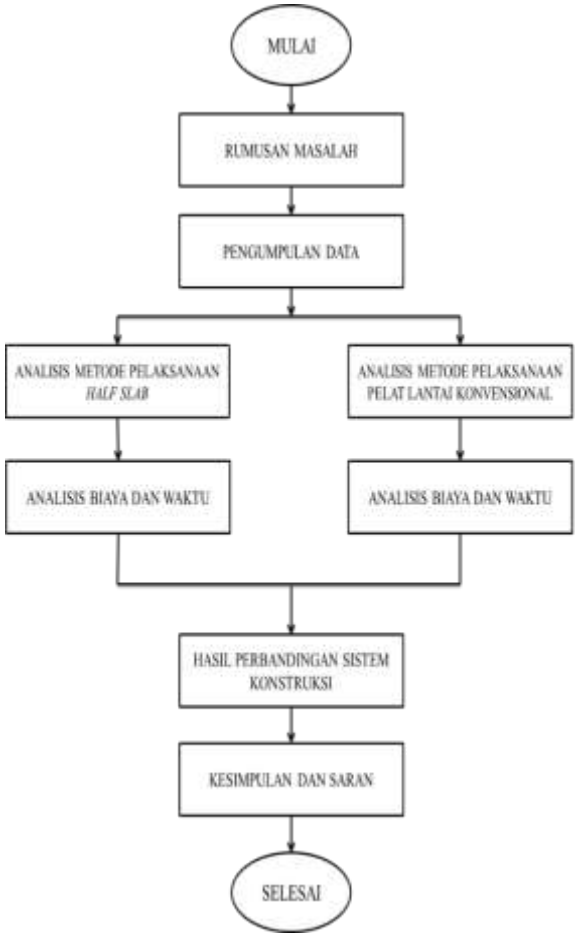

Figure 1. Flowchart
Source: Author, 2020

The sequence of stages used for research is as follows:

1. Literature Study of Data Collection: Calculation of floor slab structure conversion, regulations or SNI related to floor slab work, implementation method, project unit price.
2. Calculation of material using conventional method and half slab method.
3. Calculation of work costs analyzed from the Project BoQ, Project Unit Price Analysis.
4. Calculation of time and number of workers based on the labor coefficient of SNI (2008).

Table 1. Material Prices and Equipment Rental in Conventional Methods

No.	Bahan/Alat	Satuan	Harga Satuan	
A	**Bahan**			
1	Multiplex Poly Film	lbr	Rp	275.000
2	Balok 8cmx12cm P=4m	m^3	Rp	2.779.500
3	Kaso 5cmx7cm P=4m	m^3	Rp	2.796.000
4	Minyak Bekisting	ltr	Rp	7.100
5	Paku	kg	Rp	16.700
6	Besi D16 - BJTD 40	kg	Rp	9.030
7	Besi D22 - BJTD 40	kg	Rp	9.030
8	Beton Ready Mix K-350 T=12 cm	m^3	Rp	784.750
B	**Alat (Sewa per Bulan)**			
1	Concrete Pump	Unit	Rp	59.040.000
2	Concrete Vibrator	Unit	Rp	47.232.000
3	Air Compressor	Unit	Rp	88.560.000
C	**Upah**			
1	Pekerja	OH	Rp	135.500
2	Tukang	OH	Rp	155.800
3	Kepala Tukang	OH	Rp	170.000
4	Mandor	OH	Rp	170.500
5	Pasang + Bongkar Bekisting Pelat	m^2	Rp	41.000

Source: Project Unit Price Analysis xyz project

Table 2. Material Prices and Equipment Rental Half Slab Method

No.	Bahan/Alat	Satuan	Harga Satuan	
A	**Bahan**			
1	Beton Precast T=60mm	m^2	Rp	382.295
2	Besi D22 - BJTD 40	kg	Rp	9.030
3	Beton Ready Mix K-350 T=60mm	m^3	Rp	784.750
B	**Alat (Sewa per Bulan)**			
1	Concrete Pump	Unit	Rp	59.040.000
2	Concrete Vibrator	Unit	Rp	47.232.000
3	Air Compressor	Unit	Rp	88.560.000
4	Crane 25 ton	Unit	Rp	280.440.000
C	**Upah**			
1	Pekerja	OH	Rp	135.500
2	Tukang	OH	Rp	155.800
3	Kepala Tukang	OH	Rp	170.000
4	Mandor	OH	Rp	170.500

Source: Project Unit Price Analysis xyz project

Place and Time

Place : This research was conducted in the XYZ Project in the Soekarno-Hatta International Airport area (Perimeter Area). This project is a bridge project (Fly Over).

Time : The time of this study lasted approximately 1 month, which was divided into two stages. The first stage is conducting observations and interviews at the XYZ project location. Furthermore, the second stage is the implementation stage which includes data processing.

3. Results and Discussion

3.1. Results of Cost Analysis of Conventional Methods

The following are the results of the conventional method cost analysis of Rp. 2,353,749,140

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Table 3. The Results Of The Conventional Method Cost Analysis

No.	Uraian Pekerjaan	Satuan	Volume	Harga Satuan		Jumlah	
A	**Pelat Lantai**						
1	Multiplex Poly Film	lbr	338,54	Rp	275.000	Rp	93.098.500
2	Balok 8cmx12cm P=4m	m³	39	Rp	2.779.500	Rp	108.400.500
3	Kaso 5cmx7cm P=4m	m³	78	Rp	2.796.000	Rp	218.088.000
4	Minyak Bekisting	ltr	585	Rp	7.100	Rp	4.153.500
5	Paku	kg	1170	Rp	16.700	Rp	19.539.000
6	Besi D16 - BJTD 40	kg	46218	Rp	9.030	Rp	417.348.540
7	Besi D22 - BJTD 40	kg	87175	Rp	9.030	Rp	787.190.250
8	Beton Ready Mix K-350 T=12 cm	m³	351	Rp	784.750	Rp	275.447.250
					SUB TOTAL :	**Rp**	**1.923.265.540**
B	**Alat Ringan**						
1	Concrete Vibrator	Unit	1	Rp	47.232.000	Rp	47.232.000
2	Air Compressor	Unit	1	Rp	88.560.000	Rp	88.560.000
					SUB TOTAL :	**Rp**	**135.792.000**

Table 4. The Results Of The Conventional Method Cost Analysis

No.	Uraian Pekerjaan	Satuan	Volume	Harga Satuan		Jumlah	
C	**Alat Berat**						
1	Concrete Pump	Unit	1	Rp	59.040.000	Rp	59.040.000
D	**Upah**						
1	Pekerja	OH	453	Rp	135.500	Rp	61.381.500
2	Tukang	OH	292	Rp	155.800	Rp	45.493.600
3	Kepala Tukang	OH	29	Rp	170.000	Rp	4.930.000
4	Mandor	OH	23	Rp	170.500	Rp	3.921.500
5	Pasang + Bongkar Bekisting Pelat	m²	2925	Rp	41.000	Rp	119.925.000
					TOTAL :	**Rp**	**2.353.749.140**

Source: Results of Analysis & BoQ Project xyz project

3.2. Results of the Half Slab Method Cost Analysis

Here are the results of the analysis of the half slab method cost of Rp. 2,598,711,750, -

Table 5. The Results Of The Conventional Method Cost Analysis

No.	Uraian Pekerjaan	Satuan	Volume	Harga Satuan		Jumlah	
A	**Pelat Lantai**						
1	Beton Precast T=60mm	m²	2925	Rp	382.295	Rp	1.118.212.875
2	Besi D22 - BJTD 40	kg	87175	Rp	9.030	Rp	787.190.250
3	Beton Ready Mix K-350 T=60 mm	m³	175,5	Rp	784.750	Rp	137.723.625
					SUB TOTAL :	**Rp**	**2.043.126.750**
B	**Alat Ringan**						
1	Concrete Vibrator	Unit	1	Rp	47.232.000	Rp	47.232.000
2	Air Compressor	Unit	1	Rp	88.560.000	Rp	88.560.000
					SUB TOTAL :	**Rp**	**135.792.000**
C	**Alat Berat**						
1	Concrete Pump	Unit	1	Rp	59.040.000	Rp	59.040.000
2	Crane 25 Ton	Unit	1	Rp	280.440.000	Rp	280.440.000
D	**Upah**						
1	Pekerja	kg	280	Rp	135.500	Rp	37.940.000
2	Tukang	kg	225	Rp	155.800	Rp	35.055.000
3	Kepala Tukang	kg	27	Rp	170.000	Rp	4.590.000
4	Mandor	kg	16	Rp	170.500	Rp	2.728.000
					TOTAL :	**Rp**	**2.598.711.750**

Source: Results of Analysis & BoQ xyz project

3.3. Results of Time Analysis with Conventional Methods

Following are the results of the time analysis of the conventional method obtained for 67 days.

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Table 6. The Results Of The Time Analysis Of The Conventional Method

No.	Uraian	Volume (m^3)	Satuan	Koefisien	Produktifitas 1 group/hari	Kebutuhan Tenaga Kerja	Durasi (hari)	Kebutuhan tenaga kerja jika pekerjaan di selesaikan oleh 6 Group	Kebutuhan waktu jika pekerjaan diselesaikan oleh 6 group (hari)
	a	b	c	d	e=1/d	f=(b/e)*d	g=b/ (f/d)	h	i=b/ (h/d)
1	Pekerjaan Bekisting	2925							
	Pekerja		OH	0,66	3,03	637	3	106	18
	Tukang Kayu		OH	0,33		319	3	53	18
	Kepala Tukang		OH	0,033		32	3	5	18
	Mandor		OH	0,033		32	3	5	18
							SUB TOTAL :	170	18
No.	**Uraian**	**Volume (Kg)**	**Satuan**	**Koefisien**	**Produktifitas 1 group/hari**	**Kebutuhan Tenaga Kerja**	**Durasi (hari)**	**Kebutuhan tenaga kerja jika pekerjaan di selesaikan oleh 3 Group**	**Kebutuhan waktu jika pekerjaan diselesaikan oleh 3 group (hari)**
	a	b	c	d	e=1/d	f=(b/e)*d	g=b/ (f/d)	h	i=b/ (h/d)
2	Pekerjaan Pembesian	133393							
	Pekerja		OH	0,07	14,28	654	14	218	43
	Tukang Besi		OH	0,07		654	14	218	43
	Kepala Tukang		OH	0,007		65	14	22	43
	Mandor		OH	0,004		37	14	12	43
							SUB TOTAL :	470	43

Source: Analysis Results & (SNI 2008)

Table 7. The Results Of The Time Analysis Of The Conventional Method

No.	Uraian	Volume (m^3)	Satuan	Koefisien	Produktifitas 1 group/hari	Kebutuhan Tenaga Kerja	Durasi (hari)	Kebutuhan Tenaga Kerja Jika Pekerjaan di selesaikan oleh 2 Group	Kebutuhan waktu jika pekerjaan diselesaikan oleh 2 group (hari)
	a	b	c	d	e=1/d	f=(b/e)*d	g=b/ (f/d)	h	i=b/ (h/d)
3	Pekerjaan Pengecoran	351							
	Pekerja		OH	2,1	2,86	258	3	129	6
	Tukang Kayu		OH	0,35		43	3	21	6
	Kepala Tukang		OH	0,035		4	3	2	6
	Mandor		OH	0,105		13	3	6	6
							SUB TOTAL :	159	6
							TOTAL :	799	67

Source: Analysis Results & (SNI 2008)

3.4. Results of Time Analysis with Half Slab Method

Following are the results of the time analysis using the half slab method obtained for 49 days.

Table 8. The Results Of The Time Analysis Using The Half Slab Method

No.	Uraian	Volume (bh)	Satuan	Koefisien	Produktifitas 1 group/hari	Kebutuhan Tenaga Kerja	Durasi (hari)	Kebutuhan Tenaga Kerja Jika Pekerjaan di selesaikan oleh 2 Group	Kebutuhan waktu jika pekerjaan diselesaikan oleh 2 group (hari)
	a	b	c	d	e=1/d	f=(b/e)*d	g=b/ (f/d)	h	i=b/ (h/d)
1	Pemasangan Beton Precast	609							
	Pekerja		OH	0,067	7,46	5	7	3	15
	Tukang Kayu		OH	0,038		3	7	2	15
	Kepala Tukang		OH	0,134		11	7	5	15
	Mandor		OH	0,019		2	7	1	15
							SUB TOTAL :	11	15
No.	**Uraian**	**Volume (kg)**	**Satuan**	**Koefisien**	**Produktifitas 1 group/hari**	**Kebutuhan Tenaga Kerja**	**Durasi (hari)**	**Kebutuhan tenaga kerja jika pekerjaan di selesaikan oleh 2 Group**	**Kebutuhan waktu jika pekerjaan diselesaikan oleh 2 group (hari)**
	a	b	c	d	e=1/d	f=(b/e)*d	g=b/ (f/d)	h	i=b/ (h/d)
2	Pekerjaan Besi	87175							
	Pekerja		OH	0,07	14,28	427	14	214	29
	Tukang Besi		OH	0,07		427	14	214	29
	Kepala Tukang		OH	0,007		43	14	21	29
	Mandor		OH	0,004		24	14	12	29
							SUB TOTAL :	461	29

Table. 9. The Results Of The Time Analysis Using The Half Slab Method

No.	Uraian	Volume (m^3)	Satuan	Koefisien	Produktifitas 1 group/hari	Kebutuhan Tenaga Kerja	Durasi (hari)	Kebutuhan Tenaga Kerja Jika Pekerjaan di selesaikan oleh 2 Group	Kebutuhan waktu jika pekerjaan diselesaikan oleh 2 group (hari)
	a	b	c	d	e=1/d	f=(b/e)*d	g=b/ (f/d)	h	i=b/ (h/d)
3	Pekerjaan Pengecoran	175,5							
	Pekerja		OH	2,1	2,86	129	3	64	6
	Tukang Kayu		OH	0,35		21	3	11	6
	Kepala Tukang		OH	0,035		2	3	1	6
	Mandor		OH	0,105		6	3	3	6
							SUB TOTAL :	79	6
							TOTAL :	551	49

Source: Analysis Results & (SNI 2008)

From the results of the analysis of the conventional method and the half slab method above, it can be concluded that the two methods of implementation can each be compared using the graph below:

Figure 2. Perbandingan Biaya
Source: Author, 2020

It can be seen from the graph above that the conventional method is cheaper than the half slab method. The conventional method is Rp.2,353,749,140 while the half slab method is Rp. 2,598,711,750. The difference between these two methods is Rp. 244,962,610 with an efficiency of 9.42% cheaper conventional methods.

Figure 3. Perbandingan Waktu
Source: Author, 2020

The graph above shows the comparison of time to days and total labor between the two methods. It can be seen that the half slab method is faster than the conventional method. The processing time for the half slab method is 49 days, while the conventional method takes 67 days. The difference between these two methods is 18 days with an efficiency of 26.86% faster half slab method work.

4. Conclusion

1. The cost of implementing the conventional method is Rp. 2,353,749,140 and the cost of implementing the half slab method is Rp. 2,598,711,750. So that the work of the floor slabs using conventional methods is cheaper Rp. 244,962,610 with an efficiency of 9.42% compared to the half slab method.
2. The time required in conventional method floor slab planning during 67 days while the time needed in floor slab planning half slab method for 49 days. So that the slab work using the half slab method is faster 18 days with an efficiency of 26.86% than conventional methods.

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Biography

Muhammad Fadhiil Dwi Sukmana is a student from Mercubuana University Bekasi with a Civil Engineering Study program. Before majoring in civil engineering, at the previous level, namely SMA Bina Bangsa Mandiri, majoring in Science, the author graduated from high school in 2016 and then immediately continued studying at Mercu Buana University majoring in Civil Engineering in 2016, during college the author was active in academic and non-academic organizations. During college, the author attended a seminar event as a security division, a friendly event as an entertainment division. With this research, the writer hopes that the research can become something of learning and hope that further research can be developed properly.

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The Impact of Covid-19 on Areas Prone to Traffic Accidents in Depok City (Margonda Raya Road Case Study)

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Abstract

Traffic accidents and congestion is one of the main problems in Depok city. Jalan Margonda Raya is one of the streets in Depok city. Jalan Margonda Raya is one of the roads in Depok city with quite high traffic activity. To prove this, research is done by analyzing the area of accident prone and road performance with the aim of analyzing the areas prone to traffic accident and know the performance of mesh and how to correct alternative solution to overcome it. The method used in this research to analyse areas prone to accident is to use the AEK (equivalent number of accident) approach, and to know the area of traffic accident (black spot) with the method BKA (upper control limit), while to know the performance of the segment using Manual Road capacity 1997. Based on the results of analysis concluded that Jalan Margonda Raya, belongs to the category of road prone traffic accidents, because it has a value of AEK greater or greater than the value of BKA and UCL. Road with the highest AEK value is Jalan Margonda Raya with a value of AEK 40 where the value of BKA is only 24.250 and UCL value of 35.949. On the road, there have been 4 accidents with the total death toll of 1 person, 3 people with severe injuries, a light injury of 5 people, and a material loss of 5.3 million Rupiah. The most common type of accident is the front-back sprinrack of 45.45% of the total number of accidents. The most common time for accident at Jalan Margonda Raya Depok is at night at 18.00 WIB – 06.00 WIB with a percentage of 63.63% from the total accident. As for the level of service on Jalan Margonda Raya Sunday Direction Jakarta-Depok is B, this is due to the degree of saturation (V/C ratio) of 0.530, while the direction of Depok-Jakarta is B, this is because the degree of saturation (V/C ratio) of 0.540 and for the day, Monday 15 May 2020 direction Jakarta-Depok is B, this is because the degree of saturation (V/C ratio) of 0.669 while the direction of Depok-Jakarta is B, this is because the degree of saturation (V/C 0.608 From the analysis obtained some alternative solution that is to install and repaint road markers and Zebra Cross, repaint on sidewalks or kerb, and do periodic supervision work, check periodically on street lighting lamps.

Keywords
Area Prone To Accident, Degree Of Saturation, Number Equivalent Accidents, Service Level, Traffic Accident.

1. Introduction

1.1. Background

Transportation is a very important part of human life, especially transportation by motor vehicle, both for the needs of human movement and freight transport. In the transportation of safety is serious and must be taken into account by the service users. According to the law No. 14 years 1992 about traffic and road transport, transportation aims to realize traffic and road transport safely, securely, quickly, smoothly, orderly and orderly, comfortable and efficient, able to integrate other modes of transportation, reaching all corners of the mainland, to support equitable, growth and stability as a driver, Mobilizer and support national development at an affordable cost by the purchasing power of the public. This makes the safety aspect should be a major concern. At the end of the year 2019 a virus appeared first in the wild animal market in Wuhan City, the Chinese virus is called Corona Virus or COVID-19. The spread of viruses that have not been found by the antiarism is now uncontrollable. Already 200 more countries in the world reported a case of exposure to Corona virus. In Indonesia, this case was first found in two people in Depok, West Java in early March. Data until July 14, 2020 the number of citizens expressed positively affected corona virus reached 78,572 people with 3,710 of whom died and 37,636 people were declared cured (Source: Task Force acceleration Handling Covid-19 https://covid19.go.id/). Corona-transmitted Virus through mucus (droplet) a positive human COVID-19 that jumps to the negative human COVID-19. The slime is splashed when the human positive COVID-19 sneezes. coughing, or speaking and then exposed to other negative people, in the middle of March, the Government appealed to all the people to indirectly contact to reduce the spread figures of this COVID-19 Virus. Along with

increasingly gencar-gencarnya the government's efforts in tackling the spread of the COVID-19 Virus, one of them performs PSBB (large scale social restriction).On Jalan Margonda Raya which is the main access link Depok City with the capital of DKI Jakarta, based on a report issued by the National Police of the Republic of Indonesia region of Metro Jaya Resort Depok City There is a total accident throughout the year 2020 amounted to 11 incidents with a loss of Rp. 11,350, 000. Based on the matter outlined above, the study aims to determine the number of traffic accidents with the method of the AEK (equivalent of accident number) approach, and to know the area prone traffic accident (black Spot) with method BKA (upper control limit) then in the effort to reduce the accident on Jalan Margonda Raya then done research with the title impact Covid-19 on the vulnerable area traffic accident in Depok City (case studies Margonda Raya).

1.2. Library Overview

1.2.1 Identification of areas prone to accidents

Areas prone to accidents are an area or location where high accident figures with repeated accidents in a space and a relatively equal time span caused by a certain cause (Pd T-09-2004-B).

One method for identifying accident-prone locations, namely the accident equivalent number (AEK) method. AEK calculation is bound by the level of accident fatality and the number of accident events. The AEK is calculated by summing the accident event at each kilometer of the road, then multiplied by the weight of the value according to the fatality level due to the accident. From this weighted you will get a list of new accident rankings.

This method is determinated by the formula:

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

Where:

MD = Deceased
LB = Heavy Injuries
LR = Light Cuts
K = Accident with Material Loss

The value of accidents occurring on road segments taking into consideration the level of fatality of victims:

Tabel 1. Pembobotan AEK

Fatality rate	Weights
Deceased (MD)	12
heavy injuries (LB)	3
Light Cuts (LR)	3
accident with material loss (K)	1

Source: Location Handling prone traffic accidents (Pd T-09-2004-B) Department of Settlements and regional infrastructure

The determination of accident-prone locations is based on the number of each kilometer of road that has a value of AEK exceeds certain limits. This limit value is calculated by using the upper control boundary (BKA) method (Margareth Evelyn Bolla et al., 2013) Upper control limit Value formula:

$$BKA = C + 3\sqrt{C}$$

Where :
C = Average of AEK accidents

1.2.2. Road Performance

Road performance is the ability for road segments to serve the needs of traffic flows according to their functions that can be measured and compared with the level of road service standards. The road service level value is used as a road performance parameter (Ahmad Syukarman,Indra Syahrul Fuad, 2017)Road performance includes:

a. Road capacity

Capacity is defined as the maximum current through a the in the path that can be maintained per unit of hour under certain conditions (eg: geometric plans, environment, traffic composition and so on. Usually expressed in a kend/hour or Junior/h)(erwin kusnandar, 2009)

C = Co x FCW x FCSP x FCSF x FCCS

Where:
C = Capacity (SMP/hr)
Co = Basic Capacity (SMP/hr)
FCw = Traffic path width adjustment factor
FCSP = directional Separation adjustment factor
FCSF = side barrier Adjustment factor

FCCS = City Size Adjustment factors

b. Free flow speed

This speed can be measured in different ways. In general, vehicle speed is measured using light vehicles (LV). In MKJI (1997) The speed of free flow of light vehicles (FV) is expressed with the following equation.

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

Where:
FV = Light base free flow speed (km/h)
FVo = Light vehicle base free current speed (km/h)
FVW = wide adjustment of effective traffic path (km/h)
FFVSF = adjustment factor of side barrier condition
FFVCS= City Size adjustment factor

c. Degrees of saturation

The degree of saturation (DS) is defined as the ratio of road currents to capacity, which is used as a major factor in determining the level of junction performance and road segments.

$$DS = \frac{Q}{C}$$

Where:
DS = degree of saturation
Q = traffic flow (SMP/hr)
C = Capacity (SMP/hr)

d. Service level

The size of the effectiveness of the road service level or Level of Service (LOS) is differentiated into six classes, i.e. from A to the best level up to F level for the worst conditions.

Level Service	Characteristics of related operations
	1. Arus bebas 2. Kecepatan perjalanan rata-rata ≥ 80 km/jamV/C ratio ≤ 0,6 Load factor pada simpang = 0
	1. Arus stabil 2. Kecepatan perjalanan rata-rata turun s/d ≥ 40 km/jamV/C ratio ≤ 0,7 Load factor ≤ 0,1
	1. Arus stabil 2. Kecepatan perjalanan rata-rata turun s/d ≥ 30 km/jamV/C ratio ≤ 0,8 Load factor ≤ 0,3
	1. Mendekati arus tidak stabil 2. Kecepatan perjalanan rata-rata turun s/d ≥ 25 km/jamV/C ratio ≤ 0,9 Load factor ≤ 0,7
	1. Arus tidak stabil, terhambat, dengan tundaan yang tidak dapat ditolerir 2. Kecepatan perjalanan rata-rata sekitar 25 km/jam Volume pada kapasitas Load factor pada simpang ≤ 1/
	1. Arus tertahan, macet 2. Kecepatan perjalanan rata-rata < 15 km/jamV/C ratio permintaan melebihi 1 Simpang Jenuh

Figure 1. Service level

Sumber: Peraturan Menteri Perhubungan Nomor: KM 14 Tahun 2006 Tentang Manajemen Dan Rekayasa Lalu Lintas Di Jalan

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2. Methodology

2.1. Final Task Research flowchart

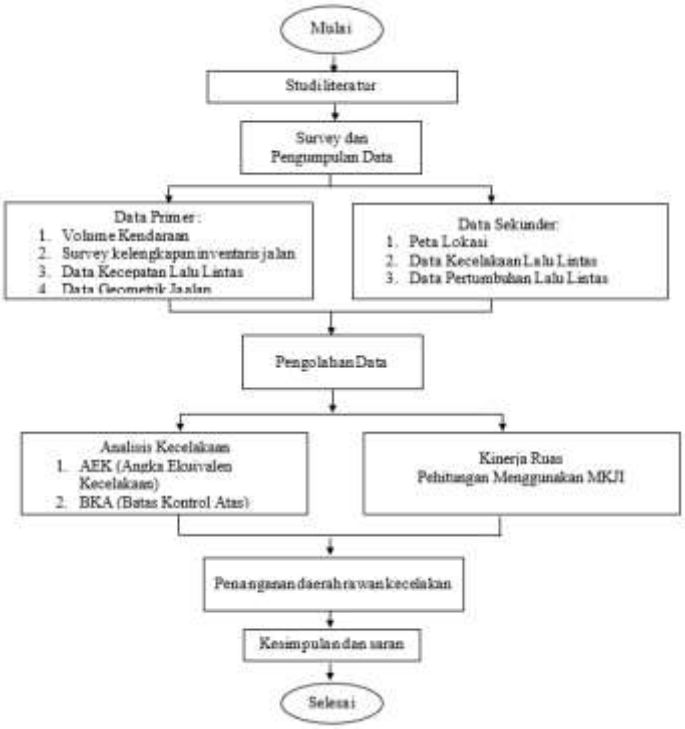

Figure 2. Final task Research Flow Diagram
Source: Personal Picture

2.2. Location and research time

Research analysis conducted in the Area of Margonda Raya Road, the time of research was conducted in May 2020-June 2020 using traffic accident data in the year 2020. Road performance surveys are conducted on Sundays and Mondays, 14-15 May 2020 at 06.30-17.30 WIB.

3. Result and Discussion

3.1. Overview

Research analysis is conducted on Jalan Margonda Raya, Depok City with a length of road 2 KM can be seen in Figure 4.1

Figure 3. Research location
Sumber: www.google.co.id/maps

3.2. Primary Data

Primary data is data collected directly by the study through observations in the field or research site namely Jalan Margonda Raya. Primary Data The final project includes:

1. Vehicle Volume Data

Traffic vehicle surveys are conducted on holidays and weekdays in times of unoccupied hours and peak hours. Survey time selected based on preliminary survey, namely:

a. Day : Sunday, 14 May 2020
   Hours : 06.30 – 17.30 WIB
b. Day : Monday, 15 May 2020
   Hours : 06.30 – 17.30 WIB

2. Surveying completeness of road inventory

Data collection completeness of road inventory is done to see the completeness of supporting components such as road markers, traffic signs, etc.

3. Geometric Data Path

The collection of road geometric data is done by measuring the length of the examined road segments and then measuring the road width as well as the road shoulder width. In this data collection used meter as measuring aids.

3.3. Secondary Data

Secondary data is the data that researchers can do not go through direct observation on the field but by looking at other people's observations. This Data usually comes from research conducted by institutions or organizations such as the Department of Transportation and the Department of Population and Civil registry. Secondary Data used in this final project can be from the traffic Unit (satafterwards) of the city of Depok. It is necessary to support this research:

1. Accident data covering data about accident location;
2. Number of accidents, causes of accidents;
3. And the casualty of Margonda Raya Road in 2018 and 2020;
4. Population growth Data.
5. Traffic growth Data.

3.4. Regional analysis prone to accidents

Here is a table of traffic accident fatalities on the road of Margonda Raya City of Depok in the year 2020.

Table 2. Fatality of traffic accident in Depok city street Margonda Raya

No	Tanggal Kejadian	Tingkat Kecelakaan	MD	LB	LR	Jumlah Korban	Perkiraan Nilai Rugi Material
1	20/01/2020 16:00	Berat	1	1	2	4	Rp 2.000.000
2	20/02/2020 01:30	Ringan	0	0	1	1	Rp 250.000
3	14/03/2020 07:10	Ringan	0	0	1	1	Rp 1.000.000
4	14/03/2020 08:30	Berat	1	1	1	3	Rp 1.500.000
5	14/03/2020 23:30	Sedang	0	1	1	2	Rp 1.000.000
6	15/03/2020 20:00	Sedang	0	1	2	3	Rp 300.000
7	28/03/2020 02:00	Ringan	0	0	1	1	Rp 2.500.000
8	05/03/2020 21:15	Sedang	0	1	1	2	Rp 400.000
9	08/03/2020 04:30	Ringan	0	0	1	1	Rp 500.000
10	04/03/2020 08:30	Sedang	1	1	0	2	Rp 1.200.000
11	11/03/2020 23:30	Sedang	0	0	0	0	Rp 700.000

The result of identification of accident prone location with the AEK method can be seen in Table

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Table 3 of Accident prone location identification calculation

Panjang (km)	AEK					Nilai				
	12MD	3LB	3LR	1K	AEK	C	BKA	λ	Ψ	UCL
0,5	12	6	9	3	30	24,250	39,023	24,250	2.576	34,501
0,5	12	9	15	4	40					35,949
0,5	0	3	3	1	7					31,106
0,5	12	3	3	2	20					32,892

Source: Calculation result

Example of identification calculation area prone road accident Margonda Raya Depo City:

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

Rata-rata AEK (C) atau (λ)= $\frac{AEK}{Jumlah\ Segmen\ Jalan}$

$= \frac{30+40+7+20}{4}$

$= \frac{97}{4}$

= 24,250

Batas Kontrol Atas (BKA) = C + 3√C

= 24,250 + 3√24,250

= 39,023

Upper Control Limit (UCL)= $\lambda + \Psi \text{ x } \sqrt{\left(\frac{\lambda}{m} + \frac{0,829}{m} + \left(\frac{1}{2}xm\right)\right)}$

$= 24,250 + 2,576 \text{ x } \sqrt{\left(\frac{24,250}{30} + \frac{0,829}{30} + \left(\frac{1}{2}x\ 30\right)\right)}$

= 34,501

Table 4. difference in AEK, BKA, and UCL values

No. Segmen	Nilai				
	AEK	BKA	UCL	Deviasi (BKA)	Deviasi (UCL)
1	30	39,023	34,501	9,023	4,501
2	40		35,949	-0,977	-4,051
3	7		31,106	32,023	24,106
4	20		32,892	19,023	12,892

Source: Calculation result

Based on table 4.3, it can be concluded that Jalan Margonda Raya is included in the road prone traffic accident, especially in segments 1 and 2 with the value of AEK greater than the value of BKA and UCL. The highest deviation value is in segment 2 with the coordinate point (L =-6.389022; B = 106.819795) up to (L =-6.3822578; B = 106.832605) So it needs to be given special handling to reduce the accident prone level on the road.

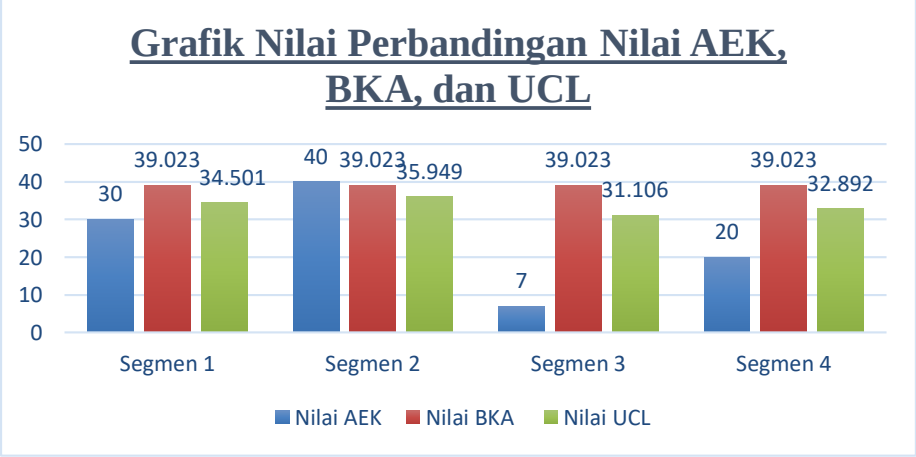

Figure 2. Here is a graph of the value comparison of the AEK, BKA, and UCL values can be seen in

Accident causing factors :

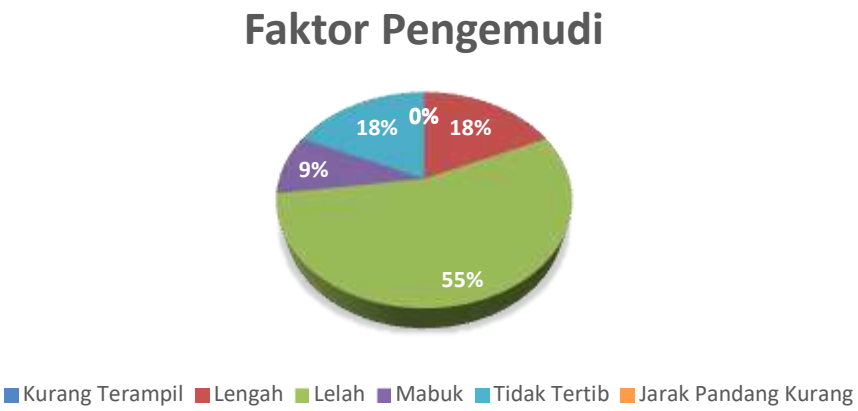

Figure 3. Accident causing factors

Figure 4. the driver's factor

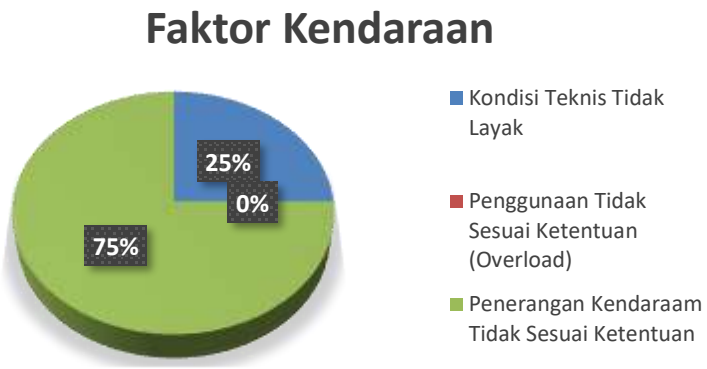

Figure 5. vehicle factor

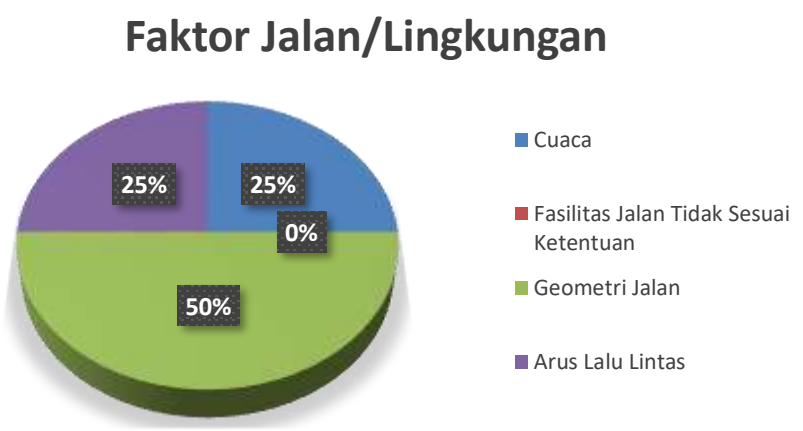

Figure 6. road / environmental factors

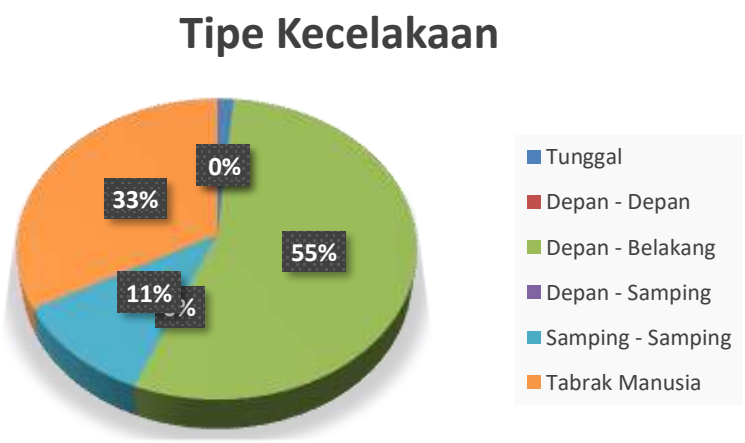

Figure 7. accident type

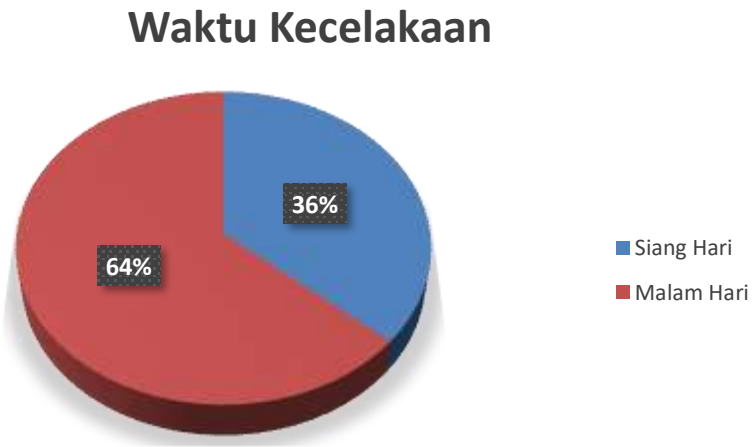

Figure 8. the time of the accident

Comparison of accidents at the time before the Covid-19 and when Covid-19 can be seen as follows:

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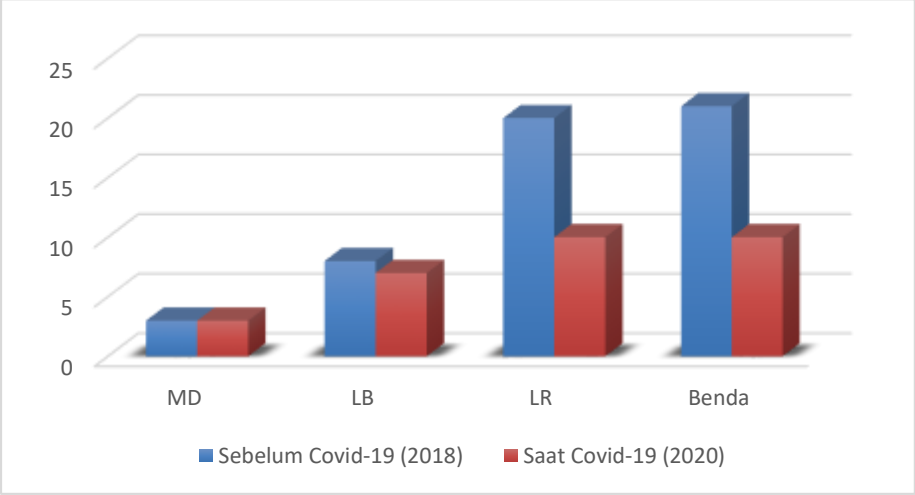

Figure 9. Comparison of accidents at the time before the Covid-19 and when Covid-19 can be seen as follows

Table 5. Comparison of accidents at the time before the Covid-19 and after the Covid-19

No. Segmen	Nilai					Saat Terjadi Wabah Covid-19 (2020) Nilai				
	AEK	BKA	UCL	Deviasi (BKA)	Deviasi (UCL)	AEK	BKA	UCL	Deviasi (BKA)	Deviasi (UCL)
1	48	53,062	48,066	5,062	0,065	30	24,250	34,501	9,023	4,501
2	54		48,800	-0,938	-5,200	40		35,949	-0,977	-4,051
3	8		42,765	45,062	34,764	7		31,106	32,023	24,106
4	31		45,766	22,062	14,765	20		32,892	19,023	12,892

3.5.Road performance analysis

Performance calculation on Jalan Margonda Raya includes calculation of traffic volume, capacity, speed of free flow, degree of saturation, travel time and analysis of service level based on road capacity Manual Indonesia (MKJI), geometric conditions Jalan Margonda Raya are as follows:

a. Road type: Secondary artery
b. Road type: 6/2D
c. Length of road section: 2,135 m
d. Road width: 12 m/Line
e. Median width: 2 m
f. Jalan Margonda Raya consists of 6 lanes and 2 lanes, with the width of each column is 4 m.
g. Jalan Margonda Raya has no road shoulder, but has a sidewalk with a width of 2.2 m.
h. Jalan Margonda Raya has a separator on the Jakarta-Depok line of Flyover Universitas Indonesia to the Simpang Jalan Juanda with a width of separator is 0.5 m.

Pictures of Margonda Raya Road can be seen in Figure 10.

Figure 10. The Cross of Margonda Raya Road

The results of the performance analysis can be seen as follows:

Table 6. Recapitulation of analysis results

Arah	Volume Kendaraan Lalu Lintas (Q)	Kapasitas Dasar	Kapastias Aktual	Kecepatan Arus Bebas	Derajat Kejenuhan	Vlv	LOS	Keccepatan Aktual	LOS
	Smp/jam	Co	C	FV	DS	Km/jam	Q/C	Km/jam	
				Hari Minggu, 14 Mei 2020					
Jakarta-Depok	2726	4950	5146	59	0.530	49	A	59,06	B
Depok-Jakarta	2784	4950	5146	61	0.540	59	A	59,87	B
				Hari Senin, 15 Mei 2020					
Jakarta-Depok	3445	4950	5146	59	0.669	49	B	59.03	B
Depok-Jakarta	3130	4950	5146	61	0.608	59	B	59.17	B

4. Conclussion

4.1. Conclusion

Based on the results of the research in the analysis, it can be concluded that:

1. The factors causing the traffic accident in Depok Street of Margonda Raya in 2020 include:
   A. The driver factor is the most dominant cause of the accident with a percentage of 83.75% with the majority of motorists who are not orderly traffic.
   B. Lack of facilities for pedestrians such as Zebra cross to cross the road, road marking colors and sidewalks have faded, road surfaces there are many holes or puddles and the result of patchwork of holes arising, and there are some waypoints that are not exposed to lighting into additional factors that can cause accidents.
2. Level of road service Margonda Raya on Sunday, May 14th 2020 Direction Jakarta-Depok is A, this is because the degree of saturation (V/C ratio) of 0.530, while the direction of Depok-Jakarta is A, this is due to the degree of saturation (V/C ratio) of 0.540 and for the day, Monday 15 May 2020 direction Jakarta-Depok is b, this is because the degree of saturation (V/C ratio) of 0.669 while the direction of Depok-Jakarta is B, this is because the degree of saturation (V/C) 0.608
3. After the analysis using the method of accident equivalent number (AEK), upper control limit (BKA), and Upper Limit Control (UCL) concluded that the Jalan Margonda Raya Depok City is included in the category of roads prone to traffic accidents, because there are two road segments that have a value of AEK greater or greater than the value of BKA and UCL, the number of accidents on Jalan Margonda Raya Depok city decreased by 28.812% when reviewed from the value of BKA, in the year 2020 (when Covid-19) amounted 24.250% and in 2018 amounted to 53.062% (before Covid).
4. Solution and handling of traffic accident on Jalan Margonda Raya city in the future, namely:
   A. Perform installation and repainting of road markers and zebra cross according to the function and placement that suits the needs of the road Margonda Raya
   B. Repaint on the sidewalk or kerb on the side of Jalan Margonda Raya according to the function.
   C. Conduct periodic supervision work on Jalan Margonda Raya to prevent road damage that could result in traffic accidents.
   D. Periodic check on street lighting to prevent lights from dying, and cuts against trees that cover street lighting

4.2. Advice

1. There is counseling about the importance of safe driving or safety riding for riders and conducting special operations from the police in the field of traffic to deal with traffic problems or things that can trigger traffic accidents.
2. There is improvement on the road Margonda Raya section including: To Repaint road markers, zebra cross and sidewalks and the addition of supporting signs.
3. Need to do additional analysis to complement secondary data such as number of vehicles involved, weather, gender and the age of the victim. And also can be used other methods in determining the prone point of accident in the Jalan Margonda Raya Depok City to get more accurate results.

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Biography / Biographies (Optional)

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Comparative Analysis of Semi Basement Wall With Different Cohesion and Basement Depth in West Jakarta

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Abstract

DKI Jakarta has a population density of 19,516 people / square km. Government of Jakarta in the PERDA DKI Jakarta No. 7-2010 CHAPTER 5 Article 42 Paragraph 1 states that "every building must provide parking space". To overcome this, semi-basement will be an option to make a parking space that does not require too much excavation costs. This analysis will compare two types of retaining walls, cantilever retaining walls and conventional retaining walls using the Rankine method for static conditions and the Mononobe-Okabe method for dynamic conditions. This analysis results in the conclusion that for a depth of 2.00m, conventional walls are found to be more efficient in terms of costs with a difference of up to Rp. 178,700 / m'. For soil with a depth of 1.75m, cost efficiency depends on soil cohesion. For the higher soil cohesion, the cost of making cantilever walls is more efficient, reaching Rp. 130,600 / m '. For soil with a depth of 1.50m, with higher cohesion, the cantilevered wall will be more cost-efficient than conventional wall making, reaching Rp. 232,400 / m'.

Keywords
Basement Wall, Cantilever Retaining Wallmononobe-Okabe Method, Rankine Method, Semi Basement.

1. Introduction

To make basement, the retaining wall structure have to be able to withstand the active lateral pressures of the soil. In principle, the retaining receives force such as rolling moment, self-weight, active - passive lateral pressure of soil / water, sliding / sliding and uplift. To obtain the best type of retaining wall that can be used for shallow basements in the West Jakarta, it is necessary to compare the strength and costs according to SNI 2847:2013 (2013). To be able to calculate the shape and size of the semi-basement retaining wall suitable for soil in West Jakarta, it is necessary to carry out an analysis of the general description of the shape and size of the soil retaining wall. The shape and size of the walls are influenced by the type of soil in Jakarta and since the soils are not mutual in different areas, this will result in differences in the appropriate shape and different costs of constructing retaining walls.

1.1. Retaining Wall

Retaining walls are structures designed to maintain two different ground elevations (Coduto, 2001).

1.2. Cantilever Retaining Wall

Cantilever retaining wall is a wall consisting of a combination of walls and T-shaped concrete. The thickness of these two parts is relatively thin and fully reinforced to withstand the moment and earth pressure against it.

1.3. Conventional Basement Wall

Conventional basement wall is a concrete wall whose main structure rests and is held together by the lower floor and the upper floor. Soil outside the wall will produce a shear force that is resisted by the lower and upper floor.

1.4. Active Earth Pressure Rankine Method

The minimum lateral soil pressure, which results in shear failure due to the movement of the wall away from the soil behind it is called active soil pressure. Rankine mentions the active earth pressure equation as:

$$P_a = 0{,}5H^2\gamma K_a \quad (1)$$

with:

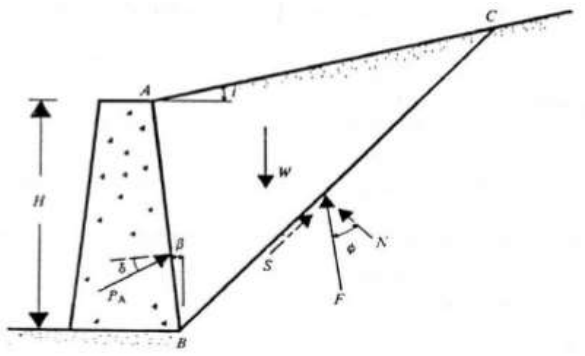
$$Ka: \frac{\sigma h(active)}{\sigma v} = \frac{\sigma 3}{\sigma 1} = \frac{1-\sin\varphi}{1+\sin\varphi} = tg^2(45-\frac{\varphi}{2}) \quad (2)$$

1.5 Active Earth Pressure Mononobe-Okabe Method

The M-O method is an equilibrium-limit approach based on the Coulomb failure field assuming that the walls are moved or turned outward sufficiently to produce a minimum active earth pressure state.

The M-O formulation is expressed as:

$$P_{AE} = (1/2)\gamma H^2(1-k_v)K_{AE} \text{ [10]} \quad (3)$$



Picture1 Active Earth Pressure Coloumb

where:

PAE : Total Lateral Earth Pressure (static + dynamic)
γ : Soil Weight (kN/m³)
H : Height of Backfill(m)
kv : The Vertical Ground Acceleration.
KAE : Static Lateral Ground Pressure Plus Dynamic Ground Pressure Coefficient.

$$K_{AE} = \frac{\cos^2(\phi-\theta-\beta)}{\cos\theta.\cos^2.\beta.\cos(\delta+\theta+\beta)\left[1+\frac{\sin(\delta+\phi).\sin(\phi-\theta-t)}{\cos(\delta+\beta+\theta).\cos(\tau-\beta)}\right]^2} \quad (4)$$

$$\theta = \tan^{-1}\left[\frac{kh}{1-kv}\right] \quad (5)$$

1.6 Shifting Stability

The safety factor against shifting (Fgs), is defined as:

$$F_{gs} = \frac{\Sigma R_h}{\sum P_h} \geq 1{,}5 \quad (6)$$

with:

ΣRh : The resistance of the retaining wall to displacement
W : Total weight of the retaining wall and soil over the foundation plate (kN)
δ_h : Angle of friction between the ground and the foundation
c : Adhesion between the soil and the base of the wall (kN / m²)
B : Foundation width (m)
ΣPh : The sum of the horizontal forces (kN)

1.7. Stability Against Overturning

Lateral ground pressure, caused by soil backfill behind the retaining wall, tends to roll the wall with the center of rotation at the hell end of the foundation plate. The moment of overturning is countered by the moment due to the weight of the retaining wall itself and the moment due to the weight of the soil on the foundation plate. Safe factor against overthrowing, defined as:

$$F_{gl} = \frac{\Sigma M_W}{\sum M_{gl}} \geq 1{,}5 \quad (7)$$

$$F_{gl} = \frac{\sum Mw}{\sum Mgl} \quad (8)$$

with:

$\sum M_w$: Wb1

$\sum M_w$: the moment against the overturning (kN.m)

$\sum M_{gl}$: ΣPah h1 + ΣPav B

$\sum M_{gl}$: Overturning moment (kN.m)

W : weight of soil above foundation + own weight (kN)

B : the width of foundation

ΣPah : the number of horizontal forces (kN)

ΣPav : the number of vertical forces (kN)

1.8 Support Capacity

Like other structures, the retaining wall will also settle. Therefore, the basic principles for calculating the settlement of cantilever wall are the same as calculating the settlement of the foundation.

The bearing capacity equation is:

Fq : $\frac{qu}{q'}$ (9)

with:

qu : q ultimate

qu : ic .c.Nc + iγ.0,5B'γ.Nγ (10)

ic, iγ : load slope factor

Nc, Nq, Nγ : support capacity factor

q' : W/B' (11)

1.9 Reinforcement Bar

To find concrete reinforcement bar, according to the SNI 2847:2013 (2013) are:

As needed : ρbd (12)

Or

As min : 0,0015 (bw) (d) (13)

where

ρ : $\frac{0{,}85 f'c}{fy}\left[1-\sqrt{1-\frac{2Rn}{0{,}85 f'c}}\right]$ (14)

Rn : $\frac{Mu}{\phi bd}$ (15)

b : concrete width

d : concrete thickness effective

2. Methodology

Research Procedure Flowchart

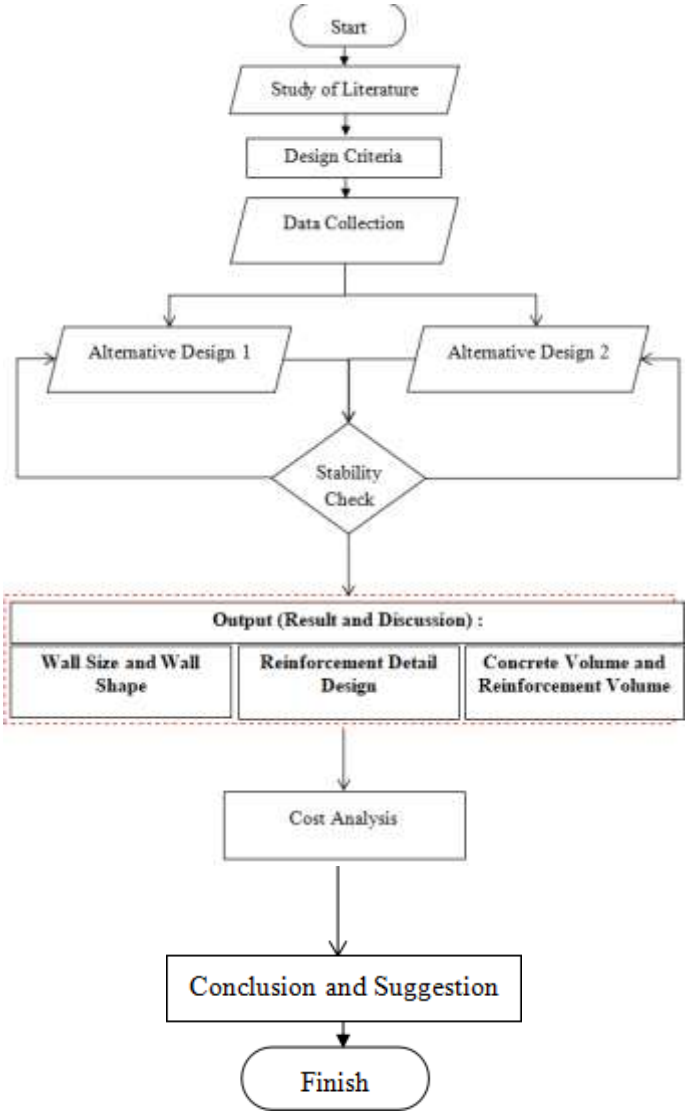


Figure 2 .Research Flow Chart

2.1. Soil Data

The land in West Jakarta tends to be a silt type with the category E area with the N-SPT value being 5> N> 10. So, for this calculation will be based on the smallest value of the data and use the N-SPT 6 data.

2.2. Soil Shear Angle

The equation of the N-SPT value for the soil shear angle can be formulated as follows:

ø :(13N)0,5 + 15 (16)

So;

ø :(13 x 6)0,5 + 15 = 23,83 ~ 24°

2.3. Soil Weight

In 1977, Bowless provided an interpolation chart of Moist Unit for Soil against N-SPT which was described as follows:

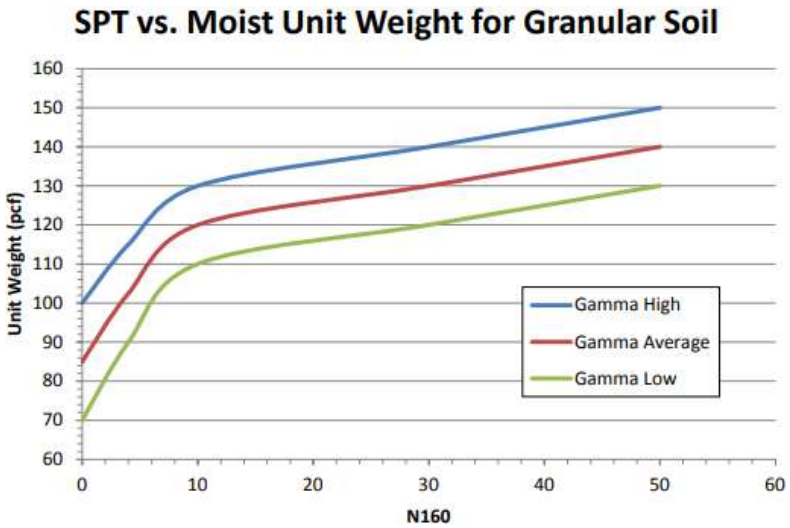


Figure 3. Interpolation of N-SPT Against Soil Weight (Bowless, 1977)

2.5 Conditions to be Calculated

a. Depth of 2.00m

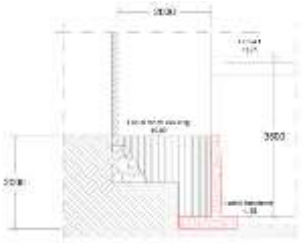


Figure 4. 1a Alternative Design

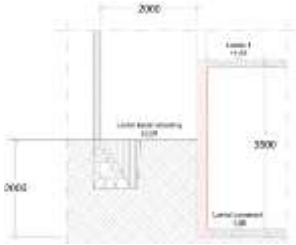


Figure 5. 2a Alternative Design

b. Depth of 1.75m

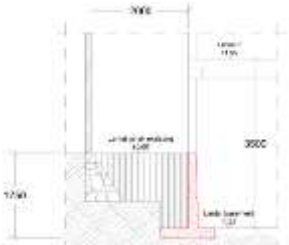


Figure 6. 1b Alternative Design

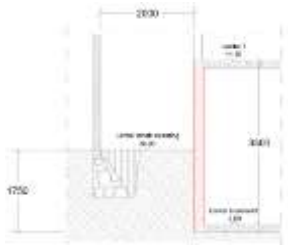


Figure 7. 2b Altervatice Design

c. Depth of 1.50m

Figure 8. 1c Alternative Design

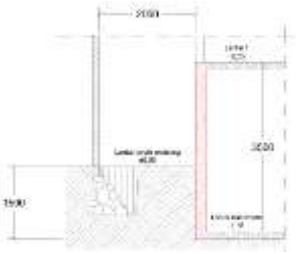


Figure 9. 2c Alternatice Design

3. Result and Discussion

3.1. Analysis

In this analysis phase, retaining walls will be analyzed with two types of retaining walls to obtain the strength and dimensions of the walls. It is hoped that after obtaining the calculation of the strength of the retaining wall, we will get the calculation of the cost requirements to construct the retaining wall and make a comparison between the 2 (two) types of retaining walls.

3.2. Soil Parameter

Based on all the data correlations mentioned in the previous stage, the soil parameters for the DKI Jakarta area were obtained as follows.

Soil Weight (γw) = 1,696 t/m³
Concrete Weight (γc) = 2,4 t/m³
Soil cohesion (c1) = 2 t/m²
Soil cohesion (c2) = 1,75 t/m²
Soil cohesio (c3) = 1,50t/m²
Soil shear angle (ø) = 24°
Ka (static) = tg^2 (45°-24/2) = 0,4217
Bearing capacity factor for longitudinal foundations
Nc = 19,32
Nq = 9,60
Nγ = 5,72

3.3. Alternative Design

3.3.1 Static Condition

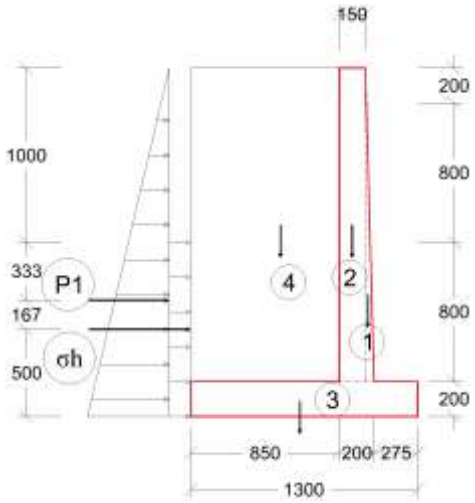


Figure 10. 1a Load Scheme

Table 1. 1a Own Weight

No.	Weight (W) (ton)	Distance from O (m)	Moment to O (ton.m)
1	0,11	0,28	0,03
2	0,65	0,38	0,26
3	0,64	0,66	0,42
4	2,60	0,9	2,33
ΣW	3,99	ΣMw	3,05

$$\sigma h = \frac{4q}{\pi H}\frac{m^2 n}{(m^2+n^2)^2}$$ Form>0,4

$$\sigma h = \frac{q}{H}\frac{0{,}203n}{(0{,}16+n^2)^2}$$ For m<0,4

So,
σh = 0,401 ton
Pa = 0,5H²γKa
Pa1 = 0,5 (2)² (0,421) = 1,43
Pa2 = (0,401) (1) (0,421) = 0,17
Mgl = (1.43) (0,67) + (0,17) (0,50) = 1,04 t.m

3.3.2 Shifting Stability

Rh =(2,00) (1,33) + (3,98) (tg 24°) = 4,42 t/m

$$F_{gs} = \frac{4,42}{1,60} = 2,76 > 1,50...OK!$$

3.3.3

3.3.3 Overturning Stability

$$F_{gl} = \frac{3,05}{1,04} = 2,93 > 1,5...OK!$$

3.3.4 Dynamic Conditions

kv = 0
kh = 0,365g/g = 0,365
KAE = 0,765

$$P_{AE1} = (1/2)\gamma H^2(1-k_v)K_{AE}$$

PAE1 = 2,60 ton
PAE2 = σh H KAE
PAE2 = 0,30 (1) (0,765) 0,30
Mgl = (2,6) (0,67) + (0,30) (0,5) = 1,88 ton.m

3.3.5 Shifting Stability

$$F_{gs} = \frac{4,42}{1,60} = 1,52 > 1,50...OK!$$

3.3.6 Overturning Stability

$$F_{gl} = \frac{3,05}{1,88} = 1,61 > 1,5...OK!$$

3.3.7 Collapse Stability

The calculation is based on the Hansen equation

$$x_e = \frac{3,05-1,88}{3,99} = 0,29m$$

e = B/2-xe = 1,33m/2 - 0,29m = 0,37m >B/6
B/6 = 1,36m /6 = 0,225m
B' = B-2e = 1,33m - 2(0,37m) = 0,71m
A' = B' x 1m' = 0,71m x 1m' = 0,71m².
Load slope factor:

$$i_q = \left[1 - \frac{0,5(2,95)}{3,99 + (0,70)(2,00)(ctg\,24°)}\right]^5 = 0,9965 \geq 0$$

$$i_c = 0,9966 - (1-0,9966)/((19,32)(tg\,24°)) = 0,9963$$

$$i_y = \left[1 - \frac{0,7(2,90)}{(3,99) + (0,70)(2,00)(ctg\,24°)}\right]^5 = 0,9822$$

qu = ic. c. Nc + iγ.0,5B' γ Nγ
qu = 17,05 t/m²
q' = W/B'
q' = 5,62 t/m²

$$F = \frac{qu}{q'} = \frac{17,04}{5,62} = 3,03 > 3(OK!)$$

Or it can also be calculated by:

$$F = \frac{qu(B')}{W} = \frac{17,04(0,71)}{3,99} = 3,03(sama!)$$

3.3.8 Reinforcement Bar

Flexible reinforcement
Mu = 2,14 ton.m
t = 200mm
d = 120mm

$$Rn = \frac{2,14}{(0,9)(1000)(120)^2} = 1,65$$

$$\rho need = \frac{0,85(20)}{400}\left[1 - \sqrt{1 - \frac{2(1,65)}{0,85(20)}}\right] = 0,0043$$

As need = ρbd = (0,0043) (1000) (120) = 520 mm²
As min = (0,0015) (1000) (200) = 300 mm²
Will be installed D10 - 140mm (As = 549 mm²)

3.3.9 Horizontal Reinforcement

As shrinkage and temperature reinforcement. The minimum required horizontal reinforcement at the base of the wall according to SNI 2847: 2913 Article 14.3.3 is :
As min = 0,0020 (1000) (200) = 400mm²
0,5 As = 0,5 (400) = 200 mm² and will be installed D10-300mm (As = 235,5 mm²) di both side.
As a vertical reinforcement on the outer wall to support the horizontal reinforcement, reinforcement can be installed D10-300mm.

3.3.10 Design Against Sliding

The critical section for shear views is d = 120mm from the base of the wall. This section is located at 1.80m - 0.12m = 1.68m from the top edge of the wall so that:
PAE = (1,6) (0,5) (KAE) (γ) (H²) = (1,6) (0,5) (0,765) (1,696) (1,68)² = 2,93 ton
σh = (1,2)(q)(H)(KAE) = (1,2)(1,8)(0,68)(0,765) = 0,21 ton
Vu = PAE + σh
Vu = 3,14 ton

$$\phi Vu = \phi(0,17\lambda\sqrt{f'c}(b_w)(d)$$

$$\phi Vu = (0,75)(0,17)(1)\sqrt{20}(1000)(120)$$

øVu = 68423 N = 68,42 kN = 6,82 ton > Vu .. OK!

3.3.11 Heel Design

Vu = 1,2 [(1,696 x 0,90 x 1,80m) + (2,4 x 0,9 x 0,20)]
= 4,45 < øVu = 6,82 ton … **OK!**

$$Mu = Vu.\frac{1,7}{2}$$

$$Mu = 3,82\frac{1,7}{2} = 3,24ton.m$$

$$Rn = \frac{3,24x10^7}{0,9(1000)(120)^2} = 2,50$$

$$\rho need = \frac{0,85(20)}{400}\left[1 - \sqrt{1 - \frac{2(2,50)}{0,85(20)}}\right] = 0,0068$$

As need= ρbd = (0,0068)(1000)(120) = 816 mm²

$$As\min = \frac{1,4}{fy}bd = \frac{1,4}{400}(1000)(120) = 420mm^2$$

Will be installed **D10-90mm (As=863mm²)**
In the horizontal direction will be installed **D10-300**

3.3.12 Toe Design

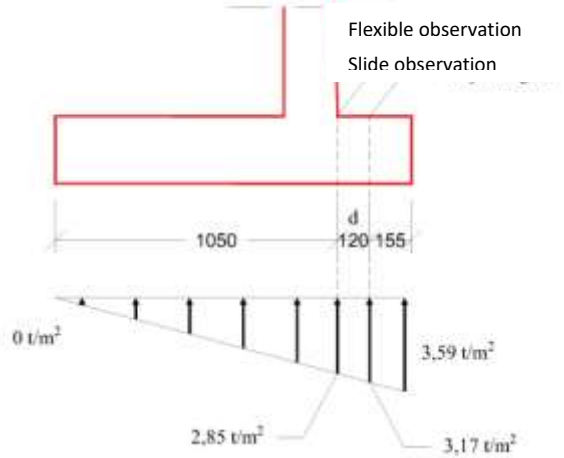


Figure 11. Foundation load distribution

Mu = 1,6 [(3,34) (0,25) (0,25/2) + (0,5) (0,25) (3,69-3,34) (2/3) (0,25)] - 1,2 (0,25) (0,20) (0,25/2) (2,4) = 0,17 ton.m

$$Rn = \frac{0,17}{(0,9)(1000)(120)^2} = 0,12$$

$$\rho need = \frac{0,85(20)}{400}\left[1-\sqrt{1-\frac{2(0,12)}{0,85(20)}}\right] = 0,0003$$

$$As\min = \frac{1,4}{fy}bd = \frac{1,4}{400}(1000)(120) = 420mm^2$$

And will bi installed D10-160mm (As = 471 mm²)
In the horizontal direction will be installed D10-300

3.3.13 Reinforcement Cantilever Wall

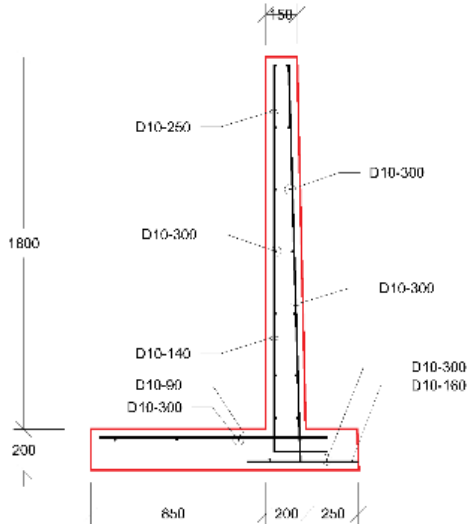


Figure 12. 1a Reinforcement Design

Type 1 Design Alternative

d. The depth of 1.75m

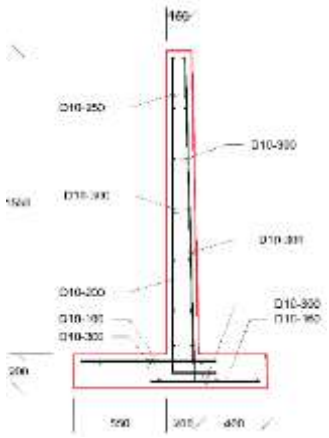


Figure 13. 1b Reinforcement Design

e. The depth of 1.50m

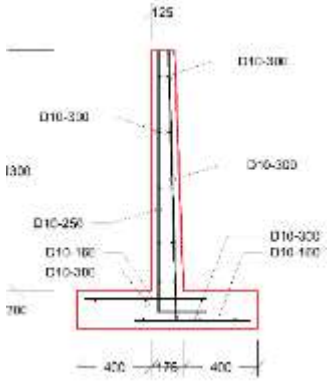


Figure 14. 1c Reinforcement Design

Type 1 Calculation Resume

Table 2. type 1 calculation resume

No.	Depth(m)	Cohesion (t/m^2)	Dynamic Safety Factor		Concrete Volume (m^3/m')	Reinforce-ment Volume (kg)
			Overtur-ning	Shifting		
1	2,00	2,00	1,57	1,51	0,58	37,07
2		1,75	1,99	1,53	0,62	38,40
3		1,50	2,20	1,50	0,63	41,38
4	1,75	2,00	1,55	1,58	0,50	28,92
5		1,75	1,70	1,52	0,51	29,24
6		1,50	1,91	1,50	0,52	31,10
7	1,50	2,00	1,51	1,76	0,30	24,38
8		1,75	1,60	1,66	0,39	24,78
9		1,50	1,60	1,51	0,39	24,88

3.2 Alternative Design

3.2.1 Load Scheme

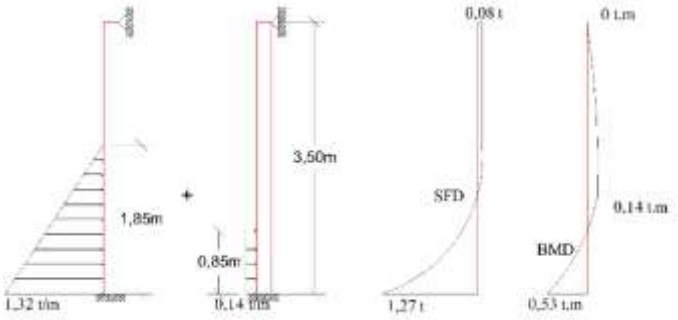


Figure 15. Static load scheme

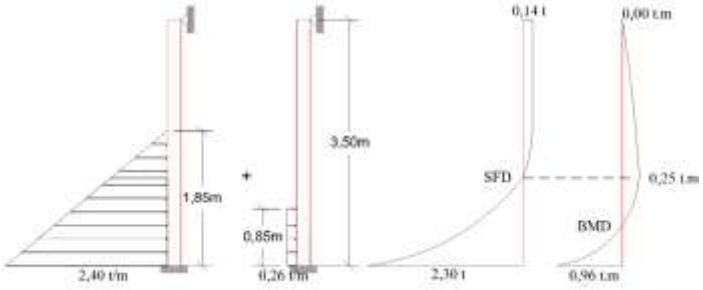


Figure 16. Dynamic load scheme

From the two conditions of the latitude diagram and the bending moment in the figure above, it is obtained:
Vu max = 1,6 (2,3) : 3,68 t
Mu-max = 1,6 (0,96) : 1,53 t.m
Mu+max= 1,6 (0,25) : 0,40 t.m

3.2.2 Sliding check

The basement walls will be designed with a thickness of 150mm.
So: d = 150mm - 75mm(cover) - 10mm(bar diameter = 65mm.

$$\phi Vc = \phi(0{,}17\lambda\sqrt{f'c}(b_w)(d) = 0{,}75(0{,}17)(1{,}0)(\sqrt{20})(1000)(65)$$

øVc = 37062N = 37,06 kN = 3,71 t > Vu (3,68t) ...OK!

3.2.3 Negative bending reinforcement

$$Rn = \frac{Mu}{\phi bd^2} = \frac{1{,}53x10^7}{0{,}9(1000)(65^2)} = 4{,}02$$

$$\rho need = \frac{0{,}85f'c}{fy}\left[1-\sqrt{1-\frac{2Rn}{0{,}85f'c}}\right] = \frac{0{,}85(20)}{400}\left[1-\sqrt{1-\frac{2(3{,}75)}{0{,}85(20)}}\right] = 0{,}0117$$

As need= ρbd = 0,0117(1000)(65) = 758,03mm²
And will be installed D10-100 (785mm²)

3.2.4 Positive bending reinforcement

$$Rn = \frac{Mu}{\phi bd^2} = \frac{0{,}40x10^7}{0{,}9(1000)(65^2)} = 1{,}04$$

$$\rho need = \frac{0{,}85f'c}{fy}\left[1-\sqrt{1-\frac{2Rn}{0{,}85f'c}}\right] = \frac{0{,}85(20)}{400}\left[1-\sqrt{1-\frac{2(1{,}04)}{0{,}85(20)}}\right] = 0{,}0027$$

As need= ρbd = 0,0027(1000)(65) = 174,47mm²

$$A_{s\min} = \frac{1,4}{fy} bd = \frac{1,4}{400}(1000)(65) = 227,50mm^2$$

And will be installed D10-300 (235,5mm²)

3.2.5 Reinforcement Design

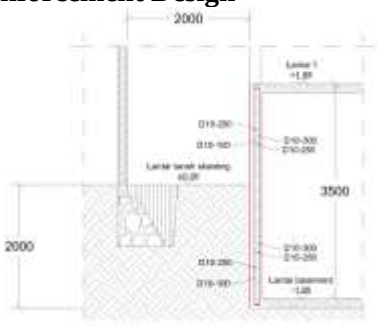


Figure 17. 2a Alternative Design

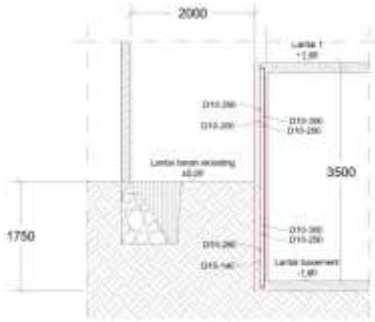


Figure 18. 2b Alternative Design

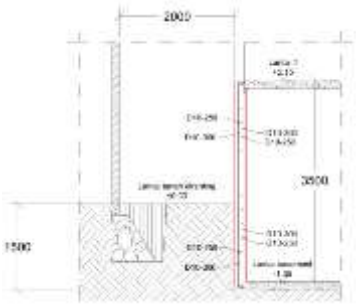


Figure 19. 2c Alternative Design

3.2.6 Alternative 2 Resume

Table 3.Type 2 calculation resume

No.	Depth(m)	Concrete Vol. (m^3/m')	Reinforcement Vol. (kg/m')
1	2.00	0,5025	47,29
2	1.75	0,5025	38,08
3	1.50	0,5025	34,18

Unit price analysis

Table 4. Unit price of concrete work f'c 20 Mpa

No.	Description		Unit	Index	Unit Price (Rp)	Sum Price (Rp)
A	Material	Portland Cement	Kg	371	1.360	522.240
		Concrete Sand	m3	0,494	260.000	128.514
		Gravel	M3	0,577	290.000	167.394
		Water	Lir	215	3	1.075
B	Man power	Workers	MP	1,65	90.000	148.500
		Stonemason	MP	0,275	100.000	27.000
		Head stonemason	MP	0.028	120.000	3.360
		Foreman	MP	0.083	150.000	12.450
	Total price per unit work					1.012.000

Table 5. Unit price of reinforced bar work per 10kg

No.	Description		Unit	Index	Unit Price (Rp)	Sum Price (Rp)
A	Material	Reinforced Bar	Kg	10,50	12.500	131.250
		Concrete wire	Kg	0,150	22.500	3.375
B	Man power	Worker	MP	0,070	90.000	6.300
		Stonemason	MP	0,070	100.000	7.000
		Head stonemason	MP	0,007	120.000	840
		Foreman	MP	0,004	150.000	600
Total price per unit work						150.000

Table 6. Unit price of excavation work

No.	Description		Unit	Index	Unit Price (Rp)	Total price (Rp)
1	Man power	Worker	MD	0,09	90.000	81.000
2		Foreman	MD	0,045	150.000	6.750
Total price per unit work						87.750

Table 7. Budget Comparison

No	Depth (m)	Cohesion (t/m^2)	Type 1 (Rp)	Type 2 (Rp)	Difference cost (Type1 – type 2) (Rp)
1	2,00	2,00	1.292.200	1.255.100	37.100
2		1,75	1.352.600	1.255.100	97.500
3		1,50	1.433.800	1.255.100	178.700
4	1,75	2,00	1.024.300	1.154.900	-130.600
5		1,75	1.046.800	1.154.900	-108.100
6		1,50	1.107.900	1.154.900	-47.000
7	1,50	2,00	788.800	1.021.200	-232.400
8		1,75	832.200	1.021.200	-189.000
9		1,50	833.700	1.021.200	-187.500

5. Conclussion And Suggestion

5.1. Conclussion

1. The depth of excavation will affect the shape, volume of concrete and volume of iron required for cantilevered walls because the deeper the excavation, the greater the soil pressure, whereas in conventional walls, the 3 types of depth do not affect the volume of concrete but only affect the volume of iron.
2. Soil cohesion is very influential on the volume of concrete and reinforcement bar volume. The higher soil cohesion, the more economical the cantilever wall will be, while the conventional walls, the soil cohesion has no effect on the volume of concrete nor the iron volume.
3. A suitable retaining wall in West Jakarta is a cantilevered wall for the depths of 1.50m and the depth of 1.75m, while for a depth of 2.00m, conventional walls will be more efficient given the condition in this research.

5.2. Suggestion

1. The calculation uses parameters that are correlated with previous studies so to obtain a more accurate size and reinforcement bar, soil investigation will be needed to determine the condition of existing soil parameters.
2. Cost efficiency can change depending on the depth and distance between the basement floors to the 1st floor, so a careful design is needed to maximize cost efficiency.
3. The distance to the fence and the backfill load design is needed so that we could know more about the difference in wall design.

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Analysis of The Cost Comparison of Bridge Floor Plate Formr on Toll Road Project

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Abstract

In this study, researchers wanted to discuss the installation of formisting to be installed on the floor plate structure between the girders inside the concrete bridge. In this case the authors want to know the comparison of cost analysis using conventional form form, bondek plate and deckslab. Because the Cost Budget Plan is very much related to the design and selection of materials to be used on girder bridge type I. In construction projects in Indonesia especially on the installation of formware residual material, the use of tools, the location of material procurement is very influential to the cost of construction work therefore it is necessary to be considered and taken into account carefully the selection of efficient formery so that the costs that will be incurred are not overbudget. In the research process this final task requires the foundations of the theory that support the problems that are reviewed. Through the study of literature is expected to be able to increase knowledge and study the basic theory used as a reference. At this stage the activity is a review of literature related to similar case studies from journals, literature books, and previous research reports. Cost analysis is reviewed in terms of services / labor namely, labor users for conventional systems and bondek in the same amount, while for deckslab precast less, but requires more precision. Cost analysis reviewed in terms of equipment, that is, for bondek system equipment does not require complicated equipment, unlike conventional ones that use scafolding aids as well as deckslab precast that use heavy equipment such as crawler cranes and hyab cranes. Price analysis in terms of materials namely, materials for conventional and bondek is very easy to obtain for the price depending on the area of the project location, for deckslab precast is required special supplier because the manufacture is directly from fabrication with a higher price when compared to conventional and bondek. Price analysis of each formisting system is, the installation of conventional formisting with a price of /m2 of Rp. 729,371. The total price of installing bondek form form with a price of /m2 is Rp. 367.593. Total installation price of deckslab precast form work with /m2 price of Rp. 803.795. From the results of the analysis, it can be concluded, that bondek form form form method is worth using for the toll bridge project because in terms of simpler methods and in terms of cost more efficient and effective.

Keywords
Comparison, Conventional, Cost, Deckslab Precast, Formse.

1. Introduction

The development of construction technology is currently progressing rapidly, which is characterized by the emergence of various types of modern materials and equipment. In ancient times with simple equipment can build monumental buildings that today still remain in use. With the development of this construction technology makes contractors consider all methods in the implementation of construction of several existing implementation methods. The way that contractors do that is by changing conventional methods to modern (Diandra, 2017).

A form of construction must qualify strength, rigidity, and stability. This requirement should be met given that formwork is repeated work on multi-storey buildings and costs a great deal to create (the American Concrete Institute). The cost for form formness ranges from 40%-60% of the cost of concrete work or about 10% of the total cost of building construction (Hidayat, Arif; Radian, 2017) Currently in Indonesia there are 3 types of formisting namely conventional form of form, semi system and system. The selection of types of form matter is an important decision on multi-storey building projects because it affects the cost, time of work and the quality of construction (Hidayat, Arif; Radian, 2017).

In construction projects in Indonesia especially on the installation of material residual formery, the use of tools, the location of material procurement is very influential to the cost of construction work therefore it is necessary to be considered and taken into account carefully the selection of efficient formery so that the costs that will be incurred are not overbudget . Easy, safe, and fast installation method is required because it has a very influential effect on baiaya that will be issued later. In this study, researchers wanted to discuss the

installation of formisting to be installed on the floor plate structure between the girders inside the concrete bridge. In this case the authors want to know the comparison of cost analysis using conventional form form, bondek plate and deckslab. Because the Budget Plan is very much related to the design and selection of materials to be used on the girder bridge type I.

2. Library Overview

According to Project Management Institute (2017) a project is a temporary effort made to create unique products, services, and results. A project can involve a single organizational unit or multiple organizational units. In the journal Henong (2016) construction projects are one form of activity that takes place in a limited time and uses resources and costs that have been taken into account, to achieve results in the form of buildings or infrastructure.

According to S AbhiyanD R PatelNeerajd SharmaBhavinkkashiyani (2013) explained that, Bekisting is a shaper or mold including all supporting structures, which are used to form and sustain concrete until it reaches enough strength to sustain its own weight. This form of formness should be able to carry all the dead loads and forced burdens in addition to the weight itself.

The floor yard is a thin structure made of reinforced concrete with horizontal direction and load that works perpendicularly on the field of the structure so that in the building this court building serves as a diaphragm or horizontal edict element that is very useful to support the kink of the portal beam. In the planning, the floor plate must be made flat, rigid and straight so that the user of the building can steadily massage his feet. Things that are taken into account include a fixed load that works for a long time. Other things like unexpected loads of earthquakes, winds, tremors, etc. are not taken into account (Harya Wisanggeni, 2017).

2.1. Conventional Formery Reasoning Method

The wooden method used is the structure of the floor plate that is done in a direct casting site that covers the whole by using plywood as a formwork and scaffolding as scaffolding. This method is quite ancient and most widely used but can take a long time and cost.

2.2. Decklsab Installation Method

The floor structure of the decklsab method is a reinforced concrete floor plate work in a half precast way and the other half is made on site. The reason is only made half precast because adjusting the maximum load that is still safely lifted by the crane, if the project location is available machine that is able to lift the entire thickness of the plate then it would be better if using a single precast system intact, this can happen on a floor with a small span.

2.3. Bondek Installation Method

Bondek method is a substitute for wood formwork that is permanently installed on the plate, by replacing the lower bone into a bondek plate in hopes of saving the iron of the bone and the formwork of the bottom. Upper bones can be made in the form of bars or can also be replaced with wiremesh iron or threaded iron to be faster in installation. As well as the method of installation is considered easier than using wood formwork. The use of bondek is expected to speed up the time of making floor plates when compared by wood.

3. Research Methods

Research flow chart in figure 1. This research method uses two ways of data retrieval techniques, namely primary data and secondary data.

The sequence of stages used for research is as follows:

1. Data Collection Literature Study: Calculation of conversion of Form form of structure, floor plate. regulations or SNI related to bekisting work, implementation method, project unit price.
2. Calculation of conventional method materials, Deck slab and Bondek methods.
3. Calculation of the cost of work analyzed from BoQ Project, Project Unit Price Analysis.
4. Calculation of time and number of workers based on labor coefficient (Badan Standardisasi Nasional, 2008)

3.1. Diagram Alir Penelitian

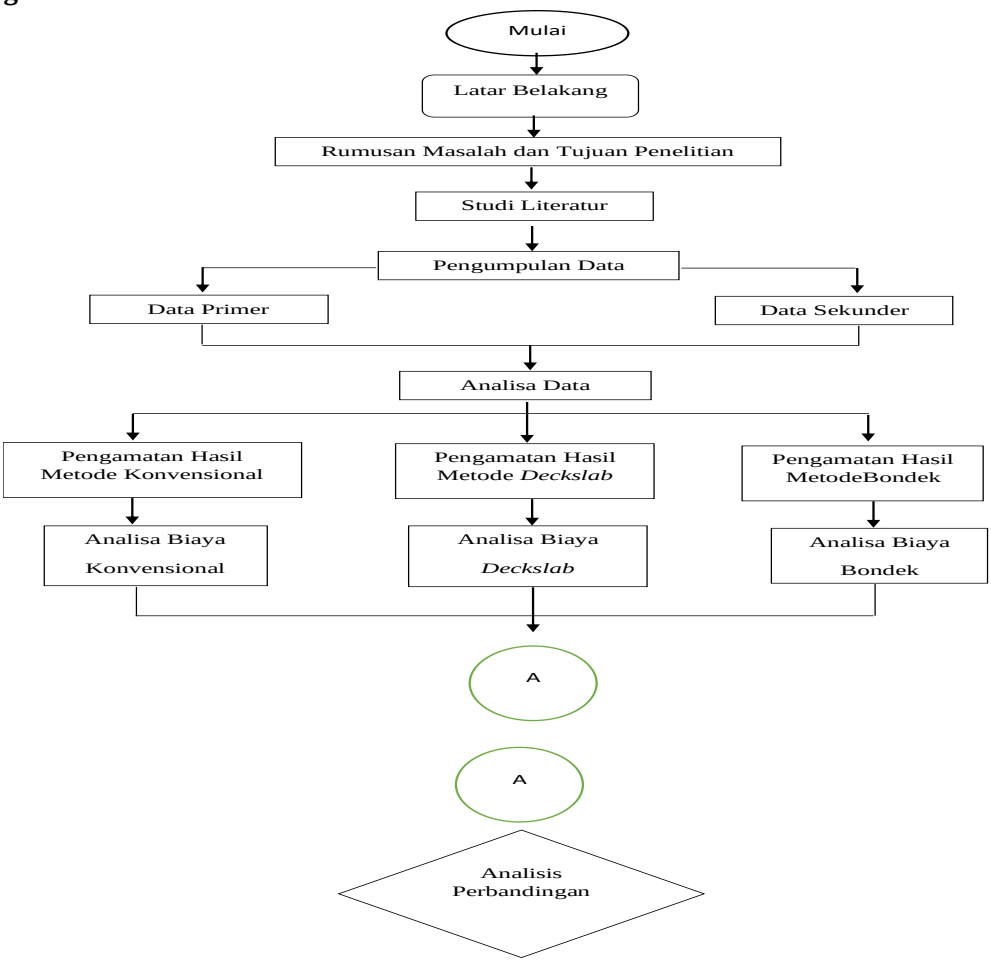

Figure 1 Flowchart
Source: Research Data

3.2. Research Place and Time

Place : This research was conducted in Project xyz. This project is a bridge project (Toll Road).
Time: The time of this study lasts about 1 month, which is divided into two stages. The first stage is to conduct observations and interviews located at the XYZ project site. The second phase is the implementation phase which includes data processing.

4.Discussion

4.1. Conventional Methods

Tabel 1 Conventional Material Price List

Berdasarkan Pekerjaan m^2				
No	Deskripsi	Satuan	Harga (Rp)	Keterangan
1	Material			
	Multyplex 12mm	lembar	175.400	
	Besi Hollow	lembar	96.000	
	Minyak bekisting	lembar	7.100	
	Paku	lembar	16.700	

Tabel 2 Conventional Labor Price List

Berdasarkan Pekerjaan m2				
No	Deskripsi	Satuan	Harga (Rp)	Keterangan
2	Tenaga Kerja			
	Tukang	OH	150.000	
	Mandor	OH	198.000	

Source: SNI (2018)

Tabel 3 Conventional Equipment Price List

Berdasarkan Pekerjaan m				
No	Deskripsi	Satuan	Harga (Rp)	Keterangan
3	Peralatan			
	Scaffolding	Set		
	Main Frame 180	unit	10.000	
	Cat walk	unit	40.000	
	Joint Pin	unit	3.500	
	Balok kayu	Batang	28.000	
	Jack base	unit	9.000	
	U-head 60cm	unit	10.000	
	Cross brace	unit	8.000	

Tabel 4 Conventional Bekisting Price Analysis

No	Item Perkerjaan	Volume	Satuan	Harga Satuan	Harga Pekerjaan	
A	Pekerjaan plat Lantai Sistem konevensional per m2					
1	material					Rp 325.573
	Multyplex 12mm	0,0875	lbr	175.400	15.350	
	Besi Hollow	0,2002	btg	96.000	19.223	
	balok kayu	2,00	btg	140.000	280.000	
	Paku	0,64	kg	16.700	11.000	
2	man power					Rp 122.500
	tukang	0,7424	OH	150.000	111.364	
	mandor	0,0562	OH	198.000	11.136	
3	machine					Rp 279.026
	frame 180	4	bh	10.000	40.000	
	Cat walk	1	bh	40.000	40.000	
	pin	8	bh	3.500	28.000	
	cross brace	16	bh	8.000	128.000	
	U-head	2	bh	10.000	20.000	
	base jack	2	bh	9.000	18.000	
	alat kerja	1	lot	5.000	5.000	
	gerinda	0,0096	jam	2.720	26	
4	consumable					Rp 2.272
	minyak bekisting	0,3200	ltr	7.100	2.272	
					TOTAL	Rp 729.371

4.2. Bondek Method

Tabel 5 Material Bondek Price List

No	Deskripsi	Satuan	Harga (Rp)	Keterangan
1	Material			
	Semen	Sak	65.000	50 kg
	Besi Beton	Kg	9.000	SNI bjtd 40
	Pasir	M	243.000	
	Bondek	M	106.700	

Source: Penawaran Harga Supplier (2018)

Tabel 6 Bondek Labour Price List

Berdasarkan Pekerjaan m2				
No	Deskripsi	Satuan	Harga (Rp)	Keterangan
2	Tenaga kerja			
	Tukang	OH	150.000	
	Mandor	OH	198.000	

Tabel 7 Bondek Equipment Price List

	Harga (Rp)	Ket.	Harga satuan (Rp)	Ket.	Total harga
Biaya Gerinda					2.720
Alat gerinda	850.000	1 bln	1.250	jam	
Cutting disk	50.000	week	70	jam	
Listrik	1.000.000	bln	1.400	jam	

Tabel 8 Bondek Bekisting Price Analysis

No.	Item Perkerjaan	Volume	Satuan	Harga Satuan	Harga Pekerjaan	
B	Pekerjaan plat Lantai Sistem Bondek per m2					
1	material					Rp 240.067
	Portland cement	0,0450	sak	65.000	2.925	
	Besi D22	5,96	kg	10.900	64.964	
	pasir beton	0,0060	m3	243.000	1.458	
	plat bondek	1,600	m2	106.700	170.720	
2	man power					Rp 122.500
	tukang	0,7424	OH	150.000	111.364	
	mandor	0,0562	OH	198.000	11.136	
3	machine					Rp 5.026
	Gerinda	0,0096	jam	2.720	26	
	Alat kerja	1	lot	5.000	5.000	
				TOTAL		Rp 367.593

4.3 Deckslab Precast Method

Tabel 9 Material Deckslab Price List

Berdasarkan Pekerjaan m^2				
No	Deskripsi	Satuan	Harga (Rp)	Keterangan
1	Material			
	Deckslab precast	m2	318.200	

Tabel 10 Deckslab Labor Price List

Berdasarkan Pekerjaan m2				
No	Deskripsi	Satuan	Harga (Rp)	Keterangan
2	Tenaga kerja			
	Tukang	OH	150.000	
	Mandor	OH	198.000	

Tabel 11 Deckslab Equipment Price List

Berdasarkan Pekerjaan m^2					
		Total harga	Jumlah biaya	Luas area	Harga *crane per* m^2
Hyab crane		55.225.000	172.175.000	395,52	435.313
- Mobdemob	2.000.000				
- Sewa rental	40.000.000				
- Operator	7.000.000				
- Bahan bakar	6.225.000				
Crane 50T		116.950.000			
- Mobdemob	7.500.000				
- Sewa rental	90.000.000				
- Operator	7.000.000				
- Bahan bakar	12.450.000				

Sumber: Penawaran Harga Supplier (2018)

Tabel 12 Deckslab Precast Bekisting Price Analysis

no.	item perkerjaan	volume	satuan	harga satuan	harga pekerjaan	
C	Pekerjaan plat Lantai Decksclab Precaast per m2					
1	material					Rp 509.120
	Deckslab Precast t = 80mm	1.6	m2	318.200	509.120	
2	man power					Rp 122.500
	tukang	0,7424	OH	150.000	111.364	
	mandor	0,0562	OH	198.000	11.136	
3	machine					Rp 172.175
	crawler crane	0,0010	bulan	116.950.000	116.950	
	hyap crane	0,0010	bulan	55.225.000	55.225	
				TOTAL		Rp 803.795

Tabel 13 Recapitulation of Floor Plate Form forming Costs

Perbandingan Biaya Bekisting Lantai Jembatan Proyek Tol Bocimi			
No.	1	2	3
Metode yang digunakan	**Konvensional**	**Bondek**	***Deckslab Precast***
Keterangan	Bekisting multiplek dengan bantuan besi hollow	Bekisting baja yang bentuknya bergelombang	Bekisting *precast* berbentuk segiempat
Luas plat lantai seluruhnya (m^2)	2.925	2.925	2.925
Biaya /m^2 (Rp)	**Rp 729.371**	**Rp 367.593**	**Rp 803.795**

Tabel 14 Labor Productivity

Uraian	Konvensional	Bondek	Deckslab
Luas area (m^2) (a)	2.925	2.925	2.925
Pekerja (b)	2	2	1
Tukang (c)	8	8	4
Mandor (d)	1	1	1
Rigger (d')	-	-	2
Operator *Crane*	-	-	1
Hari kerja (hari) (e)	7	7	7
Total man days (f = (b + c + d+d') x e)	77	77	63
Produktivitas (g)	Luas area/ mandays (g = a/f)	Luas area/ mandays (g = a/f)	Luas area/ mandays (g = a/f)
(m2/orang/hari)	37,98	37,98	46,42

5. Results and Conclusions

From the analysis of conventional methods and deck slab and bondek methods above, it can be concluded that from the three methods of implementation each can be compared:

1. The results of the comparison of implementation methods between conventional form form work, bondek and deckslab precast are more effective and feasible to be used on the floor plate of toll road bridge X,Y,Z i.e. as follows:

a. Analytically, the advantages of bondek formage and deckslab precast can be used forever, but not for conventional formage that only has a lifespan of 4x usage and causes waste material.
b. Conventional formwork methods require tools such as scaffolding as scaffolding on bridges, and for deckslab precast methods require the help of heavy equipment such as cranes for heavy precast erection and unable to use the power of workers.
c. Bondek formwork installation method is easier and simpler, because it does not require difficult enough equipment and the working process does not require such amperial space.

2. Based on the results of the cost analysis that has been done, it can be noted that the large cost incurred on the bridge floor plate work using conventional form form form system, bondek system and deckslab precast is for

conventional form work cost of Rp 729,371, for bondek form form of Rp 367,593, and for precast deckslab of Rp 803,795. Thus it can be concluded that the most cost incurred is bondek system.

5.1. Advice

From the analysis of the method of form form of the floor plate of the bridge, the advice that can be conveyed is as follows:

1. When wanting to do cost analysis on each method of floor plate form work should be done survey to the supplier because the costs incurred affect the area of the job site.
2. Be more careful in understanding each method of project work in order to make the Budget Plan (RAB) easier and more precise.
3. Further research is needed for each method of form a form of bridge floor plate, if you want to be used as a reference for further research.
4. More in the science of cost analysis from previous studies as well as by reading literature on the cost analysis of floor plate form form.

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Analysis of The Acceleration of Time and Cost of Construction Projects by Adding Labor and Working Hours (Overtime) using The Time Cost Trade Off Method (Case study: Construction of The Conexio Apartment Project)

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Abstrack

Systematic project management is needed to ensure the project implementation time is in accordance with the contract or even faster, so the cost incurred can provide benefits and also avoid the existence of fines due to delays in project completion. This study discusses the acceleration of time and cost project in the implementation of high rise building construction projects using the Time Cost Trade Off method. The author will analyze the scenario of accelerating the completion of the project by comparing the addition of working hours by 4 hours (scenario 1) and additional labor (scenario 2). The results of the analysis found the estimated time to accelerate the implementation of the project is from the normal duration of 600 calendar days, after a crash duration there is an acceleration of time to 582 calendar days. With a time efficiency of 18 days / 3.00%. The total cost due to acceleration of time (including indirect cost) for the addition of overtime hours for 4 hours (scenario 1) obtained a normal cost of IDR 66,637,746,719 (excl. VAT), then after the crash cost there is an increase in the cost to IDR 70,224,661,008 (excl. VAT) with an over cost of IDR 3,586,914,289 / 5.38%. Whereas with the addition of labor (scenario 2) a normal cost of IDR 66,637,746,719 (excl. VAT), then after the crash cost there is an increase in the cost to IDR 71,454,128,134 (excl. VAT) with an over cost of IDR 4,816,381,415 / 7.23%.

Keywords :
Crash Cost, Crash Duration, Project Acceleration, Time Cost Trade Off

1. Introduction

Time and cost greatly affect the success and failure of a project. Benchmarks for project success are usually seen from the short completion time at minimal cost without leaving the quality of the work. Systematic project management is needed to ensure that the project implementation time is in accordance with the contract or even faster, so that the cost incurred can provide benefits, and also avoid fines due to delays in project completion (Priyo, M., Sumanto, 2016).

This study discusses the acceleration of time and project cost in the implementation of the High Rise Building Project with the Time Cost Trade Off method. This method can be done by the method of implementing work by increasing the workforce, adding equipment or increasing work hours (overtime). To be able to achieve this, what must be done in order to accelerate time and cost is to create a project network, look for critical activities and calculate the duration of the project and know the number of resources.

In this case study, the project development experienced a work delay of -5.47% so that it would result in the postponement of completion of the completion of the Structural and Architectural work, while the target of the Owner was to hand over the Apartment Unit to consumers in July 2020 and to avoid contractor penalties due to late work. To find a solution to this, it is necessary to carry out an analysis of the acceleration of the implementation of the Structural work so that the project construction can be completed on time.

2. Stage of Problem Identification

In this case study project, it is known that per the end of August 2019 based on the weight of the S-curve, the work progress has a deviation of -5.47% from the cumulative plan of 36.99%. In addition, from the data obtained from the field, the workforce from the Formwork Sub-Construction has decreased greatly, with an average of 15 people in July 2019 and 12 people in August 2019, so that progress has decreased.

3. Scope and Limitation of the Problem

In general, the scope to be discussed in this study is as follows:

1. Time acceleration analysis using the Time Cost Trade Off method on projects that are experiencing delays.
2. Analysis of cost arising from the acceleration of the duration of the project so that direct and indirect cost can be found.

4. Analysis of Acceleration of Project Time and Cost

4.1 Accelerate Project Completion Time

There are four factors that can be optimized to carry out acceleration in an activity, which includes scheduling additional working hours (overtime), increasing the number of workers, using heavy equipment and changing construction methods in the field (Frederika, 2010).

1. Additional working hours (overtime)
   Overtime work can be done by increasing the hours worked every day with the same resources without increasing the workforce. The addition of working hours aims to increase production for one day so that the completion when adding work hours needs to pay attention to the length of time someone works so that it can cause that person's productivity to decrease due to being too tired. The reduced productivity value, especially for overtime work with the same human resources, can be seen in Figure 4.1.
2. Implementation of additional workforce
   The addition of manpower is intended as an increase in the number of workers in one work unit to carry out a certain activity without adding working hours. An optimum addition of labor will increase work productivity, but adding too much will actually reduce labor productivity due to various reasons, such as too little land to work and difficulty in supervision.

With the acceleration of this project there will be a reduction in the duration of activities. The total project cost is the sum of the direct cost and the indirect cost incurred by the project. The amount of the total cost depends on the length of the project implementation time. Both will change according to the time and progress of the project even though it cannot be calculated with a certain formula, but generally the longer the project runs, the higher the cumulative indirect cost required.

4.2 Time and Cost Relations

To determine the relationship between time and cost of an activity can be seen in Figure 4.2. Point A indicates normal conditions, while point B indicates accelerated conditions. The line connecting these points is called the time cost curve (soeharto, 1999)

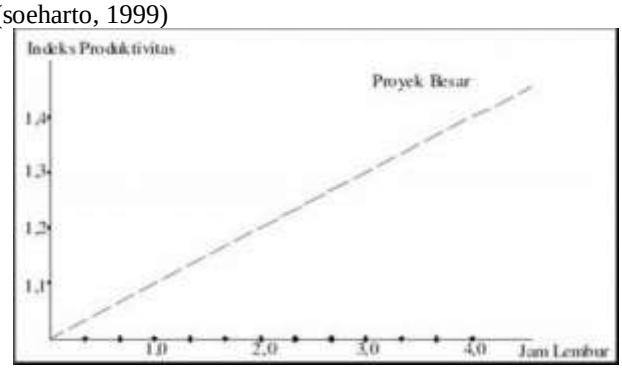

Figure 1. Graph of indication of decreased productivity due to overtime work

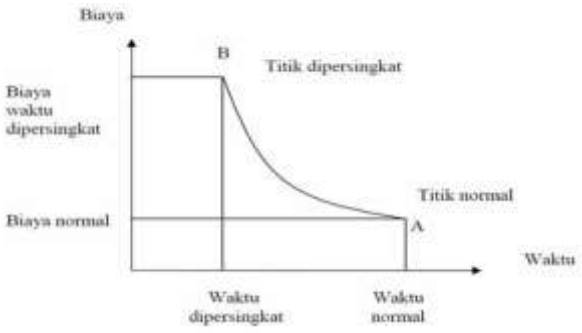

Figure .2 Normal and shortened time-cost relationship grap

There are two time values that will be shown by each activity in a network when there is an acceleration yaitu (ardika o p, 2014) :

1. Normal Duration
   The time needed to complete an activity or activities with existing normal resources without any additional cost in a project.
2. Crash Duration
   The time required by a project in its attempt to shorten the duration is shorter than normal duration.
   The acceleration process also causes changes in the cost elements, namely:
3. Normal Cost
   Cost incurred with the completion of the project in normal time. This cost estimate is at the time of planning and scheduling along with normal time determination.
4. Crash Cost
   The cost used to carry out the activity in a period is equal to the duration of its acceleration. This cost spurred work to be completed faster. The cost of the crash will be greater than the original cost, this is because the time is faster than normal.

In the end, the acceleration of the project duration can lead to an increase in direct cost that are used to increase the level of work productivity.

Definition of time cost trade off is a deliberate, systematic, and analytical process by testing all activities in a project that are focused on activities that are on a critical path. Next, do the compression starting from the critical path which has the lowest cost slope value. As for the formulation of the cost slope is as follows (Ervianto, 2004) :

$$\text{Cost Slope} = \frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal Duration} - \text{Crash Duration}}$$

5. Methodology and Work Stages

The stages in the analysis of the calculation of time and work cost are as follows:

5.1 Additional Overtime Hours (Scenario 1)

1. Calculate the coefficient of reduction in worker productivity

The normal working time for workers is 8 hours (starting at 08.00 and finishing at 17.00 with one hour of rest). In this alternative, this is done by providing an additional 4 hours of overtime work. The productivity reduction coefficient can be calculated using a graph indicating a decrease in productivity due to overtime working hours Figure 4.1. The calculation of the decrease in productivity due to overtime working for 4 hours is as follows:

Difference in productivity index = 1,4 – 1,3
= 0,1

Where can be calculated the difference in productivity index value is 0.1 in every hour. The calculation for overtime work for 4 hours is as follows:

Decreased work performance = 0,1 x 4 hours = 0,4/hours
Percentage reduction = 0,4 x 100% = 40%
The coefficient of reduced productivity due to overtime working for 4 hours:
= 100% - 40%
= 60% ~ 0,6

Furthermore, the coefficient of reducing productivity due to overtime working hours can be seen in the following table:

Table 1. The Coefficient of Reducing Productivity

Overtime Hours (hours)	Productivity Index Decrease	Decrease in Work Performance (/hour)	Percentage of Decreased Job Performance (%)	Productivity Reduction Coefficient
A	b	c = a x b	d = c x 100%	e = 100% - d
1	0.1	0.1	10%	0.9
2	0.1	0.2	20%	0.8
3	0.1	0.3	30%	0.7
4	0.1	0.4	40%	0.6

Source: Data Processing Results, 2020

2. Calculate daily productivity, with formulas:

Daily Productivity $= \frac{Job\ Volume}{Job\ Duration}$

The results of daily productivity calculations can be seen in the following table:

Table 2. The Result of Daily Productivity

Job description	Unit	Lower Structural Work	Upper Structural Work
Concrete work	m3/day	11.39	22.30
Iron work	Kg/day	1,667.81	4,051.22
Formwork	m2/day	49.45	143.14

Source: Data Processing Results, 2020

3. Calculating hourly productivity, using the formula:

Productivity / hour $= \frac{Daily\ productivity}{8\ hours}$

The results of the calculation of hourly productivity can be seen in the following table :

Table 3. The Result of the Calculation of Hourly Productivity

Job description	Unit	Lower Structural Work	Upper Structural Work
Concrete work	m3/day	1.42	2.79
Iron work	Kg/day	208.48	506.40
Formwork	m2/day	6.18	17.89

Source: Data Processing Results, 2020

4. Calculate daily productivity after crash

In this calculation daily productivity is added to the results of labor productivity for 4 hours of overtime work, with the formula:

= (8 hours x prod. / hour) + (decreased work performance x prod. / hour)

The results of daily productivity calculations after the crash can be seen in the following table:

Table 4. The Result of Daily Productivity Calculation After The Crash

Job description	Unit	Lower Structural Work	Upper Structural Work
Concrete work	m3/day	11.96	23.41
Iron work	Kg/day	1,751.20	4,253.79
Formwork	m2/day	51.92	150.30

Source: Data Processing Results, 2020

5. Counting crash duration, with the formula:

Crash duration $= \frac{Job\ Volume}{Daily\ Productivity\ After\ Crash}$

The results of the calculation of crash duration can be seen in the following table:

Table 5. The Result of The Calculation of Crash Duration

Job description	Unit	Lower Structural Work	Upper Structural Work
Concrete work	Day	315	372
Iron work	Day	315	372
Formwork	Day	315	372

Source: Data Processing Results, 2020

So that the crash duration from the start of the structure work to the completion of the structural work if calculated based on the S-Curve schedule is as follows:

1. Preparation & Foundation Work = 120 day / 4 month
2. Soil work = 90 day / 3 month
3. Lower Structure Work to Upper Structure = 372 day / 12,4 month +
4. *Total crash duration* = *582 day / 19,4 month*

6. Calculate the total crash cost

Based on the decree of the Minister of Manpower and Transmigration of the Republic of Indonesia Number KEP.102/MEN/VI/2004 whereas the wages for additional work vary, for the addition of the first hour of work, the worker is paid 1.5 times the normal hourly wage and for the next additional work hour the worker gets 2 times the normal hourly wage.

The calculation of cost due to additional overtime working hours can be formulated as follows:

1. Normal wages of workers daily,
   = Productivity daily x Unit price for workers' wages
2. Normal wages of workers / hour,
   = Productivity / hour x Unit price for workers' wages
3. Overtime fee of 4 hours (1 day),

a. = (1,5 x Normal hourly wages (first hour of overtime work)) + (2n x Normal hourly wages
b. (for the next hour of overtime))
c. *) n = Additional working hours

The results of calculating the cost of overtime working 4 hours (1 day) can be seen in the following table:

Table 6. The results of calculating the cost of overtime working

d. Lower Structural Work

NO	Job description	Unit	Normal hourly wages (IDR/ hour)	First hour of overtime work (IDR/1 hour)	For the next hour of overtime (IDR/3hour)	Overtime fee of 4 hours (IDR)
1	Concete work					
	-Wages for installing a concrete stop	m3	7,119.73	10,679.59	42,718.37	53,397.97
	-Concrate curing waages	m3	22,783.13	34,174.70	136,698.80	170,873.50
	-Wages for cast concrete with a pump	m3	46,990.21	70,485.32	281,941.27	352,426.59
2	Iron Work					
	-Wages lower iron	kg	5,211.89	7,81.84	31,271.37	39,089.21
	-Wages for installing iron	kg	187,628.21	281,442.31	1,125,769.25	1,407,221.56
3	Form work					
	-Wages for installing formwork	m2	219,546.66	329,319.99	1,317,279.96	1,646,599.95

Source: Data Processing Results, 2020

Table 7. The results of calculating the cost of overtime working

e. Upper Structural Work

NO	Job description	Unit	Normal hourly wages (IDR/ hour)	First hour of overtime work (IDR/1 hour)	For the next hour of overtime (IDR/3hour)	Overtime fee of 4 hours (IDR)
1	Concete work					
	-Wages for installing a concrete stop	m3	13,935.02	20,902.52	83,610.10	104,512.62
	-Concrate curing waages	m3	44,592.05	66,888.08	267,552.31	334,440.38
	-Wages for cast concrete with a pump	m3	91,971.11	137,956.66	551,826.63	689,783.29
2	Iron Work					
	-Wages lower iron	kg	12,660.07	18,990.11	75,960.45	94,950.56
	-Wages for installing iron	kg	455,762.69	683,644.03	2,734,576.13	3,418,220.16
3	Form work					
	-Wages for installing formwork	m2	635,558.61	953,337.92	3,813,351.68	7,766,689.60

Source: Data Processing Results, 2020

4. Crash Cost of workers wages daily
= Normal wages of workers /day + Worker's overtime cost /day

The results of the calculation of the Crash Cost of workers wages per day can be seen in the following table:

Table 8. The results of calculating the cost of overtime working

a. Lower Structural Work

NO	Job description	Unit	Normal hourly wages (IDR/ hour)	Overtime fee of 4 hours (IDR)	Crash cost of workers' wages (IDR/day)
1	Concete work				
	-Wages for installing a concrete stop	m3	56,957.83	53,397.97	110,355.80
	-Concrate curing waages	m3	182,265.06	170,873.50	353,138.56
	-Wages for cast concrete with a pump	m3	375,921.69	352,426.59	728,348.28
2	Iron Work				
	-Wages lower iron	kg	41,695.16	39,089.21	80,784.37
	-Wages for installing iron	kg	1,5011,025.67	1,407,211.56	2,908,237.23
3	Form work				
	-Wages for installing formwork	m2	1,756,373.28	1,646,599.95	3,402,973.23

Source: Data Processing Results, 2020

Table 9. The results of calculating the cost of overtime working

b. Upper Structural Work

NO	Job description	Unit	Normal hourly wages (IDR/ hour)	Overtime fee of 4 hours (IDR)	Crash cost of workers' wages (IDR/day)
1	Concete work				
	-Wages for installing a concrete stop	m3	111,480.13	104,512.62	215,992.75
	-Concrate curing waages	m3	356,736.41	334,440.38	691,176.79
	-Wages for cast concrete with a pump	m3	735,768.84	689,783.29	1,425,552.13
2	Iron Work				
	-Wages lower iron	kg	101,280.60	94,950.56	196,231.16
	-Wages for installing iron	kg	3,646,101.50	3,418,220.16	7,064,321.67
3	Form work				
	-Wages for installing formwork	m2	5,084,468.90	4,766,689.60	9,851,158.50

Source: Data Processing Results, 2020

5. Total crash cost

= Crash Cost of workers wages /day x Crash Duration

The results of the total crash cost calculation can be seen in the following table:

Table 10. The results of calculating the cost of overtime working

a. Lower Structural Work

No	Job desciption	Unit	Crash cost of worker's wages (IDR/day)	Crash duration (day)	Total wagr crash cost (IDR)
1	Concrete work				
	-Wages for installing concrete stop	m3	110,355.80	315.00	34,762,076.92
	-Cocrete curing wages	m3	353,138.56	315.00	111,238646.15
	-Wages for cast concrete with a pump	m3	728,348.28	315.00	229,429.707.68
2	Iron work				
	-Wages Lower iron	Kg	80,784.37	315.00	25,447,705.75
	-Wages for installing iron	Kg	2,908,237.23	315.00	916,094,726.91
3	Form work				
	-Wages for installing formwork	m2	3,402,973.23	315.00	1,071,936,568.36
				Total crosh	2,388,908,801.76

Source: Data Processing Results, 2020

For material and subcontractor cost for earthworks and foundations (A) IDR 11,651,727,571 as well as lower structure works (B) IDR 10,649,939,567 determined based on the normal price obtained from the contractor. So that the total crash cost for substructure and foundation work are as follows:

= The total crash cost of lower structure wages + (A) + (B)

= IDR 2,388,908,801 + IDR 11,651,727,571 + IDR 10,649,939,567

= IDR 24,690,575,940

Table 11. The results of calculating the cost of overtime working 4 hours

b. Upper Structural Work

No	Job desciption	Unit	Crash cost of worker's wages (IDR/day)	Crash duration (day)	Total wagr crash cost (IDR)
1	Concrete work				
	-Wages for installing concrete stop	m3	215,992.75	372.00	80,349,301.91
	-Cocrete curing wages	m3	691,176.79	372.00	257,117,766.10
	-Wages for cast concrete with a pump	m3	1,425,552.13	372.00	530,305.392.59
2	Iron work				
	-Wages Lower iron	Kg	196,231.16	372.00	72,997,990.55
	-Wages for installing iron	Kg	7,064,321.67	372.00	916,094,726.91
3	Form work				
	-Wages for installing formwork	m2	9,851,158.50	372.00	3,664,630,960.98
				Total crosh	7,233,329,071.85

Source: Data Processing Results, 2020

For the cost of materials and subcontractors for the upper structure work (C) IDR 26,601,344,562 determined based on the normal price obtained from the contractor. So that the total crash cost for superstructure work is as follows:

= *The total crash cost of upper structure wages + (C)*
= IDR 7,233,329,071 + IDR 26,601,344,562
= IDR 33,834,673,634

6. Calculation of indirect cost in the addition of overtime working hours

For the calculation of indirect cost, the unit price is obtained from the contractor, so that the calculation of the Crash cost at the Indirect Cost cost can be formulated as follows:

= *Duration after crash (month) x Unit Price*

The results of the calculation of indirect cost can be seen in the following table:

Table 12.. The results of the calculation of indirect cost s

No	Job description	Unit	Volume normal duration (month) a	Volume crash duration (month) b	Unite price / month (IDR) c	Total (IDR) D = b x c
1	General/ / overhead cost					
	Staff salary cost	Month	20.00	19.40	189,422,500	3,674,769,500
	Operating cost	Month	20.00	19.40	28,934,050	561,320,570
	Project office cost	Month	20.00	19.40	36,288,500	703,996,900
	Overhead cost	Month	20.00	19.40	7,452,750	144,583,350
	Kitchen cost	Month	20.00	19.40	26,198,095	508,243,044
2	Tool cost					
	Tower crane	Month	20.00	19.40	63,590,00	1,272,446,000
	Pessenger holst	Month	5.00	4.40	44,000,000	193,600,000
	Concrete pump etc.	Month	7.00	6.40	93,400,000	597,892,034
	PLN electricity cost	Month	20.00	19.40	49,633,610	962,892,034
	Rent a survey tool	Month	20.00	19.40	2,612,500	50,682,500
	Rent iron fabrication tools	Month	20.00	19.40	7,050,000	136,770,000
	Rent a compressor	Month	7.00	6.40	9,914,286	63,451,429
	Rent a vibrator	Month	7.00	6.40	21,142,857	135,314,286
	Genset cost 150 KVA	Month	1.00	1.00	182,170,000	182,170,000
	Work ald cost	Month	20.00	19.40	11,550,000	224,070,000
3	Cost of facilliaties – Project infrastrustur					
	Project office creation	Month	1.00	1.00	887,928,800	887,928,800
	K3 equipment	Month	20.00	19.40	17,416,566	337,881,379
	Rent a scaffolding	Month	20.00	19.40	6,005,836	116,513,210
	Electricity & water cost	Month	20.00	19.40	43,001,008	834,219,552
	Backup cleaning cost	Month	20.00	19.40	5,709,891	110,771,880
					Total	11,669,411,433

Source: Data Processing Results, 2020

So that the total Crash cost value due to the addition of 4 hours of work (Scenario 1) is as follows:

Crash cost of substructure and foundation work = IDR 24,690,575,940
Crash cost of upper structure work = IDR 33,834,673,634
Crash cost for indirect cost = IDR 11,699,411,433 +
Total Cost (Excl. VAT) = IDR 70,224,661,008

7. Calculating the cost slope, using the formula:

$$\text{Cost Slope} = \frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal Duration} - \text{Crash Duration}}$$

$$= \frac{70{,}224{,}661{,}008 - 66{,}637{,}746{,}719}{600 \text{ day } (20 \text{ month}) - 582 \text{ day } (19.4 \text{ month})}$$

$$= \text{IDR } 199{,}273{,}016$$

5.2 Additional Workforce (Scenario 2)

Another strategy taken to accelerate the project duration is by increasing the number of workers. The coefficient of labor uses the SNI coefficient with the duration of the work using the results of the crash duration calculation in Scenario 1, so that it can be compared with the same amount of duration between the two scenarios. The steps for crashing the program in scenario 2 are as follows:

1. Calculate the number of workers and the cost of wages of workers

The labor coefficient on Concrete, Ironing and Formwork can be seen in the table below:

Table 13. The labor coefficient on Concrete, Ironing and Formwork

No	Job description	Unit	Labor Coefficient			Labor Unit Price		
			Concrete work (1m3)	Iron work (1kg)	Formwork (1m2)	Concrete work (IDR)	Iron work (IDR)	Formwork (IDR)
1	Workers	Oh	1.323	0.007	0.660	75,000.00	75,000.00	75,000.00
2	Repairman	Oh	0.189	0.007	0.330	85,000.00	90,000.00	90,000.00
3	Foreman	Oh	0.019	0.001	0.033	90,000.00	100,000.00	100,000.00
4	Foreman	Oh	0.132	0.000	0.033	100,000.00	100,000.00	100,000.00

Source: SNI

For the calculation of the amount of labor and wage cost using the following formula:

$$\textit{Total manpower} = \frac{\textit{Labor Coefficient x Volume}}{\textit{Job Duration}}$$

$$\textit{Labor Wages} = \textit{Total manpower x Unit wage price}$$

The results of the calculation of the number of workers and the cost of wages can be seen in the following table:

Table 14. The results of the calculation of the number of workers and the cost of wages

a. Lower structure work

Description	Concrete work		Iron work		Formwork	
	Total manpower	Total wages IDR/day	Total wages	Total wages IDR/day	Total wages	Total wages IDR/day
Wokers	16	1,200,000	13	975,000	35	2,625,000
Repairman	3	255,000	13	1,170,000	18	1,620,000
Foreman	1	90,000	2	200,000	2	200,000
Foreman	2	200,000	1	100,000	2	200,000
Total wages		1,745,000		2,445,000		4,645,000

Source: Data Processing Results, 2020

So the total wage cost for concrete work, ironing and formwork for the substructure are as follows:
= (Wages Concrete work + Wages Iron work + Wages Formwork) x Duration (day)
= (1,745,000 + 2,445,000 + 4,645,000) x 315 day
= IDR 2,783,025,000

Table 15. The results of the calculation of the number of workers and the cost of wages

b. Upper structure work

Description	Concrete work		Iron work		Formwork	
	Total manpower	Total wages IDR/day	Total wages	Total wages IDR/day	Total wages	Total wages IDR/day
Wokers	31	2,325,000	30	2,250,000	100	7,500,000
Repairman	5	455,000	30	2,700,000	50	4,500,000
Foreman	1	90,000	3	300,000	5	500,000
Foreman	4	400,000	2	200,000	5	500,000
Total wages		3,240,000		5,450,000		13,000,000

Source: Data Processing Results, 2020

So the total wage cost for concrete work, ironing and formwork on the upper structure are as follows:
= (Wages Concrete work + Wages Iron work + Wages Formwork) x Duration (day)
= (3,240,000 + 5,450,000 + 13,000,000) x 372 day
= IDR 8,068,680,000

2. Calculate the total crash cost

a. Lower structure work

For material and subcontractor cost for earthworks and foundations (A) IDR 11,651,727,571 as well as lower structure works (B) IDR 10,649,939,567 determined based on the normal price obtained from the contractor. So that the total crash cost for substructure and foundation work are as follows:

= Total crash cost of lower structure wages + (A) + (B)
= IDR 2,783,025,000 + IDR 11,651,727,571 + IDR 10,649,939,567
= IDR 25,084,692,138

b. Upper structure work

For the cost of materials and subcontractors for the upper structure work (C) IDR 26,601,344,562 determined based on the normal price obtained from the contractor. So that the total crash cost for superstructure work is as follows:

= Total crash cost of upper structure wages + (C)
= IDR 8,068,680,000 + IDR 26,601,344,562
= IDR 34,670,024,562

he calculation of the unit price indirect cost is obtained from the contractor, so the calculation of the Crash cost at the Indirect Cost can be seen in the table in point F. So that the total Crash cost value due to the addition of labor (Scenario 2) is as follows:

Crash cost of substructure and foundation work	= IDR 25,084,692,138
Crash cost of upper structure work	= IDR 34,670,024,562
Crash cost for indirect cost	= IDR 11,699,411,433 +
Total Cost (Excl. VAT)	= IDR 71,454,128,134

3. Calculating the cost slope, using the formula:

$$\text{Cost Slope} = \frac{Crash\ Cost - Normal\ Cost}{Normal\ Duration - Crash\ Duration}$$

$$= \frac{71{,}454{,}128{,}134 - 66{,}637{,}746{,}719}{600\ day\ (20\ month) - 582\ day\ (19{,}4\ month)}$$

$$= \text{IDR } 267{,}576{,}745$$

5.3 Total Cost Graph

After the crashing program, results are obtained as shown above, then to make it easier to understand the results of the analysis that has been done it can be presented in the form of a recapitulation table and graph as below:

Table 16. Table recapitulation of analysis results

No	Method Analysis	Normal Duration (day)	Crash Duration (day)	Normal Cost (IDR)	Crash Cost (IDR)	Time efficiency	Cost Efficiency	Research Result
	Additional 4 Hours of Overtime Work (Scenario 1)	600	582	66,637,746,719	70,224,661,009	3.00%	-5.38%	- Normal Duration: 600 day --> Crash Duration: 582 day; - Normal Cost: 66,637,746,719 --> Crash Cost: 70,224,661,008; - Time efficiency: 3.00%; - Cost Efficiency: -5.38%
	Additional Workforce (Scenario 2)	600	582	66,637,746,719	71,454,128,135	3.00%	-7.23%	- Normal Duration: 600 day --> Crash Duration: 582 day; - Normal Cost: 66,637,746,719 --> Crash Cost: 71,454,128,134; - Time efficiency: 3.00%; - Cost Efficiency: -7.23%

Source: Data Processing Results, 2020

Total cost graph

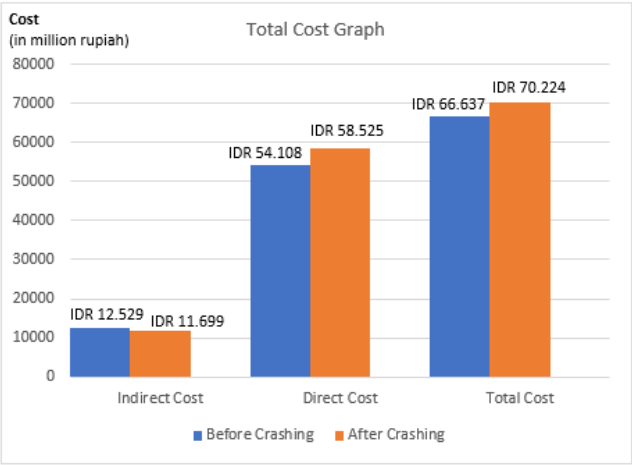

Figure 3. Total cost graph(scenario 1)

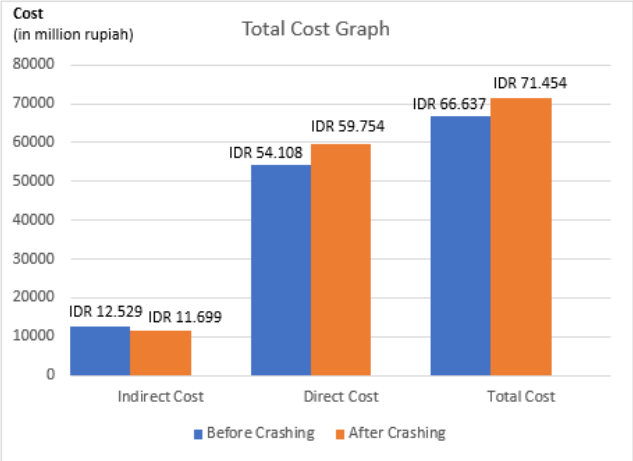

Figure 4. Total cost graph (scenario 2)

5.4 Implementation of Time Cost Trade Off (TCTO)

After analyzing the resulting total cost graph. The total project cost is the sum of the direct cost with the indirect cost incurred after the duration compression process, the direct cost will increase while the indirect cost will decrease because the duration is faster than before. The analysis results are compared with the project schedule and cost before being accelerated. On the curve, point A shows normal conditions, while point B shows accelerated conditions. The line connecting these points is called a time-cost curve. To find out the relationship between the time and cost of adding 4 hours of overtime work (scenario 1) and additional workforce (scenario 2) it can be seen in the curve below:

Figure 6. Time-cost curve (scenario 1), Time-cost curve (scenario 2)

6. Conclusions and Suggestions

6.1 Conclusion

a. Estimated Acceleration of Work Time
c. The results of the above analysis show that the estimated time for the acceleration of project
d. implementation is from the normal duration of 600 calendar days, then after the crash duration is carried out there is an acceleration of the time to 582 calendar days. With a time efficiency of 18 days / 3.00%.
e. The total cost due to time acceleration (including indirect cost) are as follows:

4. Additional 4 Hours of Overtime Work (Scenario 1)
   Dari *normal cost* sebesar IDR 66,637,746,719 (excl. VAT), kemudian setelah *crash cost* terdapat kenaikan biaya menjadi IDR 70,224,661,008 (excl. VAT). Dengan *over cost* sebesar IDR 3,586,914,289 / 5.38 %.
   Cost slope sebesar IDR 199,273,016
5. Additional Workforce (Scenario 2
   From the normal cost of IDR 66,637,746,719 (excl. VAT), then after the crash cost there was an increase in cost to IDR 71,454,128,134 (excl. VAT). With an over cost of IDR 4,816,381,415 / 7.23%.
   Cost slope of IDR 267,576,745

6.2 Suggestions

a. In the case of delays caused by man (human) factors, the selection of the method of adding overtime working hours is more effective and efficient in the case study above, because the increase in cost is less than the method of adding labor.
b. This research is carried out on building construction, therefore further research is expected to be carried out on road, bridge, dam or other civil projects.

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Comparison Analysis of A Red Brick Wall With M-Cast Wall, Assessed from The Strength of Press, Time and Cost

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Abstract

Currently there are several technologies and materials in the construction sector as substitutes for conventional building wall materials, including M-Cast and red brick. This study aims to determine the comparison of compressive strength, time and unit cost of wall work using M-Cast material and red brick based on conventional methods and SNI. Productivity data in this study were obtained by directly observing the speed of work in the field. The method used in this research is the Daily Record Sheet method and the SNI method. The job coefficient to calculate the work unit price analysis is obtained by calculating yourself based on the productivity value obtained.The results of the productivity analysis show that M-Cast has twice the strength compared to red brick, it can be seen from the final results of the compressive strength test at the age of the sample to 28 days where the red brick only has a strength of 53.92 - 58.50 Kg / cm² while M- Cast has a strength of 118.06 - 127.18 kg / cm², and the productivity value of M-Cast wall work in each type of observation is that the installation time required is 3 hours to install 1 piece of M-Cast with an area of -12m² where the time is 1 hour of installation and 2 hours of finishing Meanwhile, the red brick wall work time is 36 hours, where the installation time is 12 hours, plaster is 12 hours and finishing is 12 hours. The unit cost of the M-Cast wall works per 12m² is Rp. 7,690,000, and the red brick wall is Rp. 4,434,000.

Keywords :
Comparative Analysis of Red Brick Walls with M-Cast Walls in Terms of Compressive Strength, Time and Cost.

1. Introduction

The wall is one of the building structures that serves to protect occupants from wild animals, wind, sun or rain. Making a wall usually uses red bricks, concrete blocks, boards, or plywood.

In writing this Final Project, the author reviewed the fabrication construction in the PT Duta Sarana Perkasa site plant area (DUSASPUN), which will later be called the DSP 9 Plant, the construction of the DSP 9 will focus on the production of precast panels, and after it is done the survey is known where the implementation of the DSP Plant 9 development project will use the M-Cast method. The M-Cast wall mounting process uses a vertical mounting system and M-Cast walls are installed in a different finishing condition from the general mounting system that uses a horizontal mounting system and is installed in a non-finishing condition.

Project for building DSP 9 PT. Duta Sarana Perkasa (DUSASPUN) is interesting to study because besides in accordance with the title that the writer took, the author feels that he will get a lot of new knowledge and experience in the study of the construction of the DSP Plant 9, where the author can get many theories and systems for making M-Cast that more diverse and can do a comparison of compressive strength test, time and cost directly in the field (Retna Kristiana, 2016).

1.1. Identification of problems

This research focuses on the desires of a very diverse market because it is seen from the advantages and disadvantages of using the M-Cast system and the manufacturer's red bricks, where the use of M-Cast will take less time but more expensive costs are inversely proportional to the red bricks which take more time but with lower costs, besides the compressive strength of M-Cast and different red bricks, it becomes a market comparison in the choice of using the M-Cast or red brick system (I et al., 2014).

1.2. Research Purpose and Objectives

The aims and objectives of this research are:

1. To find out the comparison of the compressive strength of the red brick wall press Karawang with the M-Cast wall method.
2. To find out the time needed to complete the installation of red brick wall press Karawang and M-Cast walls per 12 m².
3. To find out the costs required in completing the installation of Karawang red brick walls and M-Cast walls per 12 m².

2. Methodology

This chapter will discuss the methods of collecting data from journals that support this research and consult with the supervisor to determine what type of methodology will be used in this scientific writing system, and the type of methodology that can represent the desired modeling.

The second stage of data collection is done by the method of field surveys and interviews with related workers. In addition, the authors also interviewed field workers to find out what constraints were experienced in the running process of the construction project.

The third stage of data collection will be continued by surveying respondents directly involved in the construction project.

2.1. Work steps for making samples

2.1.1. Red brick

Red brick sample composition

To determine the composition of the mortar in this study using a 2: 1 volume ratio using a 200 ml measuring cup.

1. Prepare 1 kg of mortar.
2. Prepare 500 ml of water.
3. Mix evenly the mortar mixture in the container using a mixer.
4. Mortar is ready to be printed.

Print a red brick sample

After the mortar mixture is ready, the next step is to print the mortar with red brick measuring 160 x 80 x 40 mm.

1. Prepare the mortar stir
2. Cover the red brick that has been prepared with the mortar mixture, repeat until the sample height is 20 cm, the same as the M-Cast sample that the author made.
3. Let stand for 1 x 24 hours until the sample dries.When the mortar has dried, give a date (according to the date of manufacture).

Soaking the red brick sample

4. Put all the test items into the soaking tub.
5. At this stage the test specimen is treated (curing), by immersion in water. Wait until the age of the test object matches the test, (the age of the test being tested is 7 days, 14 days and 28 days).

2.1.2 M-Cast

M-Cast sample composition

To determine the composition of the mortar in this study using a 2: 1 volume ratio using a 200 ml measuring cup.

1. Prepare 2 kg of mortar.
2. Prepare 1000 ml of water.
3. Mix evenly the mortar mixture in the container using a mixer.
4. Mortar is ready to be printed.

Print M-Cast samples

After the mortar mixture is ready, the next step is to print the mortar with M-cast measuring 200 x 200 x 120 mm.

1. Prepare the mortar stir
2. Cover the M-cast with the mortar mortar, 30 mm thick.
3. Let stand for 1 x 2 hours until the sample dries.
4. After drying, refill it with the RM-160 acian, with a thickness of 5 mm.
5. Let stand for 1 x 24 hours until the sample dries.
6. When dry, give a date (according to the date of manufacture).

M-Cast sample drying process

At this stage the test specimen is left standing until the test specimen is in accordance with the test.

2.2. Compressive Strength Testing

2.2.1. Red Brick

Compressive strength testing on red bricks is done by means of the red bricks coated with mortar on both sides as the red bricks are attached to the wall. There is one type of brick that will be tested for its compressive strength, namely the red brick produced by the Karawang press factory. The dimensions of the red brick are 160 x 80 x 40mm. To get the value of the compressive strength of the red brick must go through laboratory testing.

The red bricks to be tested are stacked vertically into 4 piles where each of the red bricks is coated using 1.5 cm thick mortar which will be used in planning, namely Rapi RM-115 mortar with a ratio of 2: 1. Top and bottom surfaces must also be mortared to provide a flat surface. After all the test pieces are ready, a pressure test is carried out. The brick is pressed until it has cracked, then the maximum compressive strength achieved is recorded.(Redha Sadhu Leksono, Data Iranata, 2012)

Figure 1. RedBrick Sample

2.2.2. M-Cast

Compressive strength testing of M-cast coated mortar on both sides as well as attached M-cast Wall. There are 6 M-cast samples that will be tested for compressive strength, with the size of 200 x 200 x 120mm. To get the compressive strength of the M-cast Wall must be tested in a laboratory. The M-Cast wall reinforcement to be tested was coated using 1.5 cm thick mortar which will be used in the planning, namely the RM-130 Neat Mortar with a ratio of 2: 1.

M-Cast is pressed until it cracks, then the maximum compressive strength achieved.

Figure 2. M-Cast Sample

2.2.3. Steps for testing the sample

In the compressive strength testing step on the sample of the red brick wall and the M-cast wall have the same method, the following are the steps for testing the specimen:

a. Drying and weighing process
   1. Remove the test object (age 7 days) from the soaking tub, wait until it is completely dry.
   2. Then weigh the test specimen.

b. Compressive strength testing
   1. Compressive strength testing is carried out after the specimen reaches 7 days, 14 days and 28 days from the time of mixing.
   2. For each age 2 pieces are made, so that in total there are 6 pieces that will be compressed.

Figure 3. Compressive Strength Testing

2.3. Measurement of Work Productivity

During the work, the amount of achievement must be recorded so that it can be compared with the initial plan as an effort to evaluate the amount of productivity that has been achieved. Monitoring (monitoring) means conducting observations and testing at each particular interval to check performance and unexpected side effects.

In general, productivity can be interpreted as a comparison between output and input. Productivity is expressed by Formulas.

Productivity = $\frac{Output}{Input}$

As for the measurement of worker productivity, what is used is:

Worker Productivity (m²/hour) $\frac{Hasil\ Kerja\ (m^2)}{Jam/Durasi\ kerja}$

2.4. Calculation of M-Cast and Red Brick Wall Costs

The calculation of the cost of a project is also a determining factor in the smooth running of a project, where if the calculation of costs in a project has been prepared carefully, the project will go according to plan, because all work depends on the costs that have been determined in one project. In calculating the cost of the case study in this study, the authors divide into 3 basic parts in the construction of this project, where the 3 parts included in the calculation of costs become one of the supporting factors in the smooth running of this project, the 3 fundamental parts of this project are the costs on material usage, costs on labor usage, and equipment costs where the author uses the reference / 12m² for each variable

3. Result and Discussion

3.1. Result

1. The compressive strength test results obtained from the test samples that have been made have the same strength increase in each age, but M-Cast has twice the strength compared to red brick.
2. The comparison result of the installation of M-cast walls and red brick is that the installation of M-Cast walls is much faster with red brick walls.
3. The result of the comparison of the total cost of work based on this research is that the cost of red brick wall work is cheaper than M-Cast wall work, while the labor wage for M-Cast wall work is cheaper than red brick wall work because of the shorter work time fast.

3.2. Discussion

a. For construction service providers (planners and executors), wall works on large projects such as high-rise buildings should use M-Cast walls because they are faster in carrying out the work so that they can reduce costs outside of implementation (staff salaries, rented beds, rented warehouses, rent. tools, workers' salaries), especially with a lighter weight so that if it is used in high rise building construction, a more economical building structure can be obtained.
b. choose the wall material according to your needs. If you need fast work and high productivity without paying too much attention to the cost of wall work, you can use M-Cast material because its productivity is the fastest compared to others. If you need materials with lower costs for business reasons or private homes, it is advisable to use conventional brick materials.
c. Construction service companies (contractors) can provide training on work methods and knowledge of materials to their workers, because mpanel wall works are still rarely used compared to red bricks and require special skills in the implementation of their work.

3.3. Compresive Strenght

Table 1. Mortar Compressive Test Results

LABORATORY DUSASPUN
Kp. Kedep. Dn. Tlajung Udik
Gn. Putri - BOGOR. Ph. 8672508

DUSASPUN
Setting the Quality

TRIAL DESIGN DRY MIX MATERIAL

Project: Sample
Characteristic : -
Sample : Bata Merah & M-Cast

No	Application For	Trade Mark & Type	Date of Casting	Jenis Sample	Umur Sample (Days)	Date of Test	Load (kN)	Compr.Strength (kg/cm2)	Review
1	Shootcrete	Bata Merah Press 20x20cm	15-Mei-20	Sample 1	7	22-Mei-20	176.7	45.05	OK
					14	29-Mei-20	184.45	47.02	OK
					28	12-Jun-20	229.5	58.50	OK
				Sample 2	7	22-Mei-20	162.7	41.48	OK
					14	29-Mei-20	173.36	44.19	OK
					28	12-Jun-20	211.54	53.92	OK
2	Shootcrete	M-cast 200x200x120mm	15-Mei-20	Sample 1	7	22-Mei-20	381.53	97.26	OK
					14	29-Mei-20	476.13	121.37	OK
					28	12-Jun-20	498.9	127.18	OK
				Sample 2	7	22-Mei-20	346.96	88.70	OK
					14	29-Mei-20	433.98	110.50	OK
					28	12-Jun-20	463.63	118.06	OK

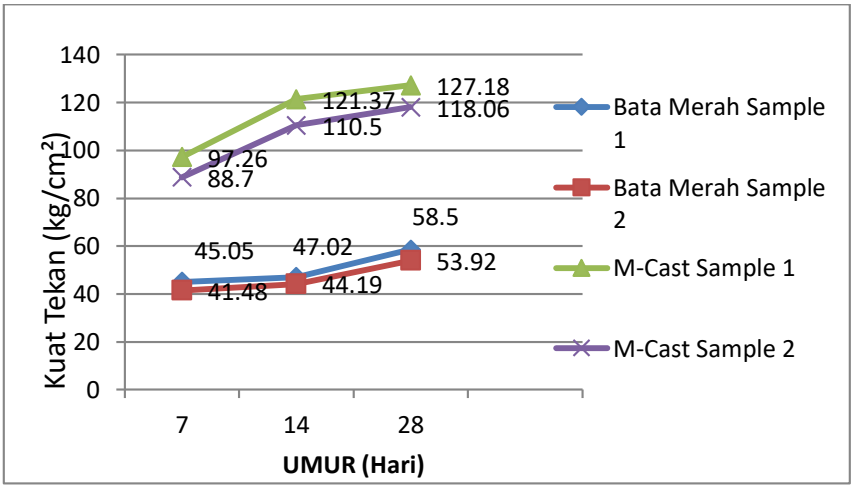

Figure 4. Mortar Compressive Test Results Graphic

The compressive strength test results obtained from the sample trials that have been made are divided into 3 sample age periods, namely 7 days, 14 days and 28 days, and after comparing the compressive strength test results of red brick and M-Cast both experience an increase in strength. In each age, however, seen from the strength results, M-Cast walls are stronger when compared to red bricks which can be seen from the final results of the compressive strength test at the age of 28 days where the red brick only has a strength of 53.92 - 58.50 Kg / cm² while M-Cast has a strength of 118.06 - 127.18 kg / cm²

3.4. Time

Table 2. Result of Red Brick Installation Using Daily Record Sheet Method

No	Dimensi Dinding (m)			Waktu Pasang			Produktivitas	Tenaga Kerja (OH)			
				Mulai	Selesai	Jam					
	Panjang	Tinggi	Luas	Jam : Menit	Jam : Menit		(m²/jam)	Pekerja	Tukang Batu	Kepala Tukang	Mandor
PEMASANGAN BATA MERAH											
1	3	4	12	8.00	12.00	4.00	1	2.6	0.8	0.08	0.12
2	3	4	12	13.00	17.00	4.00	1	2.6	0.8	0.08	0.12
PLESTER											
1	3	4	12	8.00	12.00	4.00	1	2.6	-	0.08	0.12
2	3	4	12	13.00	17.00	4.00	1	2.6	-	0.08	0.12
FINISHING											
1	3	4	12	8.00	12.00	4.00	1	2.6	-	0.08	0.12
2	3	4	12	13.00	17.00	4.00	1	2.6	-	0.08	0.12

Refer to SNI 6897-2008

Table 3. Observation Results of M-Cast Installation Using the Daily Record Sheet Method

No	Dimensi Dinding (m)			Waktu Pasang			Produktivitas	Tenaga Kerja (OH)	
				Mulai	Selesai	Jam			
	Panjang	Tinggi	Luas	Jam : Menit	Jam : Menit		(m^2/jam)	Mandor	Tukang
PEMASANGAN PANEL									
1	3	4	12	8.00	9.00	1.00	12	1	3
FINISHING									
1	3	4	12	8.00	10.00	2.00	6	1	1

for a comparison of the installation times of red brick and M-Cast that have been carried out in the field, it can be concluded that the installation of M-Cast walls is much faster with red brick walls, when viewed from the installation time of red bricks which refers to SNI 6897-2008 on the installation of red bricks with an area of 12m² from the installation stage, plastering to finishing requires 36 hours of work while for the installation of an M-Cast wall with an area of 12m² it only takes 3 hours of work from installation to finishing.

3.5. Cost

3.5.1. Calculation of M-Cast Wall Costs

Table 4. Calculation of M-Cast Wall Costs

Bahan Perbadingan	Variable	Estimasi Biaya
Biaya	Matrial	M-cast uk. 1m x (3,5cm + 5cm +3,5cm)x1m = Rp. 580.000,-/m²
		RM-130 Kamprot RAPI
		RM-160 Acian Premium
	Tenaga Kerja	Mandor = Rp. 200.000,-/hari
		Tukang = Rp. 150.000,-/hari
	Peralatan	Penyewaan Crane = Rp.350.000/jam

a. Calculation of fees for matrial usage

The installation of M-Cast walls with an area of 12m² requires the following costs:

Price of M-cast size 1m x (3,5cm + 5cm + 3,5cm) x1m Rp.580,000, - / m² which includes matrial costs for mortar raw materials.

Total cost of Matrial = M-cast size 1m x (3,5cm + 5cm + 3,5cm) x1m x 12
= Rp.580,000 x 12
= Rp.6,960,000

Thus it can be concluded that in the installation of M-Cast walls with an area of 12m² a matrial cost of Rp. 6,960,000.

b. Calculation of costs on labor usage

The installation of the M-Cast wall with an area of 12m² takes 1 day to install with a workforce of 4 people consisting of 1 foreman and 3 craftsmen, the details of which are as follows:

1 Foreman / day = Rp. 200,000
1 worker / day = Rp. 150,000
The total cost of using labor = 1 foreman + 3 workers
= Rp.200,000 + 3 (Rp. 150,000)
= Rp.650,000

The total cost required in the use of labor is Rp. 650,000

c. Equipment cost calculation

M-cast installation requires Over Head Crane equipment with a capacity of 50 tons, where the cost of renting the crane is Rp.350,000 / hour and the installation time required is 1 hour / pcs.

After calculating all the variables to get the total cost, the following formula is obtained:

Total Total M-cast Wall Cost = Matrial Cost + Labor Costs + Equipment Costs
= 6,960,000 + 650,000 + 350,000
= Rp. 7,690,000.

3.5.2 Calculation of the Cost of a Red Brick Wall

Table 5. Calculation of the Cost of a Red Brick Wall

Bahan Perbadingan	Variable	Estimasi Biaya
Biaya	Matrial	Bata Merah Uk.160 x 80 x 4 cm dengan harga = Rp.450/pcs
		RM-115 Pasangan Bata + Plester @40kg = Rp. 65.000/sak
		RM-160 Acian Premium @40kg = Rp. 120.000/sak
	Tenaga Kerja	Pekerja = Rp. 100.000,-/hari
		Tukang Batu = Rp. 100.000,-/hari
		Mandor = Rp. 200.000,-/hari
		Kepala Tukang = Rp. 175.000,-/hari
	Peralatan	-

b. Calculation of fees for matrial usage

In the installation of red brick walls with an area of 12m² requires a mixture of the following composition:

RM 115 pairs of bricks + plaster as much as 800 kg or the equivalent of 20 bags

MYR 160 premium premium as much as 80 kg or equivalent to 2 bags

The total cost of Matrial = the price of 840 pcs of red brick + the price of the mix + the price of acian

= Rp. 378,000 + Rp. 1,300,000 + Rp. 240,000

= Rp. 1,918,000

Thus it can be concluded that in the installation of a red brick wall with an area of 12m², a matrial cost of Rp. 1,918,000.

d. Calculation of costs on labor usage

Installation of red brick walls with an area of 12m² takes 3 days to install with a workforce of 4 people consisting of 1 foreman, 1 mason, 1 foreman and 1 head mason, where the details are as follows:

1 Worker / day = Rp. 100,000

1 Mason / day = Rp. 100,000

1 Foreman / day = Rp. 200,000

1 Head of Artisan / day = Rp. 175,000

Total labor cost = (5.2 OH workers x 3 days) + (1.6 OH masons x 1 day) + 0.96 foreman + 0.48 head masons

= Rp.2,080,000 + Rp.160,000 + Rp. 192,000 + Rp. 84,000

= Rp.2,516,000

The total cost required in the use of labor is Rp. 2,516,000

After calculating all the variables to get the total cost, the following formula is obtained:

Total Total Red Brick Wall Costs = Matrial Costs + Labor Costs + Equipment Costs

= 1,918,000 + 2,516,000 + 0

= Rp. 4,434,000.

After seeing the results of the calculation of all costs required on the red brick wall and M-cast it can be concluded that the use of red brick walls is much cheaper than the use of M-cast walls.

4. Conclussion

From the results of research and testing obtained the following results:

a. The compressive strength test results obtained from the sample trials that have been made are divided into 3 sample age periods, namely 7 days, 14 days and 28 days, and after comparing the compressive strength test results of red brick and M-Cast both experience an increase in strength. In each age, however, seen from the strength results, M-Cast walls are stronger when compared to red bricks which can be seen from the final results of the compressive strength test at the age of 28 days where the red brick only has a strength of 53.92 - 58.50 Kg / cm² while M-Cast has a strength of 118.06 - 127.18 kg / cm². So it can be concluded that M-Cast has twice the strength compared to red bricks.

b. And for a comparison of the installation times of red brick and M-Cast that have been carried out in the field, it can be concluded that the installation of M-Cast walls is much faster with red brick walls, when viewed from the installation time of red bricks which refers to SNI 6897-2008 on the installation of red bricks with an area of 12m² from the installation stage, plastering to finishing requires 36 hours of work while for the installation of an M-Cast wall with an area of 12m² it only takes 3 hours of work from installation to finishing.

c. The total cost of red brick wall works is Rp. 4,434,000, - / 12m² and a M-Cast wall of Rp. 7,690,000, - / 12m². The difference between wall work and M-Cast is Rp. 3,256,000, -. This is due to the high cost of M-

Cast material per square meter and equipment rental prices due to the use of Over Head Cranes in the installation of M-Cast compared to red bricks whose installation is still manual using human resources.

d. The material cost for red brick wall work is cheaper than M-Cast wall work, while the labor wage for M-Cast wall work is cheaper than that for red brick wall work because of the faster work time

5. Acknowledgements

All praise and gratitude for the author, wish ALLAH SWT who has bestowed His grace and grace, so that the author can complete the final project entitled "Comparative Analysis of Red Brick Walls with M-Cast Walls in terms of Compressive Strength, Time and Cost" smoothly and just in time.

The author realizes that this final project could not have been completed without the assistance provided by various parties. So on this occasion, the author would like to thank profusely to:

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The author realizes that this Final Project, there are still shortcomings. Therefore, suggestions and constructive criticism are expected for the perfection of this Final Project.

Hopefully this Final Project is useful for fellow Civil Engineering students as well as for all interested parties.

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Biography

Catur Prayogo is a student and a private employee at a company engaged in precast. He is a senior student at Mercubuana University, Bekasi with a civil engineering study program. He also works at one of the large companies engaged in precast concrete, namely PT. Duta Sarana Perkasa, is one of the staff in the engineering division as a senior drafter who is in charge of designing precast products at the company.

The last child of 4 siblings graduated from SMK Budi Utomo Cilacap, Central Java, then he continued his education by taking a course in design using Auto Cad and after graduating he worked at the Krakatau Stell company as a Drafter before finally working at a pioneer company. precast concrete.

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The Effect of Post-Curing Sulphuric Acid Water Bath on Strong Concrete Press Comes from Three Different Sand Quarry

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Abstract

Concrete is one of the construction materials that has been commonly used for building buildings, bridges, roads, and others. Concrete as well as other building structures, not separated from damage - damage that can reduce its durability, one of the reasons is because of external influences or the environment in which the concrete structure is located, such as in certain locations, for example in environments related to chemicals, sulfate, chloride, salt or those in marine areas. The purpose of the study was the effect of sulphuric acid water baths on confensional concrete and knowing the concrete with a mixture of sand from which areas were strong press higher after being soaked with sulphuric acid soaking. The research method used is to use the experimental method by mixing sulphuric acid compounds in water as a medium of concrete curing derived from three different sand quarys with variations in the composition of sulfuric acid compounds that are berberda umtuk get strong press results data from this study. From the results of this study, the conclusion that normal concrete derived from mountain sand namely Cimangkok sand (CMK), and Cigombong (BHM) is more resistant to sulphuric acid concentrations of 2% and 5%. Normal concrete derived from river sand i.e. Citarik sand (CTK) is not resistant to sulphuric acid concentrations of 2% and 5% which results in a lower press strength than mountain sand. Normal concrete derived from a mixture of river sand (Citarik) and mountain sand (Cimangkok and Cigombong) called Sand Mix (MX) is more resistant to sulphuric acid concentrations of 5% than other sand

Keywords
Marinade, Quarry Sand, Strong Press, Water Sulfuric Acid

1. Introduction

Concrete is one of the construction materials that has been commonly used for building buildings, bridges, roads, and others. Concrete is homogeneous, this concrete can be obtained by mixing fine aggregate (sand), coarse aggregate (gravel), or other types of aggregate and water with porland cement or other hydraulic cement, sometimes with additives that are chemical or physical.

Concrete as well as other building structures, not separated from damage - damage that can reduce its durability, one of the reasons is because of external influences or the environment in which the concrete structure is located, such as in certain locations, for example in environments related to chemicals, sulfate, chloride, salt or those in marine areas. Sulfate content in soil and groundwater, decay of organic materials, and industrial waste surrounding a concrete structure can pose a threat to the long-term durability of the concrete (Fanisya and Gunawan, 2013).

Sand is one of the most important types of building materials that must exist in the construction process, matrial of this building in the form of granules with the size that has been determined. Although the magnitude of the grain of sand is determined, there are several different types of sand that are accounted for for matrial building, this different type that makes granules to the function of sand different.

Characteristic of sand, sand aggression is formed from erosion or weathering of rocks until it becomes small grains smaller than 4.75 mm in diameter. Most of these natural sand aggregates have a type weight between 1500-1700 kg/m3 and the type weight can reach 2000 kg/m3. (Sulaiman and Nurhidayah, 2018)

Sulfuric acid is a very strong mineral acid (inorganic substance). This substance is soluble in water, sulfuric acid has the chemical formulation H2SO4, and has a molar mass of 98.08 g / mol. Sulfuric acid looks like Hygroscopic, oily, colorless, and odorless liquid.

The use of concrete structures that are in direct contact with sulphuric acid compounds will affect the strong quality of concrete press because sulfuric acid can make concrete corrosion (Suhana and Mualifah, 2017). Corrosion has been known for a long time and is very detrimental. The word corrosion is derived from latin corrodere which means metal destroyer or rusty (Supardi, 1997)

Based on the background description above, a search was conducted with the title "Effect of Post Curing Sulfuric Acid Water Bath on Strong Press Concrete Coming From Three Different Sand Quarry".

2. Methodology

The research method used is to use the experimental method by mixing sulphuric acid compounds in water as a medium of concrete curing derived from three different sand quarys with variations in the composition of sulfuric acid compounds that are berberda umtuk get strong press results data from this study.

This research was conducted using Mix Design which refers to the national standard sni 03-2834-2000 . In this study the sand used for concrete making mixture comes from three different sand quary, namely cigombong quary, cimangkok quary, sukabumi quary. As for curring on concrete will be done subtitution against water i.e. by using sulphuric acid compounds with the following presentase variations namely 0%, 2%, and 5% of the volume of the tub that will be used as a place to soak concrete for 7, 21, 28 days.

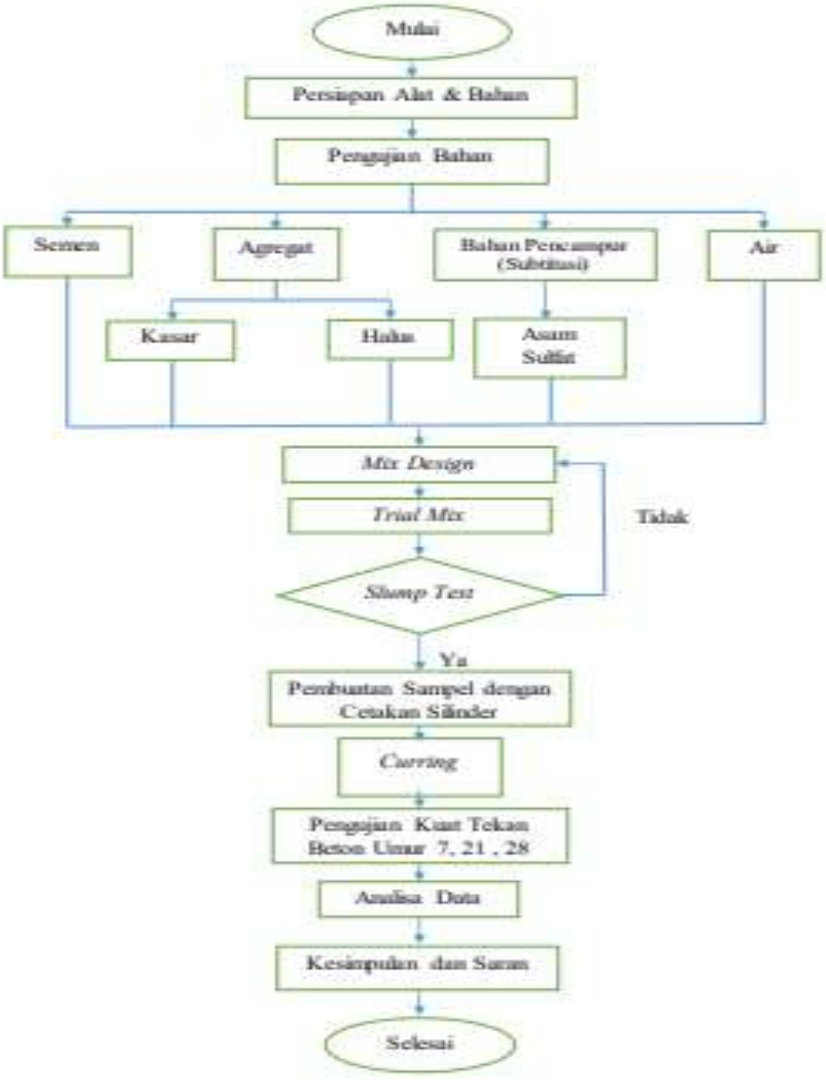

Figure 1. Metode
Source : Olahan Peneliti

This research begins by preparing the tools and materials to be used. The tool that will be used in the laboratory is ensured to be in good condition and has been calibrated before, then conducts testing on the matrial material to be used and continued with the planning of the calculation of the design mix using Microsoft Excel software with calculations referring to SNI 03-2834-2000. Then do a trial mix and slump test. After 24 hours the concrete will be opened from the mold and continued by curing by soaking the sempel into a tub filled with water mixed with sulphuric acid compounds. In this process the concrete sample will be soaked for 7, 21, 28 days before the strong testing of the concrete press, after the life of the concrete is reached then the concrete will

be removed from the tub and then will begin the testing of strong press concrete and will be obtained the results of strong data press.

a. Cement cement that will be used in this study is three-wheeled cement weighing 40 kg / zak which is portland cement type I.
b. The sand used in this study comes from three different sand quarys. The three sand quarys are quary Cigombong, quary cimangkok, quary Sukabumi.
c. Gravel gravel to be used in this research obtained from Rumpin.
d. Sulfuric acid sulfuric acid used in this study is sulfuric acid found in the Laboratory.
e. Water used in this study in the laboratory.

Table 1. Material Needs To Make 1 M3 Concrete

Materials	Kg/m3
Semen	325
Air	185
Agregat Halus	823
Agregat Kasar	1006

Place and Time

Place : This research will be conducted in the jakarta-Bandung plan halim high-speed train laboratory.

Time : This research will start from June to July 2020.

3. Result and Discussion

3.1. Analysis of cimangkok sand filter

This stage aims to know the size of the grain and the arrangement of grains (gradations) of fine aggregates (sand) based on the filter number. So that it can determine the modulus smoothness of the sand.

Table 2. Results of Analysis of Fine Aggregate Gradation of Cimangkok Sand

	Berat Bahan Kering Cimangkok :		2000,0	gr
Saringan	Berat Tertahan (gram)	Jumlah Berat Tertahan	Jumlah Persen	
			Tertahan	Lewat
50.80 (2")				
25.40 (1")				
19.10 (3/4")				
6.3 (1/4")	-	-	0,00	100,00
No. 4	360	360,00	18,00	82,00
No. 8	320,00	680,00	34,00	66,00
No. 12	100,00	780,00	39,00	61,00
No. 16	80,00	860,00	43,00	57,00
No. 30	270,00	1130,00	56,50	43,50
No. 50	260,00	1390,00	69,50	30,50
No. 80	310,00	1700,00	85,00	15,00
No. 100	120,00	1820,00	91,00	9,00
No. 200	110,0	1930,00	96,50	3,50
PAN	70,0	2000,0	100,00	0,00
Fineness Modulus	**4,36**			

3.2. Results of analysis of fine aggregate filter of Sukabumi sand (Citarik)

This stage aims to know the size of the grain and the arrangement of grains (gradations) of fine aggregates (sand) based on the filter number. So that it can determine the modulus smoothness of the sand.

Table 3. Citarik Sand Fine Aggregate Gradation Analysis Results

	Berat Bahan Kering Sukabumi :		2000,0	gr
Saringan	Berat Tertahan (gram)	Jumlah Berat Tertahan (gram)	Jumlah Persen	
			Tertahan	Lewat
50.80 (2")				
25.40 (1")				
19.10 (3/4")				
6.3 (1/4")	-	-	0,00	100,00
No. 4	450	450,00	22,50	77,50
No. 8	790,00	1240,00	62,00	38,00
No. 12	140,00	1380,00	69,00	31,00
No. 16	70,00	1450,00	72,50	27,50
No. 30	180,00	1630,00	81,50	18,50
No. 50	160,00	1790,00	89,50	10,50
No. 80	140,00	1930,00	96,50	3,50
No. 100	20,00	1950,00	97,50	2,50
No. 200	40,0	1990,00	99,50	0,50
PAN	10,0	2000,0	100,00	0,00
Fineness Modulus	**5,91**			

3.3. Analysis of cigombong sand fine aggregate sieve (Bulb)

This stage aims to know the size of the grain and the arrangement of grains (gradations) of fine aggregates (sand) based on the filter number. So that it can determine the modulus smoothness of the sand.

Table 4. Cigombong Sand Fine Aggregate Gradation Analysis Results

	Berat Bahan Kering Cigombong :		2000,0	gr
Saringan	Berat Tertahan (gram)	Jumlah Berat Tertahan	Jumlah Persen	
			Tertahan	Lewat
50.80 (2")				
25.40 (1")				
19.10 (3/4")				
6.3 (1/4")	-	-	0,00	100,00
No. 4	320	320,00	16,00	84,00
No. 8	540,00	860,00	43,00	57,00
No. 12	145,00	1005,00	50,25	49,75
No. 16	120,00	1125,00	56,25	43,75
No. 30	350,00	1475,00	73,75	26,25
No. 50	170,00	1645,00	82,25	17,75
No. 80	110,00	1755,00	87,75	12,25
No. 100	83,00	1838,00	91,90	8,10
No. 200	90,0	1928,00	96,40	3,60
PAN	72,0	2000,0	100,00	0,00
Fineness Modulus	**5,01**			

3.4. Sand Mix fine aggregate sieve analysis results

This stage aims to know the size of the grain and the arrangement of grains (gradations) of fine aggregates (sand) based on the filter number. So that it can determine the modulus smoothness of the sand.

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Table 5. Results of Fine Aggregate Gradation Analysis of Sand mix

	Berat Bahan Kering Mix :		2000,0	gr
Saringan	Berat Tertahan (gram)	Jumlah Berat Tertahan (gram)	Jumlah Persen	
			Tertahan	Lewat
50.80 (2")				
25.40 (1")				
19.10 (3/4")				
6.3 (1/4")	-	-	0,00	100,00
No. 4	470	470,00	23,50	76,50
No. 8	580,00	1050,00	52,50	47,50
No. 12	100,00	1150,00	57,50	42,50
No. 16	90,00	1240,00	62,00	38,00
No. 30	200,00	1440,00	72,00	28,00
No. 50	160,00	1600,00	80,00	20,00
No. 80	180,00	1780,00	89,00	11,00
No. 100	50,00	1830,00	91,50	8,50
No. 200	100,0	1930,00	96,50	3,50
PAN	70,0	2000,0	100,00	0,00
Fineness Modulus	**5,28**			

Here are the strong press results from the slump testing on the search this time:Hasil test slump

Table 6. Slump Test

Pasir	Nilai Slump (cm)
Cimangkok	9
Sukabumi (Citarik)	10
Cigombong (Bohlam)	8
Mix (Cimangkok,Cigombong,Sukabumi)	8,5

Table 7. Strong results press sukabumi sand (citarik)

JMF CTK 0%	Asam sulfat 0%
7	12,18
21	4,36
28	15,79
JMF CTK 2%	Asam sulfat 2%
7	12,06
21	4,05
28	14,7
JMF CTK 5%	Asam sulfat 5%
7	11,94
21	4,77
28	15,48

Table 8. Strong results of Cimangkok sand press

JMF CMK 0%	Asam sulfat 0%
7	11,58
21	8,42
28	19,36
JMF CMK 2%	Asam sulfat 2%
7	11,72
21	9,38
28	14,54
JMF CMK 5%	Asam sulfat 5%
7	11,35
21	8,5
28	16,8

Table 9. Strong result of Cigombong sand press (Bulb)

JMF BHM 0%	Asam sulfat 0%
7	13,73
21	6,5
28	18,34
JMF BHM 2%	Asam sulfat 2%
7	14,45
21	7,58
28	16,56
JMF BHM 5%	Asam sulfat 5%
7	14,36
21	7,14
28	18,83

Table 10. Strong result press sand Mix

JMF MX 0%	Asam sulfat 0%
7	13,02
21	5,71
28	15,87
JMF MX 2%	Asam sulfat 2%
7	13,61
21	5,88
28	16,11
JMF MX 5%	Asam sulfat 5%
7	13,29
21	5,91
28	20,15

4. Conclussion

1. Normal concrete derived from mountain sand namely Cimangkok sand (CMK), and Cigombong (BHM) is more resistant to sulphuric acid concentrations of 2% and 5%.
2. Normal concrete derived from river sand i.e. Citarik sand (CTK) is not resistant to sulphuric acid concentrations of 2% and 5% resulting in stronger press lower than mountain sand.
3. Normal concrete derived from a mixture of river sand (Citarik) and mountain sand (Cimangkok and Cigombong) called sand Mix (MX) is more resistant to sulphuric acid concentration 5% than other sand.
4. Normal concrete on the 7th day that is resistant with sulphuric acid concentration 0% with strong highest press is Cigombong sand with a strong press number 13.73 Mpa, then sand Mix with strong number press 12.18 Mpa, Citarik sand with strong press 12.18 Mpa, and last sand Cimangkok 11.58 Mpa.
5. Normal concrete on the 7th day that is resistant with sulphuric acid concentration 2% with strong highest press is Cigombong sand with a strong press number of 14.45 Mpa, then sand Mix with a strong number press 12.06 Mpa, citarik sand with strong press 12.06 Mpa, and last sand Cimangkok 11.72 Mpa.
6. Normal concrete on the 7th day that is resistant with sulphuric acid concentration 5% with strong highest press is cigombong sand with a strong press number 14.36 Mpa, then Chapter V Cover V-2 sand Mix with a strong press number 13.29 Mpa, citarik sand with strong press 11,94 Mpa, and finally cimangkok sand 11.35 Mpa.
7. Normal concrete on the 21st day that is resistant with sulphuric acid concentration 0% with strong highest press is Cimangkok sand with a strong number press concrete 8.42 Mpa, then cigombong sand with a strong press number 6.5 Mpa, Pasir Mix with strong press 4.36 Mpa, and finally citarik sand with strong press 4.36 Mpa.
8. Normal concrete on the 21st day that is resistant with sulphuric acid concentration 2% with strong highest press is Cimangkok sand with a strong number press concrete 9.38 Mpa, then cigombong sand with a strong press number 7.58 Mpa, Pasir Mix with strong press 4.05 Mpa, and finally citarik sand with strong press 4.05 Mpa.
9. Normal concrete on the 21st day that is resistant with sulphuric acid concentration 5% with strong highest press is Cimangkok sand with a strong number press concrete 8.50 Mpa, then cigombong sand with a strong press number 7.14 Mpa, Pasir Mix with strong press 5.91 Mpa, and finally citarik sand with strong press 4.77 Mpa.
10. Normal concrete on the 28th day that is resistant with sulphuric acid concentration 0% with strong highest press is Cimangkok sand with a strong number press concrete 19.36 Mpa, then cigombong sand with a strong press number 18.34 Mpa, Citarik Sand with strong press 15.79 Mpa, and finally sand Mix with strong press 15.79 Mpa.
11. Normal concrete on the 28th day that is resistant with sulphuric acid concentration 2% with strong highest press is Cigombong sand with a strong number press concrete 16.56 Mpa, then sand Mix with strong press number 14.70 Mpa, Citarik Sand with strong press 14.70 Mpa, and last cimangkok sand with strong press 14.54 Mpa.
12. Normal concrete on the 28th day that is resistant with sulphuric acid concentration 5% with strong highest press is sand Mix with strong number press concrete 20.15 Mpa, then Chapter V Cover V-3 cigombong sand with strong number press 18.83 Mpa, Cimangkok Sand with strong press 16.80 Mpa, and lastly citarik sand with strong press 15.48 Mpa.

13. From this research it can be concluded that the concrete includes the natural group of grade I concrete that is non-structural concrete.

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Biography / Biographies (Optional)

Yudhistira Saptapringga Riezky Sundani is a student from Mercu Buana University Bekasi with civil engineering study program. Prior to majoring in civil engineering, at the previous level of high school, he majored in Natural Sciences at a private school in Jakarta, namely PGRI 4 Cipayung East Jakarta. The writer graduated from high school in 2016 and then went on to study at Mercu Buana University in 2016. During the lecture the author was active in various campus events such as the asco pensi committee, vice chairman of cultural seminars. For activeness in the department, namely as Chief Executive of Civil Expo 2019, as the committee of the night of familiarity 2017. In the course of lectures the author does work as a Surveyor in a consultant, and as a surveyor in the Central Bureau of Statistics (BPS).

Agyanatha Tua Munthe, a lecturer from Mercubuana University Bekasi, mr. Agyanatha studied at Atmajaya University in Yogyakarta, majoring in civil engineering and graduated in 2004 with a bachelor's degree in engineering. Mr. Agyanatha then went on to study at Gadjah Mada University in Yogyakarta, majoring in civil engineering and graduating in 2006 with a megister engineering degree. In 2007 – 2010 Mr. Agyanatha worked at PT. INDALEX (MASPION GROUP) and served as a site engineer. PT. DUTA SARANA PERKASA (Dusaspun) in 2010 – 2013 served as Technical Sales Engineer M-System, PT CIPTA MORTAR UTAMA (CMU) in 2013 march- 2013 december served as Ass. Manager Technical External Development then in 2014 – 2016 served as Jr. Manager Product Management. PT BOSTIK INDONESIA in 2016 – 2017 served as Senior Technical Consultant and Support Sales. PT. MASJAYA SEJAHTERA in 2017 until now serves as Project Manager.

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Differences in Student Learning Outcomes Between Before and After Using Video Media Tutorials on Research Statistics Through E-Learning

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Abstract

The purpose of this study was to determine the differences in student learning outcomes between before and after the use of research statistics tutorial videos through e-learning. The method used in this research is a comparative method with a quantitative approach. Data analysis techniques used documentation and tests. Data analysis used the IBM SPSS 24 application. The results showed that there were significant differences in student learning outcomes between before and after the use of statistical research video tutorials through e-learning both descriptively and by hypothesis testing. So it is recommended that the instructors use video tutorials as a medium to help the learning process.

Keywords
E-Learning, Learning Outcomes, Research Statistics, Video Tutorials.

1. Introduction

The development of the industrial revolution is increasingly developed and developing, are initially still manually or using manpower where must go to the field until it feels more difficult, slow or requires a long process and need to be expensive to become more sophisticated, faster, cheaper, even without being limited by space and time, namely using machine power or robots that are integrated with cyber technology. This development affects many aspects of life, especially the development of education in Indonesia today, to be precise in the industrial era 4.0 where learning activities are required to follow the era of disruptive innovation that is developing very rapidly with the characteristics of the use of digital technology in the learning process (cyber system), so learning can be done online or initial with the term synchronous or e-learning.

E-learning or distance learning can be done without having to meet face to face in a room like the usual learning process because e-learning can be done through a virtual world where the learning process can be done anywhere and does not have to be in one room or one place between students. and lecturers. E-learning is also a solution to continue to carry out the learning process in the face of the Covid-19 pandemic which is currently sweeping the world, including Indonesia. Where this pandemic demands to remain social distancing or maintain a safe distance to avoid transmission of the Covid-19 virus.

The existence of the Covid-19 pandemic and technological advances require education actors, especially lecturers, to think creatively so that learning materials can be channelled according to the learning objectives that have been set for students. This is because students are used to getting material or knowledge transfer through face-to-face, where the lecturer explains the material in front of the class with all the methods used and students pay attention while being able to have direct discussions without being limited by space. For subjects that are theoretical demands of development and the state are not too difficult, but for the practical subjects or exact, it would be rather difficult, moreover subjects with materials containing certain applications.

One of the practical or exact courses in which it provides material on data analysis with certain applications is the research statistics course. The research statistics course is one of the subjects taught in higher education, especially in the accounting education study program. This subject is a compulsory subject for students because by following the research statistics course students can extract quantitative information which can later be used for a scientific approach such as in writing a final project to solve a problem. Where in solving a problem statistics serve as a tool to help to analyze quantitative data research results eventually analysis can provide a reasonable conclusion. However, the reality behind the importance of these courses is that students are less interested in learning them because of the perception that statistics is a difficult subject matter, especially when analyzing using a tool in the form of an application.

To overcome this, many media, tools, or applications can be used to bridge this. One of them is through the use of video tutorial media. According to Baharuddin (2014) " Video tutorial media can replace educators when students want to repeat the learning material that has been learned in class, and can be a tool that is conveyed by teachers to students and can be repeated at any time by students". Meanwhile in the opinion of Hidayah (2019) stated that " Video tutorials are very helpful to the delivery of material because they can record, process, and rearrange moving images by displaying videos containing the process '. Thus, when a learning material has not been understood, students can repeat it by playing the video tutorial while applying the material in the tutorial.

Video tutorials can be studied without limits on space and time because these videos can not only be played via a laptop or notebook but can also be opened via a smartphone or tablet so that this convenience is expected to be effective in improving student learning outcomes. This is in line with the opinion (Schneps et al. In Carmichael (2019) " Researchers note an explosion in online courses and a rapidly changing comprehension of how video can be used effectively to enhance learning". Meanwhile, according to Guolin Lai, Zhiwei Zhu (2017)" The study results showed the availability of video tutorials enriched students' learning experiences and enchanted their academic performance".

Based on the description above, the researcher is interested in researching differences in student learning outcomes between before and after the use of research statistics tutorial videos through e-learning. The purpose of this study was to determine differences in student learning outcomes between before and after the use of statistical research video tutorials through e-learning with comparative hypothesis testing materials using manual analysis and IBM SPSS 24.

2. Research Methods

"The research method is a scientific way to obtain data with specific purposes and uses (Sugiyono 2018). The research method used in this study is a comparative method with a quantitative approach which aims to determine whether there are differences in student learning outcomes between before and after using the research statistics tutorial video through e-learning learning on comparative hypothesis testing material with case resolution using the SPSS application. Population and sample in this study were students of accounting education FKIP PGRI Palembang University who took a course statistics k study consisted of 27 students.

According to Sugiyono (2018), "research variables are anything in the form that is determined by the researcher to study so that information is obtained about it, then conclusions are drawn". "The research variable is the object of research, or what is the point of attention of a study (Arikunto 2010)". From these two definitions, the variables in this study consisted of two, namely student learning outcomes before the use of statistical research video tutorial media through e-learning (X1) and student learning outcomes after using research statistics tutorial video media through e-learning (X2).

Data collection techniques used in this research are documentation and tests. With the following explanation:

1.1 Documentation

" Documentation is written items such as books, magazines, documents, regulations, meeting minutes, diaries, and so on, as well as not written in the form of relics such as inscriptions and symbols (Arikunto 2010)". The documentation in this study was used to obtain data regarding the number of students, student conditions, learning tools and student learning outcomes and achievements during the learning process of research statistics.

1.2 Test

"The test is a systematic procedure in observing one or more characteristics of a person. Examples of tests are tests used to measure abilities, namely competency tests and learning outcomes (Basir 2017)". In this study, t es was used to obtain data on student learning outcomes before and after the use of video tutorials. In this research, pre-test and post-test will be carried out. A pre-test to see student learning outcomes before using video tutorials. Furthermore, the post-test is carried out to see student learning outcomes after the use of video tutorials. All tests are carried out via e-learning using the google form application.

3. Result and Discussion

3.1. Result

1) Description of the Implementation of Research Results

This research was conducted in the Accounting Education Study Program FKIP, PGRI University of Palembang in students who took the research statistics course even semester of the 2019/20 20 academic years, amounting to 27 students but those who attended before and after the research statistics tutorial video were only 22 students, 5 students. not present due to limited signal during implementation. In this study, researchers wanted to see student learning outcomes before and after the use of research statistical video tutorials on the comparative hypothesis test material.

2) Description of Pre-Test Student Learning Outcomes Data (Before) Using Video Tutorials

Student learning outcomes data obtained from the pre-test (before) using video tutorials can be seen in the following table :

Table 1. Distribution Study Results in Pre Test Students (Study Results Before Using the Research Statistics Tutorial Video)

Score Interval	Frequency	Percentage	Category
8.5 - 10	4	18.18 %	Very good
7.6 - 8.4	17	77.27 %	Very well
7.0 - 7.5	1	4.55 %	Well
6.0 - 6.9	0	0 %	Pretty good
5.5 - 5.9	0	0%	Enough
4.5 - 5.4	0	0%	Less
0 - 4.4	0	0%	Very less
Total	22	100%	Very well
Average	7.9		

Source: Processed from research results

From the learning results obtained by students through the test (pre-test) before the use of statistical research tutorial videos, it is known that the students who get the very good category are 4 students with a percentage of 18.18 %, the category is like once 1 7 students (77.27 %), both 1 student with a percentage of 4.55 %, and for good enough, enough, less and very poor, namely 0% or none. The average student learning outcomes before the use of research statistics tutorial videos were 7, 9 with very good categories. Based on the description above, it can be concluded that more than most students get excellent learning outcomes, namely 77, 27 % in other words, student learning outcomes have been quite successful.

3) Data Description Student Learning Outcomes Post Test (After) Using Video Tutorials

After student learning by using video tutorials on student learning outcomes carried out by giving tests (post-tests), the results are as follows:

Table 2. Distribution of Student Post Test Results (Learning Outcomes After Using the Research Statistics Tutorial Video)

Score Interval	Frequency	Percentage	Category
8.5 - 10	7	31.82 %	Very good
7.6 - 8.4	15	68.18 %	Very well
7.0 - 7.5	0	0%	Well
6.0 - 6.9	0	0%	Pretty good
5.5 - 5.9	0	0%	Enough
4.5 - 5.4	0	0%	Less
0 - 4.4	0	0%	Very less
Total	22	100%	
Average	8.5		Very good

Source: Processed from research results

Based on Table 2 above, the obtained results of student learning are increased where the category of Most well increased so that it becomes as big as 31, 82 % (7 students). For the Good category, once decreased by 9, 09 % (2 students), where before the use the percentage was 77.27% and after the use of video tutorials became 68.18%. Then for the Well category after using the video tutorial it becomes 0% or nothing. Meanwhile, the percentage was good enough, adequate, insufficient, and very poor. The percentage was still 0% or not.

4) Description of Comparison of Student Learning Outcomes for Pre-Test (Before) and Post-Test (After) Using Video Tutorials

Comparison of student learning outcomes data before and after the use of video tutorials can be seen in the table below:

Table 3. Distribution of Comparison of Student's Pre-Test and Post-Test Results (Learning Outcomes Before and Se has Usage Video Tutorial Statistical Research)

Score Interval	Before (Pre Test)		After (Post Test)		Category
	F	%	F	%	
8.5 - 10	4	18.18%	7	31.82%	Very good
7.6 - 8.4	17	77.27%	15	68.18%	Very well
7.0 - 7.5	1	4.55%	0	0%	Well
6.0 - 6.9	0	0%	0	0%	Pretty good
5.5 - 5.9	0	0%	0	0%	Enough
4.5 - 5.4	0	0%	0	0%	Less
0 - 4.4	0	0%	0	0%	Very less
Total	22	100%	22	100%	
Average	-	7.9	-	8.5	

Source: Processed from research results

From table 3 above, it can be concluded that student learning outcomes before the use of video tutorials are in the Very Good category, namely 7, 9 and after the application of the video tutorial it increases to the Very Good category, namely 8.5. This means that video tutorials have a role in improving student learning outcomes.

5) Hypothesis test

Hypothesis testing is used to answer problems in research. The comparative hypothesis testing using the help of SPSS 24. The output is as follows:

Table 4. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Mean Error
Pair 1	Before	79.68	22	4,005	.854
	After	84.55	22	8,836	1,884

Source: SPSS Output Processed From Research Results

From table 4, it can be seen in the mean column that the average student learning outcomes before and after the use of video tutorials are different, where before the use of video tutorials the mean or average value was 79.68, while after using video tutorials the average was 84, 55 (round to 85).

Table 5. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Before after	22	.366	.094

Source: SPSS Output Processed From Research Results

Table 6. Paired Samples Test Paired Differences

				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Mean Error	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1 Before - After	-4,864	8,259	1,761	-8,526	-1,202	-2,762	21	.012

Source: SPSS Output Processed From Research Results

Based on Table 6 above shows the kolo m significant is 0.012 <0.05 then Ha Ho accepted and rejected. While the price of t table is based on DK 21 (22-21) with a degree of error of 5%, the two-party test results in t table 2.080. So that the t value that can be seen in the t column above is 2.762 > 2.080, then Ha is accepted and Ho is rejected. This means that there is a significant difference between before and after the use of statistical research video tutorials through e-learning.

3.2. Discussion

Based on the research results, seen from the descriptive learning outcome data, there are differences in student learning outcomes before and after the use of video tutorials, where the learning outcomes before the use of video tutorials show the Very Good category with an average of 79.68, while after the use of video tutorials, student learning outcomes change categories. to be Very Good, namely 84.55. So that there is an increase in the average learning outcomes of 4, 87. Meanwhile, based on the results of the research hypothesis testing, it shows a significance value of 0.012 which is smaller than 0.05, this means that there is a significant difference in

student learning outcomes between before and after the use of statistical research video tutorials through e-learning. Thus based on these two results it can be said that video tutorials can improve student learning outcomes in taking research statistics courses.

The results of this study are relevant to the opinion of Schneps et al. (in Carmichael (2019)" Researchers note an explosion in online courses and a rapidly changing comprehension of how video can be used effectively to enhance learning". And also in line with the opinion of Lai et al. (2016: 31) "The study results showed the availability of video tutorials enriched students' learning experiences and enhanced their academic performance".

4. Conclusion

Based on the results and discussion of the research, it can be concluded that there are significant differences in student learning outcomes between before and after the use of statistical research video tutorials through e-learning with comparative hypothesis testing material both descriptively and by hypothesis testing.

Based on the conclusions of the research results, the authors suggest that the learning process through e-learning, especially for subjects that discuss data analysis or exact, can use video tutorials as a learning medium, especially in dealing with the Covid-19 pandemic and facing the advancement of the demanding industrial era 4.0. educators to always be creative in the learning process.

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Biography

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The Effect of Debt to Asset Ratio, Return on Equity, and Current Ratio on Stock Prices of Pharmaceutical Companies Listed on the Indonesia Stock Exchange 2016-2019 Period

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Abstract

This research aims to determine: The influence of Current Ratio (CR), Debt to Asset Ratio (DAR), and Return on Equity (ROE) either partially or simultaneously on Stock Price of pharmaceutical companies listed on the Indonesia Stock Exchange (IDX) 2016-2019 period. Data were taken from the Indonesia Stock Exchange (IDX) website. Analysis prerequisite test including normality test, multicollinearity, heteroscedasticity, and autocorrelation. Data analysis technique used is multiple linear regression analysis. Statistical results also show that the current ratio (X1) and return on equity (X3) partially have a positive and significant effect on stock prices (Y). Debt to asset ratio (X2) partially does not have a significant effect on stock prices (Y). Simultaneously current ratio (X1), debt to asset ratio (X2), and return on equity (X3) have a positive and significant effect on stock prices (Y).

Keywords
Current Ratio (CR), Debt to Asset Ratio (DAR), Harga Saham, Return On Equity (ROE)

1. Introduction

The development of the flow of technology and information is developing rapidly, the development of the world economy is very dynamic, including the development and growth of the business world. In order to face the competition that arises as a result of this rapid development, all companies, both domestic and foreign, must also grow and develop rapidly and sustainably in order to gain the trust of investors. One of the ways to attract investors is to register the company's shares in the capital market or better known as going public.

The capital market or stock exchange is a place for buying and selling shares, bonds and securities between companies and individuals or the public. The definition of stock exchange has been defined in Law No. 8 of 1995 concerning the capital market. The definition is that a Stock Exchange is a party that operates a system and / or means of bringing together selling and buying offers of securities of other parties for the purpose of trading securities between them. The Indonesian government has provided a capital market in Indonesia known as the Indonesia Stock Exchange (BEI). The Indonesia Stock Exchange is the result of a merger between the Jakarta Stock Exchange (BEJ) and the Surabaya Stock Exchange (SSE). The merged exchange began operating on December 1, 2007.

The pharmaceutical sector is one of the company sectors listed on the Indonesia Stock Exchange. The pharmaceutical sector has a very important role in health sector reform. According to data from the BPOM as of 30 June 2018, there are 209 pharmaceutical companies registered in Indonesia that have a CPOB (Good Manufacturing Practice) certificate, while 10 pharmaceutical companies are listed on the IDX and go public.

Indonesia has great potential for pharmaceutical companies. This was proven at the beginning of 2019, where the positive movement caused by the strengthening of the rupiah benefited companies that depend on imported raw materials, one of which is companies in the pharmaceutical sector. It is common knowledge that the majority of raw materials for drug production come from imports.

One of the indicators for measuring the value of companies that go public is the stock price of the company. Stock price movements have a reciprocal relationship with the company's financial performance. The company's financial performance is an important factor that affects the ups and downs of the company's stock prices. The level of stock prices also affects the financial performance of a company.

The movement of stock prices in the capital market is strongly influenced by many factors, such as the company's financial statements, the level of supply and demand for shares, the rate of inflation, interest rates, government policies, the level of risk, politics and security of a country. The company's financial statements are the factors that most influence stock movements.

Before make an investment, first investors will analyze the condition of the company's financial statements in the past, whether the financial position that represents the company's reality and potential performance will continue. In analyzing the financial performance of investors using financial reports as their reference. One of the ways to analyze financial reports that investors usually do before investing is fundamental analysis. The main idea of this approach is that share prices are influenced by the company's financial statements.

Based on above description, it is necessary to conduct research related to factors that can affect stock movements such as Current Ratio (CR), Debt to Asset Ratio (DAR), and Return on Equity (ROE). (Basalama, I. S., Murni, S., dan Sumarauw, 2017)

Current Ratio is a ratio that shows the ability of the company's current assets to meet short-term liabilities with current assets owned.

Debt to Asset Ratio is a debt ratio that is used to measure the ratio between total debt and total assets. The higher of the ratio value, the more funding the company's operations will be with debt loans.

Return on Equity is a ratio calculation that shows a company's ability to generate net profit using its own capital and generate net income available to owners or investors. The higher of the ROE value, the higher of the company value.

2. Literature Review and Hypothesis

2.1. Financial statements

Company financial reports should not be made carelessly. Company reports must be prepared and prepared in accordance with applicable rules and standards. This is must be done so that the financial statements can be understood easily and are useful for its users.

According to Kasmir, (2016), “Financial reports are reports that show the company's current financial condition or within a certain period. The company's current condition is the company's financial condition on a certain date (for balance sheet) and a certain period (for profit or loss)."

2.2. Purpose of Financial Statements

Every financial report certainly has a purpose. In practice, there are several goals to be achieved, especially for company owners. In general, financial statements aim to provide information about financial conditions. According to Kasmir, (2016), "Some of the purposes for making or preparing financial reports are:

e. Provide information about the types and amounts of assets the company currently owns.
f. Provide information about the types and amounts of liabilities and capital the company currently has.
g. Provide information about the type and amount of income earned in a certain period.
h. Provide information about the types and amounts of costs incurred by the company in a certain period.
i. Provide information about the changes that occur in the company's assets, liabilities and capital.
j. Provide information about the performance of company management in a period.
k. Provide information about notes to financial statements.
l. Other financial information.

2.3. Types of Financial Statements

There are several types of financial reports made by companies. Each of these financial statements has its own meaning in seeing the company's financial condition.

According to Kasmir, (2016), "In general, there are five types of financial reports that are usually prepared, namely balance sheets, income statements, changes in capital reports, cash flow reports, notes reports on financial statements."

2.4. Financial Statement Analysis

Financial statement analysis is analytical tools and techniques for general purpose financial reports and related data to produce useful estimates and conclusions. Financial statement analysis reduces reliance on hunches, guesswork, and intuition in decision making, and reduces uncertainty in analysis.

According to Harahap, (2015), "financial statement analysis is an effort to find the relationship between various posts in the company's financial statements."

2.5. Purpose of Financial Statement Analysis

Activities in financial statement analysis can be carried out by determining and measuring the items contained in a financial report. Then, financial statement analysis can also be done by analyzing financial

reports that are owned in one period. In addition, financial statement analysis can also be carried out between several periods.

According to Kasmir, (2016), "There are several goals and benefits for various parties with the analysis of financial statements. In general, it is said that the objectives and benefits of financial statement analysis are:

m. To find out the company's financial position in a certain period, whether it is assets, liabilities, capital or business results that have been achieved for several periods.
n. To find out what weaknesses the company lacks.
o. To know the strengths - the strengths that are owned.
p. To find out what corrective steps need to be taken in the future in relation to the company's current financial position.
q. To assess future management performance whether it needs refresher or not because it is considered successful or failed.
r. Can also be used as a comparison with similar companies regarding the results they have achieved.

2.6. Financial Statement Analysis Methods

To perform financial statement analysis, appropriate analytical methods and techniques are required. The purpose of determining this method is so that the financial reporting method can provide maximum results. In addition, users of the analysis results can easily interpret them. According to Kasmir, (2016), "In practice, there are two types of financial statement analysis methods commonly used, namely as follows:

14. Vertical Analysis (Static)

Vertical analysis is an analysis that is carried out on only one financial reporting period. The analysis was carried out between the existing items in one period. The information obtained is for one period only and there is no known progress from period to period.

15. Horizontal (Dynamic) Analysis

Horizontal analysis is an analysis carried out by comparing financial reports for several periods. From the results of this analysis, we can see the company's development from one period to another. "

a. Current Ratio

The elements used in the calculation of working capital can be expressed in a ratio that compares total current assets and current liabilities. This ratio is called the Current Ratio.

According to Kasmir, (2016), "Current Ratio is a ratio to measure the company's ability to pay short-term obligations or debts that are due immediately when they are collected as a whole."

In other words, how many current assets are available to cover short-term liabilities that are due soon. Current Ratio can also be considered as an indicator of a company's security level.

b. Debt to Asset Ratio

Debt to Asset Ratio is one of the solvency ratios used to measure the solvency level of a company.

According to Kasmir, (2016), "the solvency ratio is a ratio used to measure the extent to which company assets are financed with debt."

A company is said to be solvable if the company has sufficient assets and wealth to pay its debts. This ratio shows the amount of total debt to the total assets owned by a company. This ratio is the percentage of funds provided by creditors for the company.

According to Kasmir, (2016), "Debt to Asset Ratio is a debt ratio used to measure the ratio between total debt and total assets."

In other words, how much the company's assets are financed by debt or how much does the company's debt affect asset management.

c. Return On Equity

According to Kasmir, (2016), "The profitability ratio is a ratio to assess a company's ability to seek profit."

Profitability ratios can also describe a measure of the level of management effectiveness of a company. The use of profitability ratios can be done by using comparisons between the various components in the financial statements, especially the income statement and balance sheet financial statements. The purpose of using this ratio is so that the company can find out the development of the company within a certain period of time, either decrease or increase, as well as to find the causes of these changes. One of the ratios that includes the profitability ratio is return on equity.

According to Herry, (2016), "Return on equity is a ratio that shows how much equity contributes to creating net income."

Return on equity is considered as a representative of shareholder wealth or company value. The higher the value of this ratio, the better the company value.

d. Stock

All companies listed on the stock exchange are called public or go public companies. In order to meet the requirements stipulated in the PT Law in Indonesia, the public company added the abbreviation "tbk" which means open. The legal entity of a public company is in the form of a PT (Limited Liability Company), which means that each company has limited rights and obligations on each sheet of sero that is controlled. This means that sero holders do not have joint responsibility for the legal obligations arising from the company.

How much the rights and responsibilities of the companies are manifested in the amount of rupiah stated in the shares. Thus the number of shares (sero) controlled by an investor represents a form of ownership in a public company in the form of PT.

According to Desmond, (2014), "The definition of shares is a sign of a statement or ownership in a company."

3. Research Methods

This research was conducted with data available on the Indonesia Stock Exchange which was obtained using electronic research methods and literature research in order to obtain other information through internet access on the Indonesia Stock Exchange (IDX) website. With the aim of knowing the effect of Current Ratio, Debt to Asset Ratio, and Return On Equity on Stock Prices in pharmaceutical companies listed on the Indonesia Stock Exchange during the period 2015 to 2018. The variables in this study consisted of independent variables, namely Current Ratio, Debt to Asset Ratio, and Return On Equity, while Stock Price is the dependent variable. Primary data in this study is data that is collected, observed and recorded in the form of a recap of the calculation of ratios and stock prices of pharmaceutical companies listed on the IDX for the period 2016-2019. Meanwhile, secondary data used in this research is data in the form of annual financial reports (audited) of pharmaceutical companies listed on the IDX for the period 2016-2019 which are downloaded through the Indonesia Stock Exchange website. This research technique uses SPSS version 25 using normality test, classical assumption test and multiple regression test and hypothesis testing.

4. Research Results And Discussion

1. Determination Coefficient Test

The coefficient of determination test is used to determine how much the percentage of the contribution of the influence of the independent variables simultaneously (simultaneously) to the independent variable. Following are the results of the coefficient of determination test. The coefficient of determination R Square is 0.427 or 42.7%, meaning that the effect of Current Ratio, Debt to Asset Ratio, and Return On Equity on Stock Prices in pharmaceutical companies is 42.7%, while the remaining 57.3% is influenced by other variables that are not mentioned in this research model.

2. Partial Test (t)

This partial test is to find out how much influence each independent variable has on the dependent variable, how far is the influence of one variable or explanatory variable variables individually able to explain the dependent variable. The hypothesis in this study is that the CR, DAR, and ROE factors partially have a significant effect on stock prices in pharmaceutical companies listed on the IDX. can be concluded as follows:

Whereas the current ratio is partially and significantly influential on stock prices so that the hypothesis can be accepted.

Whereas the debt to asset ratio partially has no and insignificant effect on stock prices so that the hypothesis can be accepted.

Whereas return on equity partially has a significant effect on stock prices so that the hypothesis can be accepted.

3. Simultaneous Test (F)

This F-test is used to calculate whether together (simultaneously) the existing independent variables have an effect on the dependent variable. The hypothesis in this study is that the CR, DAR, and ROE factors simultaneously have a significant effect on stock prices in pharmaceutical companies listed on the Indonesia Stock Exchange for the period 2016-2019.

F count of 7,957 with a significance level of 0,000. because the value of F count> F table (7.957> 2.89) and the significance value is smaller than the significance level (0.000 <0.005), the decision taken is to reject Ho and accept Ha. This means that the variables CR, DAR and ROE simultaneously have a significant effect on stock prices in pharmaceutical companies. (Tumonggor, M., Murni, S., dan Rate, 2017)

5. Conclusions and Suggestions

1. Based on the results of simultaneous hypothesis testing (statistical F test), it shows that the current ratio, debt to asset ratio, and return on equity variables together have a significant effect on the stock prices of pharmaceutical companies listed on the Indonesia Stock Exchange in the 2016 period - 2019. The value of the coefficient of determination (R Square) is 0.427, which means that the effect of the current ratio, debt to asset ratio, and return on equity on the stock price of pharmaceutical companies listed on the IDX for the period 2016 - 2019 is 42.7%, while the rest 57.3% is influenced by other variables not mentioned in this research model.
2. Based on the results of partial hypothesis testing (statistical t test) shows that:
   s. Current ratio variable with a significance level of 0.009 (0.9%), which means the value is smaller than the significance level of 0.05 (5%). This shows that the current ratio has a significant effect on the stock price of pharmaceutical companies listed on the Indonesia Stock Exchange for the period 2016 - 2019.
   t. Debt to asset ratio variable with a significance level of 0.107 (10.7%), which means the value is greater than the significance level of 0.05 (5%). This shows that the debt to asset ratio does not have a significant effect on the stock prices of pharmaceutical companies listed on the Indonesia Stock Exchange for the period 2016 - 2019. This can be due to the poor quality of equity management in pharmaceutical companies.
   u. The variable return on equity with a significance level of 0.000 (0%), which means the value is smaller than the significance level of 0.05 (5%). This shows that return on equity has a significant effect on the stock prices of pharmaceutical companies listed on the Indonesia Stock Exchange for the period 2016 - 2019.

6. Suggestion

Based on the results of this study, the suggestions that can be given by the author are as follows:

5) To pay more attention to the value of the Current Ratio, because the value of the Current Ratio partially has a significant effect on stock prices as described in this study. The higher the Current Ratio value of a company, it means that the company can be considered as having good finances and can attract more profits. Companies with good finances can affect the company's share price in the capital market.
6) Not to pay too much attention to the value of the Debt to Asset Ratio, because the Debt to Asset Ratio does not have a partially significant effect on stock prices as has been proven in this study.
7) To pay more attention to the value of Return On Equity, because Return On Equity has a partially significant effect on Stock Prices. This ratio is used to measure how much net profit will be generated from each rupiah of funds invested in total equity. The higher the Return On Equity value, the higher the interest of potential investors to buy the company's stock price, this certainly has an effect in the form of an increase in the company's stock price.

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