CHAPTER VI

CONCLUSION AND SUGGESTION

6.1. Conclusion

From the test of compressive strength and modulus elasticiy:

1. The difference in the value of the slump caused by the condition of the mixture and the workability. If the condition of mixture is wet so the workability will be ease to work but the slump is big. If the condition of mixture is hard so the workability will be difficult to work but the slump is small.
2. The value of concrete density is determined by the manufacturing process, in this case the compaction process.
3. Based on compression strength test that has been done, the value of the average compressive strength at 28 days with comparative precursor (metakaolin:silica fume) 25:5, 50:5, 75:5 are 1.149MPa, 0.641 MPa and 0.178 MPa
4. The maximum concrete compressive strength occurred on geopolymer concrete with the composition of metakaolin is of 25%.
5. The compressive strength of the concrete is affected by the condition of the materials.

6. The combustion of the metakaolin and molarity of the NaOH can affected the geopolymer concrete. Because, the differences of component also make the binder is different.
7. Based on modulus of elasticity test that has been done, the value of the average modulus of elasticity at 28 days with comparative precursor (metakaolin:silica fume) 25:5, 50:5, 75:5 are 7.781 MPa, 2.371 MPa and 1.143 MPa
8. The greater the result, the smaller value of the stretch. So, if the value of the modulus of elasticity small it is mean that the concrete is easy to get shorten or extension.
9. Geopolymer concrete with metakaolin and silica fume cannot be used as any structural concrete but actually if the proportion between metakaolin and alkali activator is mixed properly the result can be better. In this research, the highest compressive strength at 28 days of 2.071743 MPa.

6.2. Suggestion

From the research that has been done can be given advice that is expected to be useful. Advice can be given as follows.

1. Try to aggregate conditions used really SSD.
2. For further research, the mix design about proportion of metakaolin and activator can be regenerate. So, the proportion will be mixed properly and make a strong binder.

3. The combustion of the metakaolin will be better in 500°C-800°C
4. Molarity of NaOH will be better in 12M. because the concentrate of NaOH will be strong enough for bind the materials.
5. Concrete can be tested by adding some material which has the value of lime (CaO) is high or just add the lime (CaO) as the pozzolan composition. So, there wil be a reaction between $Ca(OH)_2$ and SiO_2 that will produce (CSH) as an adhesive.
6. Keep the compaction process of each sample is done consistently so that the value of the weight density can be more consistent

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APPENDIX

A. MATERIAL TESTING

A.1. WATER CONTENT TEST IN THE SAND

Material : Sand
From : Clereng
Tested : January 3, 2015

No.	TEST	H1	H2
1	Weight of wet sand	64.965	64.758
2	Weight of dry sand	63.882	63.718
3	Weight of water = (1)-(2)	1.083	1.04
4	Water content(w) = (3)/(2)X100%	1.695	1.632
Average		1.6635	

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A.2. WATER CONTENT TEST IN THE SPLIT

Material : Split
From : Clereng
Tested : January 3, 2015

No.	TEST	H1	H2
1	Weight of wet split	73.589	73.237
2	Weight of dry split	72.567	72.314
3	Weight of water = (1)-(2)	1.022	923
4	Water content(w) = (3)/(2)X100%	1.408	1.276
Average		1.342	

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A.3. THE DENSITY AND ABSORPTION TEST OF SAND

Material : Sand
From : Clereng
Tested : November 7, 2014

	TEST	I
A	Dry weight	500 gram
B	Weight of SSD sample (V-W)	178 gram
C	Weight out from the oven (A)	482.13 gram
D	*Bulk Spesific Grafity* = $\frac{(A)}{(V)-(W)}$	2.712
E	*Bulk Spesific Grafity SSD* = $\frac{(B)}{(B)-(C)}$	2.812
F	*Apparent Spesific Grafity* = $\frac{(A)}{(V-W)-(500-A)}$	3.001
G	Penyerapan (*Absorption*) = $\frac{(500)-(A)}{(A)} x100\%$	3.701%

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A.4. THE DENSITY AND ABSORPTION TEST OF SPLIT

Material : Split
From : Clereng
Tested : November 7, 2014

	TEST	I
A	Dry weight	500 gram
B	Weight of SSD sample (V-W)	505 gram
C	Weight in the water (A)	293.5 gram
D	*Bulk Spesific Grafity* = $\frac{(A)}{(V)-(W)}$	2.3711
E	*Bulk Spesific Grafity SSD* = $\frac{(B)}{(B)-(C)}$	2.3948
F	*Apparent Spesific Grafity* = $\frac{(A)}{(V-W)-(500-A)}$	2.4289
G	Penyerapan (*Absorption*) = $\frac{(500)-(A)}{(A)} x100\%$	1%

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A.5. INVESTIGATE THE MUD IN THE SAND

I. Tested: November 6, 2014

II. Materials

a. Sand From : Clereng Weight: 100 gram

b. Distilled Water From : LSBB Prodi TS FT-UAJY

III. Tools

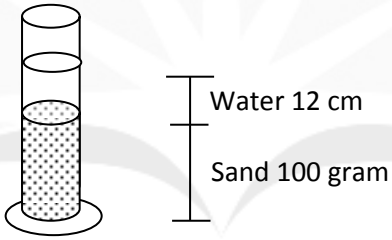
a. Measuring cup, size: 250 cc

b. Digital scale

c. Oven with the temperature is around 105-110^{o}C

d. Sand+plate were put into the oven on November 6, 2014 at 12.30 PM

IV. Sketch



V. Result

After Sand+plate were take from the oven on November 7, 2014 at 12.30 PM

a. Weight of Sand+plate = 160,7 gram

b. Weight of plate = 61,7 gram

c. Weight of sand = 99 gram

$$\text{Mud} = \frac{100-99}{100} \times 100\%$$

$$= 1\ \%$$

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A.6. INVESTIGATE THE MUD IN THE SPLIT

I. Tested: November 6, 2014

II. Materials

a. Split From : Clereng Weight: 100 gram

b. Distilled Water From : LSBB Prodi TS FT-UAJY

III. Tools

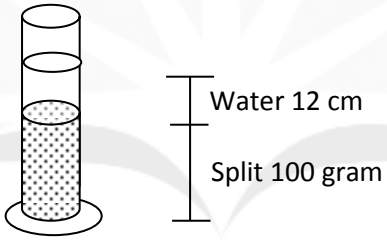
e. Measuring cup, size: 250 cc

f. Digital scale

g. Oven with the temperature is around 105-110^{o}C

h. Sand+plate were put into the oven on November 6, 2014 at 12.30 PM

IV. Sketch



V. Result

After Sand+plate were take from the oven on November 7, 2014 at 12.30 PM

d. Weight of Split+Plate = 161 gram

e. Weight of plate = 61,7 gram

f. Weight of split = 99.3 gram

Mud $= \frac{100 - 99.3}{100} \times 100\%$

= 0.7%

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A.7. ORGANIC MATER TEST IN SAND

I. Tested : 2014

II. Material

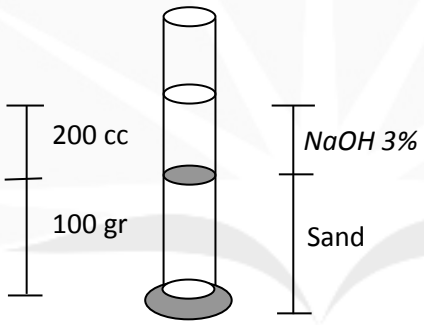
a. Sand From : Clereng, Weight : 100 gram

b. NaOH 3%

III. Tool

c. Measuring cup, size : 250 cc

IV. Sketch



V. Result

After 24 hours, the color of the sand was appropriate with the gardener color number 8.

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B. MIX DESIGN

B.1. MIX DESIGN FOR SMALL CYLINDER (70mm X 140mm)

calculation of sample			
Cylinder			
diameter (d)	=	70	mm
height (t)	=	140	mm
volume (1 cylinder)	=	0.25*22/7*d^2*t	
	=	539000	mm^3
	=	0.000539	m^3
wet density of concrete			
	=	1875	kg/m^3
density of concrete (1 concrete)	=	vol*wet density	
	=	1.010625	kg
	=	1010.625	gram
Pozzolan			
Metakaolin 25%	=	252.65625	gram
Silica Fume 5%	=	50.53125	gram
Metakaolin 50%	=	505.3125	gram
Silica Fume 5%	=	50.53125	gram
Metakaolin 75%	=	757.96875	gram
Silica Fume 5%	=	50.53125	gram
AGGREGATE AND ALKALI ACTIVATOR			
Precentage of Aggregate and Alkali Activator	=	3:1	
Aggregate	=	3/4*density of concrete	
	=	757.96875	gram
Alkali activator	=	1/4*density of concrete	
	=	252.65625	gram
Aggregate			

Coarse Aggregate and Fine Aggregate	=	2:1	
Coarse Aggregate	=	2/3*aggregate	
	=	505.3125	gram
Fine Aggregate	=	1/3*aggregate	
	=	252.65625	gram
Alkali Activator			
NaOH 12M + Na2SiO4		2:1	
NaOH 12M	=	2/3*alkali activator	
	=	168.44	gram
Na2SiO4	=	1/3*alkali activator	
	=	84.22	gram
NAOH			
Mol NaOH	=	40 g/mol	
NaOh 12 M	=	(12*40)+1000 ml aguades	
NAOH 12 M : Distilled Water	=	480 : 1000	
NaOh 12 M	=	480/1480*NaOH 12M	
		54.63	gram
Distilled Water	=	1000/1480*NaOH 12M	
		113.81	kg

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B.1. MIX DESIGN FOR BIG CYLINDER (150mm X 300mm)

calculation of sample			
Cylinder			
diameter (d)	=	150	mm
height (t)	=	300	mm
volume (1 cylinder)	=	0.25*22/7*d^2*t	
	=	5303571.429	mm^3
	=	0.005303571	m^3
wet density of concrete			
	=	1900	kg/m^3
density of concrete (1 concrete)	=	vol*wet density	
	=	10.07678571	kg
	=	10076.78571	gram
Pozzolan			
Metakaolin 25%	=	2519.196429	gram
Silica Fume 5%	=	503.8392857	gram
Metakaolin 50%	=	5038.392857	gram
Silica Fume 5%	=	503.8392857	gram
Metakaolin 75%	=	7557.589286	gram
Silica Fume 5%	=	503.8392857	gram
AGGREGATE AND ALKALI ACTIVATOR			
Precentage of Aggregate and Alkali Activator	=	3:1	
Aggregate	=	3/4*density of concrete	
	=	7557.589286	gram
Alkali activator	=	1/4*density of concrete	
	=	2519.196429	gram
Aggregate			
Coarse Aggregate and Fine Aggregate	=	2:1	
Coarse Aggregate	=	2/3*aggregate	
	=	5038.392857	gram
Fine Aggregate	=	1/3*aggregate	
	=	2519.196429	gram

Alkali Activator			
NaOH 12M + Na_2SiO_4		2:1	
NaOH 12M	=	2/3*alkali activator	
	=	1679.46	gram
Na_2SiO_4	=	1/3*alkali activator	
	=	839.73	gram
NAOH			
Mol NaOH	=	40 g/mol	
NaOh 12 M	=	(12*40)+1000 ml aguades	
NAOH 12 M : Distilled Water	=	480 : 1000	
NaOh 12 M	=	480/1480*NaOH 12M	
		544.69	gram
Distilled Water	=	1000/1480*NaOH 12M	
		1134.77	kg

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C. WEIGHT DENSITY

C.1. AVERAGE WEIGHT DENSITY IN 14 DAYS

Pozzolan Metakaolin : Silica Fume	Weight Density (gr/cm^3)	Average of Weight Density
25:5	1.9757	1.9519
	1.9381	
	1.9419	
50:5	1.8706	1.8974
	1.8929	
	1.9288	
75:5	1.7608	1.7176
	1.6988	
	1.6932	

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C.1. AVERAGE WEIGHT DENSITY IN 28 DAYS

Pozzolan Metakaolin : Silica Fume	Weight Density (gr/cm3)	Average of Weight Density
25:5	1.8616	1.9287
	1.9902	
	1.9344	
50:5	1.7159	1.8051
	1.8512	
	1.8483	
75:5	1.6783	1.6939
	1.7351	
	1.6683	

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D. COMPRESSIVE STRENGTH TEST

Pozzolan		Compressive Strength (Mpa)			
Metakaolin	**Silica Fume**	**14 days**		**28 days**	
25%	5%	2.30729	2.071743	1.10814	1.149566
		2.02273		1.20311	
		1.88520		1.13744	
50%	5%	1.37959	1.229189	0.68563	0.641213
		1.21979		0.61374	
		1.08817		0.62426	
75%	5%	0.69916	0.675865	0.15911	0.178246
		0.63963		0.19685	
		0.68879		0.17876	

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E. MODULUS OF ELASTICITY TEST

Concrete	Area (Ao)	Average of Area	Po	Maximum load	Average of Compression	Average	Average of strain	E
	(cm^2)			(kgf)	(Mpa)	(Mpa)		(Mpa)
25:5	172.5683	172.5683	21.34	725	0.2131	0.2001	0.0659	3.234
	171.1738		20.91	675	0.2115		0.0786	2.691
	170.7103		21.04	625	0.1867		0.0698	2.675
50:5	171.6380	171.6380	20.41	625	0.1857	0.1636	0.0719	2.583
	172.5683		21.34	500	0.1491		0.0643	2.319
	172.8013		20.91	525	0.1560		0.0705	2.213
75:5	172.5683	172.5683	20.32	150	0.0497	0.0673	0.0552	0.900
	171.8704		20.93	275	0.0885		0.0714	1.239
	172.8013		20.92	200	0.0638		0.0495	1.289

Modulus of Elasticity	Average Modulus of Elasticity
(Mpa)	(Mpa)
3.234	2.866
2.691	
2.675	
2.583	2.371
2.319	
2.213	
0.900	1.143
1.239	
1.289	